Connected Vehicle Pilot Deployment Program Phase 1

Comprehensive Deployment Plan – New York City

Volume 1 – Technical Application

Part I – Technical and Management Approach

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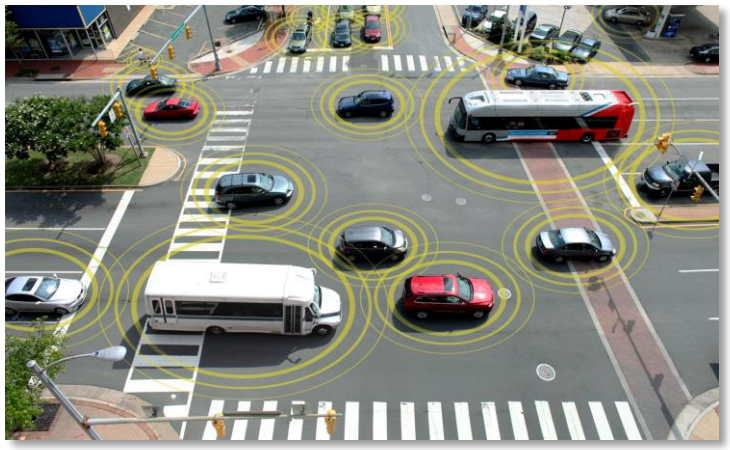

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16. Abstract

This document describes the Deployment Plan for the New York City Department of Transportation (NYC) Connected Vehicle Pilot Deployment (CVPD) Project. This plan describes the approach to complete Phase 2 Design/Build/Test, and Phase 3 Operate and Maintain of the program. In the plan are details about the design approach, procurement, development, integration, testing, and final readiness demonstration. Additional details address the preparation of project plans to secure, operate, and maintain the system and protect privacy. Other planning documents, developed under this project phase, that influence this implementation plan include the Concept of Operations, Security Management Operational Concept, Performance Measurement and Evaluation Plan, Safety Management Plan, and Human Use Approval Plan. These reports are in the series FHWA-JPO-16-299 thru FHWA-JPO-16-308.

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1 Introduction

The New York City (NYC) Connected Vehicle (CV) Pilot Deployment will be the largest deployment of connected vehicle technology to date. This project brings New York City another step towards reaching the City's ***Vision Zero*** goal of eliminating the injuries and fatalities due to traffic crashes.

The objective of the NYC pilot is to deploy CV applications on a significant number of vehicles including buses, City fleets, and other City vehicles, signalized intersections along 1st, 2nd, 5th, and 6th Avenues, the major cross-town streets consisting of 14th, 23rd, 34th, 42nd, and 57th Streets in Manhattan, and Flatbush Avenue in Brooklyn to reduce the number of vehicle crashes and pedestrian injuries. Additionally, infrastructure will be deployed along the FDR Drive and its ramps to address specific safety issues involving crashes with infrastructure. Table 1-1 identifies the City's needs, the CV application satisfying the need, and how this combination supports the Vision Zero program.

Table 1-1. New York City Department of Transportation (NYCDOT) Needs Summary

NYCDOT Needs	CV Application	Support for Vision Zero
Manage Speed On Surface Streets - 25 mph Regulatory Speed Limit	Speed Compliance	Notify the drivers when their speed exceeds the speed limit
Manage Speeds on Curves - Regulatory Speed Limit	Curve Speed Compliance	Advise drivers to comply with the speed limit on curves, thus reducing the potential of a rollover and subsequent major traffic incident
Manage Speeds in Work Zones - Speed Limit	Speed Compliance/Work Zone	Facilitate widespread adherence to the NYC speed limit. Additional time-of-day reductions, such as those associated with school zones or moving construction (e.g., pothole repair) zones
Reduce Crashes between Vehicles	Forward Crash Warning (FCW)	Warn drivers in case of an impending rear-end crash with another vehicle ahead in the same lane and direction of travel
Reduce Crashes between Vehicles	Emergency Electronics Brake Light (EEBL)	Notify drivers when a vehicle ahead generates an emergency brake event
Reduce Crashes between Vehicles	Blind Spot Warning (BSW) + Lane Change Warning/Assist (LCA)	Warn the driver if another vehicle, traveling in the same direction, occupies the blind-spot zone during an attempt to change lanes
Reduce Crashes between Vehicles	Intersection Movement Assist (IMA)	Warn the driver when it is not safe to enter an intersection because of high crash probability with other vehicles at stop-controlled and uncontrolled intersections
Reduce Crashes between Vehicles	Vehicle Turning Right in Front of Bus Warning	Warn bus drivers of vehicles pulling up behind a stopped bus, making a lane changes to pass around the bus, and exhibiting a path to cross directly in front of the bus

NYCDOT Needs	CV Application	Support for Vision Zero
Reduce Crashes between Vehicles	Red Light Violation Warning	Advise drivers if a vehicle is on an approach that is likely to result in the vehicle violating the red light
Reduce Crashes between Vehicle and Infrastructure	Oversize Vehicle Warning	Provides warnings to vehicle drivers to avoid entering a height-restricted facility and imminent low clearance location
Reduce Crashes between Vehicles and Pedestrians/Bicyclists	Pedestrian in Signalized Crosswalk Warning	Provide in-vehicle indication of pedestrian / bicyclists at intersections equipped with CV technologies
Reduce Crashes between Vehicles and Visually/Audibly-Impaired Pedestrians	Mobile Accessible Pedestrian Signal System (PED-SIG)	Allows for an automated call from the smart device of a visually impaired pedestrian to the traffic signal and notify approaching drivers of the pedestrian's presence
Inform drivers of serious incidents	Evacuation Notification	Provides notification that an area is to be avoided and why (subset of Emergency Communications and Evacuation concepts)
Provide Mobility Information Heavily Congested Areas	Intelligent Signal System CV Data (I-SIGCVDATA)	Integration of CV movements with NYC's award winning Midtown in Motion (MIM) adaptive traffic signal system

1.1 Purpose of the Report

The purpose of this document is to provide an overview of the NYCDOT team's approach for meeting the requirements of Phase 2 and 3 of the CV Pilot project. This document is a companion document to the other Volumes and Parts of the Notice of Funding Opportunity (NOFO) application. In particular, the Staffing Plan and the Budget Plan are interrelated with the information provided in the following sections.

Note that this is a revision to the Volume 1, Part 1 of the NOFO response submitted to USDOT and supersedes that submission from 2016. Many aspects of the original technical details of the NYC CV Pilot Deployment project have undergone changes. To differentiate the 2016 details from the revised ones, the figures and tables from 2016 have been marked with red X and denoted by 'per NOFO' in the figure or table caption.

1.2 Assumptions and Risks

Below are some of the initial assumptions and risks associated with the information included in this document and with the Phase 2 deployment and Phase 3 operations.

Successful execution of our deployment plan depends on a number of external factors. Each of these assumptions represents a risk to the project that will affect the ability to meet the schedule and/or performance goals. Following each assumption/risk is the team's approach to mitigating that potential impact/risk.

(a.) The *Security Credential Management System* version 1.1 will need to be available and stable by November 1, 2016. The United States Department of Transportation (USDOT) will need to define the

specific protocols for all users to incorporate and the certification processes required to ensure equipment meets the standards for security and interoperability.

The protocols (for security authentication and encryption/decryption) and their implementation will need to be able to handle messages at the rate needed for the traffic density in New York City. The response times for the Security Credential Management System (SCMS) will have an impact on the system design as to whether credentials need to be managed as store and forward due to the demands for service. Note that this is an important consideration based on the future of the use of the SCMS.

This is a deployment with actual **users in revenue service**; the security must be in place before testing moves to drivers outside the project team.

Mitigation: There is no mitigation for this risk; the project schedule will slip and costs will increase since the BAA explicitly told us to use the SCMS, we did not design or make provisions for the absence of a working SCMS. The only alternative is to run without security and for such a deployment this is far more risky.

(b.) How well the Dedicated Short Range Communications (DSRC) and Global Navigation Satellite System (GNSS) will perform in the urban canyon. The team already knows some of the issues from prior projects and preliminary testing. The early acquisition of Aftermarket Safety Devices (ASDs) will enable continued testing and development throughout Phase 2.

It is also clear that the location "tracking" mechanism needs to continue in an active mode in the urban environment where possible – or many of the freeway applications will be turned off along FDR drive. There are large areas of NYC where there is "something" overhead – it would be unfortunate if every time Global Positioning System (GPS), "lock" is lost, they all became inactive?

Mitigation: We believe this can be solved, and during the RFEI demonstrations, this was discussed with each of the vendors. One of the reasons we had them drive Manhattan and collect GPS "bread crumbs" was to make sure they understood the situation. Each vendor indicated they had been developing alternatives including data from the CAN bus, accelerometers, and even RSU triangulation. We plan to require perspective vendors to demonstrate prior to award of the procurement contract and will include extensive testing for this specific problem.

(c.) The Schedule will be met by the selected ASD and Roadside Unit (RSU) vendors. The demands on the hardware and the complexity of the software will be unprecedented for connected vehicle equipment. The team will work with vendors to establish realistic schedules and enable as much parallel work as possible. After development is complete, manufacturing and installing the units will take time.

Mitigation: We plan on awarding to two (2) vendors and evaluating prototypes early in the project (See the schedule). With two vendors, we can fall back to a single vendor and disqualify the non performing vendor and continue with the performing vendor for the full complement of units. All vendors interviewed during the RFEI indicated they could meet the schedule.

(d.) Vendor start at risk. The implementation plan is also highly dependent on the ASD/RSU vendors being motivated to initiate their activities after receiving a Notice to Proceed at Risk and before the completion of contracting. The contracting delays and schedule will require that the vendors start much of their work "at risk"; if the City takes 6 months after announcement of award, the vendors will need to proceed with the development and hardware design "at risk" in order to even come close to meeting the proposed schedule. That is – much of the development, certification, and testing must, of

necessity, begin before the City issues a billable contract. It is also likely that the prototypes will be delivered and installed before the contract is issued! Will all of the vendors accept such conditions? We have some initial indications that this will not be a problem.

Mitigation: During the RFEI, all vendors were interviewed and this specific issue was addressed. All vendors will be required to agree to this provision when preparing their bid and all vendors indicated this would not be a problem

(e.) Review & approval by USDOT of all aspects of the Phase 2 work must be done very quickly and the existing "approvals" of the phase 1 Concept of Operations (ConOps), requirements, performance evaluations, Security Management Operational Concept (SMOC) will be used to jump start the development and procurement specifications. Delays in the review and approval of such documents and completion of promised resources may extend the project schedule and budget.

Mitigation: We have allowed the 10 day approval by USDOT in our project schedule, and have encouraged the USDOT to instruct the IE to work alongside NYCDOT during the early phases of the deployment to ensure that our data collection would meet their needs.

(f.) Data collection in the "Before" period begins May 2018 at the start of Phase 3, i.e., formal data collection of any type of data collected using the deployed CV devices or that could be influenced by the CV deployment or other confounding factors will not start until Phase 3. . If the Independent Evaluator (IE) has issues with the type of data being collected and the processing, then the changes may be requested [by USDOT] and such changes may extend the project schedule and budget.

Mitigation: Knowing this, we will make the raw data available at our site (TMC) for the IE's evaluation and testing prior to Phase 3. If the IE works side-by-side with the real raw data, the risk that the data being collected is reduced or eliminated and we can adjust both the expectations and software early in the project.

(g.) There is inadequate time [schedule] and budget to deal with a vendor pre-qualification phase and bake-off. We will rely on the responses to the Request for Expression of Interest (RFEI); the vendor(s) chosen may not be the low bid as we will require further demonstrations prior to award. However, once the vendors have been chosen, the project is at significant risk until the completion of the 100 ASD/10 RSU pre-pilot installation and testing program is successfully completed; if the vendor is ultimately unable to complete this phase successfully, the schedule is at serious risk because of the time required to start with an additional vendor.

Mitigation: If we move forward with 2 vendors, the risk is mitigated, but the development costs and integration costs may double. We have assumed two bidders and two awards in our cost model.

(h.) USDOT completes its promised tools and utilities – especially for the development of the Map Data Message (MAP) message (including pedestrian (PED) crossings) by the end of 2016. Delays in the delivery of such tools may delay the project schedule.

Mitigation: We can hire this to be done but at a considerably higher cost than shown in our budget.

(i.) The Federal Communications Commission (FCC) does not change the spectrum use for the DSRC band – as this could necessitate a re-design and re-engineering of both the hardware and software – and jeopardize the funding since this project is intended to lead to permanent deployment.

Mitigation: There is no mitigation strategy. Our solutions are dependent on the use of DSRC, and changes to the channel availability and use will increase costs and cause project delays. It is up to

USDOT to strongly support the current channel allocation and to ensure that any channel sharing is done in a manner that does not compromise the current channel allocations and usage. Further mitigation would mean redesign of the radios and channel usage plans and reliance on alternate media – which could delay the project.

(j.) Continued support from the stakeholders is paramount to this project. We will continue to increase the participation throughout the initial phases of the project.

Mitigation: We will continue to increase the participation throughout the initial phases of the project. We will stand by the privacy provisions of our data collection and are now launching a "sales" campaign with the stakeholder community to "sell" the benefits of this technology and the value of the opportunity to be early adopters at no cost to them!

(k.) The initial Institutional Review Board (IRB) approval from Phase 1 is assumed to form the basis for the IRB of Record (Phase 2) based on the interaction of both IRBs during Phase 1.

Mitigation: We are transitioning and involving the IRB of Record now, and expect early acceptance to continue the past IRB recommendations; the PED applications will be delayed, with no impact to the schedule and NYU is being given a much greater role in the PED subject selection, recruitment letters etc.

1.3 Organization of the Report

This section, Section 1, provides an introduction to the plan and documents the key assumptions and risks.

Section 2 provides an overview of overall Deployment Concept for the NYCDOT CV Pilot Deployment including an Infrastructure Deployment Map.

The Deployment Approach is detailed in Section 3, the largest section of this document. This section provides details on the NYCDOT's approach to meeting the requirements of each of the Tasks outlined in the NOFO.

Section 4 provides an overview of the Deployment Schedule including a description of the schedule and supporting information regarding the acquisition and installation planning activities.

The Staffing Plan is summarized in Section 5 and the Budget Plan is summarized in Section 6.

2 Deployment Concept

The New York City deployment focuses on safety applications (both Vehicle-to-Vehicle and Vehicle-to-Infrastructure) as tools to help the City reach its Vision Zero goals to eliminate traffic related deaths, reduce crash related injuries, and reduce damage to both the vehicles and infrastructure. This section describes the general approach for deploying and measuring the performance of the CV technology in New York City's dense urban environment illustrated in Figure 2-1. It highlights the stakeholders, their needs, and vehicle fleets, the geographic areas of operation, the safety applications, and the program to assess the system's benefits.

Source: USDOT

Figure 2-1. Manhattan Dense Urban Environment

The New York City Department of Transportation has brought together a stakeholder group (Table 2-1) to achieve the Vision Zero goals. These organizations own, operate, or regulate vehicle fleets that provide services for moving people and goods in the metropolitan area. Each of these organizations has a vested interest to improve the safety of their operations and reduce the costs associated with crashes. Through a series of meetings, NYCDOT assembled a list of their needs as summarized in Table 2-2. These needs reflect the vehicle fleet operations in the city's dense urban environment and congested traffic conditions. A consistent theme expressed by both vehicle owners and operators/drivers is their need for privacy.

Table 2-1. Project Stakeholders

Project Stakeholders	
• NYCDOT • NYCDOT Fleets • NYCDOT Drivers • Metropolitan Transportation Authority (MTA) • MTA Operators • DCAS Fleets • Other City Fleets	• City of New York Department of Sanitation (DSNY) • DSNY Operators • Pedestrians • Pedestrians for Accessible and Safe Streets (PASS) • New York City Department of Information Technology and Telecommunications (DoITT) • Independent Evaluator (IE)

Table 2-2. Stakeholder Needs Summary

Stakeholder Needs Summary
• Manage speeds • Reduce vehicle-to-vehicle crashes • Reduce vehicle-to-pedestrian crashes • Reduce vehicle-to-infrastructure crashes • Preserve privacy • Manage applications within the traffic environment

The project's primary goal is to deploy the CV technology in a significant vehicle population to enable frequent encounters of similarly equipped vehicles. The City is planning to install the CV technology in approximately 3,000 vehicles which frequent the streets of Manhattan and Brooklyn as shown in Table 2-3. The current fleet size estimate is reduced from the ConOps due to a number of factors such as: a) impact of economic changes on the commercial taxi operations, b) installation time scheduling, and c) budget constraints. This equipped fleet provides an opportunity to experience a significant density of DSRC-based vehicle interactions. These vehicle's vehicle-to-vehicle (V2V) safety applications will operate anywhere they encounter another DSRC equipped vehicle.

Table 2-3. Vehicle Fleet

Fleet Owner	Equipped Vehicles (Est.)
MTA	700
DCAS	941
NYCDOT	1359
Total	3000

The City will also be installing approximately 353 Roadside Units (RSUs) at signalized intersections in midtown and lower Manhattan, along Flatbush Avenue in Brooklyn. In addition, the City will be installing a number of RSU's along portions of FDR Drive. The vehicle's Vehicle-to-Infrastructure (V2I) safety applications will function where they encounter RSUs along these streets. The geographic areas for this technology deployment are depicted in Figure 2-2 and summarized in the following table.

Table 2-4. RSU Quantities

Location	RSU Quantity (Est.)
Manhattan arterials	202
Manhattan cross streets	79
Flatbush Ave	28
FDR	8
Support locations	133
Total	450

Source: NYCDOT

Figure 2-2. Infrastructure Deployment Map

To support the overall operations and maintenance of the CV system, RSUs will be installed at other strategic locations throughout the City such as river crossings, the airports, and at the vehicle "barns" (bus, and fleet depots). These units are positioned to have longer contact with the equipped vehicles in support of system management functions such as DSRC over-the-air (OTA) parameter configuration, firmware/software updates, top-off of security credentials, location accuracy augmentation, and data collection. Additional installations will provide test intersections around the City offices at 34-02 Queens Blvd for verification and validation of applications (safety and management) and operational experience.

The New York deployment will include the V2V safety applications listed in Table 2-5 on all vehicles. The deployment will also include the Vehicle-to-Infrastructure/Infrastructure-to-Vehicle (V2I/I2V) safety applications listed in Table 2-6.

Table 2-5. V2V Safety Applications

V2V Application	Purpose
• Forward Collision Warning	Avoid rear-end crash
• Emergency Electronic Brake Light	Avoid rear-end crash due to unobservable vehicle
• Lane Change Warning/Assist	Avoid side-swipe crash
• Blind Spot Warning	Avoid side-swipe crash
• Intersection Movement Assist	Avoid crashes from cross traffic
• Vehicle Turning Right in Front of Bus Warning	Avoid cut-off crash

Table 2-6. V2I/I2V Safety Applications

V2I/I2V Application	Purpose
• Speed Compliance • Speed Compliance / Work Zone • Curve Speed Compliance	To control speeds along arterials and locations such as work zones, curves, and selected school zones
• Red Light Violation Warning	To avoid rear-end and right-angle crashes
• Oversize Vehicle Compliance	To avoid vehicle-to-infrastructure crashes
• Emergency Communications and Evacuation Information	To disseminate information for situations needing immediate changes in travel patterns

As the safety application address a variety of needs, it is important to understand where each safety application will serve those needs. All of the V2V safety applications will be loaded on each vehicle. These V2V safety applications will be enabled on all vehicles except for the Vehicle Turning Right in Front of Bus Warning that will only be enabled on the MTA bus fleet vehicles. Therefore these applications will function whenever the equipped vehicles encounter one another. All of the V2I safety applications will be loaded on each vehicle. These applications will function only where the RSUs support the application. For example, the Red Light Violation Warning will operate at the signalized intersections in Manhattan and Brooklyn. The Red Light Violation Warning will not operate on the FDR RSUs or on the RSUs located at fleet terminal facilities, river crossings, or the airports. Likewise the Curve Speed Compliance will be loaded on all RSUs however only the FDR RSUs will have the application operating. Note that the management applications are expected to operate on the support location RSUs although opportunities to operate them at signalized intersections may develop during the project. Based on the recent vendor demonstrations, we will need to engineer a mechanism to enable/disable applications as well as manage the current set of control parameters for the applications as described in the Concept of Operations.

The City is also working with a number of pedestrian advocacy groups and will be deploying two V2I/I2V pedestrian applications (Table 2-7). The first is to support the visually challenged by using the Signal Phase and Timing (SPaT message) information and the geometric information (MAP message) about the intersection transmitted by the intersection to their personal information device (using cellular service) for assisting them in determining their orientation to crosswalks and the status of the pedestrian signals to assist them in crossing the street. The goal is to equip 100 pedestrians with this technology for the project's testing.

The second application is to provide a warning to drivers when there is a pedestrian in the crosswalk the vehicle is approaching when the vehicle is a threat to the pedestrian. At ten (10) selected intersections, the City will also be installing traditional Intelligent Transportation System (ITS) pedestrian detection technology (e.g. video and/or infra-red detection TBD) which will be able to determine if there is a potential conflict between an approaching CV equipped vehicle and the presence of a pedestrian in the crosswalk.

Table 2-7. V2I/I2V Pedestrian Applications

V2I/I2V Pedestrian Applications	Purpose
• Pedestrian in Signalized Crosswalk	To avoid vehicle-to-pedestrian crashes by alerting drivers
• Mobile Accessible Pedestrian Signal	To assist visually challenged individuals crossing intersections

Because of the number of vehicles and roadside units involved, and the need to be able to update and adjust the operation of the various safety applications, the project has added a number of additional new management applications including support for over-the-air (OTA) software updates, real time RF monitoring of both the vehicles and the infrastructure, OTA changes to the operating parameters [of all applications] to be able to adjust thresholds and warnings, and traffic data collection to support the City's adaptive control system – Midtown-in-Motion. Finally, the City's deployment will include a configurable data collection application that will be used to evaluate the benefits of the system and allow USDOT to perform additional evaluations of the overall system operation.

The New York connected vehicle deployment will only utilize DSRC (802.11p) Wireless Access in Vehicular Environment (WAVE) technology (5.9 GHz) for all functions and applications listed above – including the security credentials distribution, data collection, and application uploading and adjustments. The system will be using 6 of the 7 DSRC channels allocated for CV use. All field devices including both the RSU and the in-vehicle unit ASD will contain 2 radios; one will be dedicated to monitoring or transmitting on channel 172 where it can "hear" the Basic Safety Message (BSM) from all vehicles within range of the radio communications; this is critical for the V2V applications. In addition, it will be able to receive the SPaT message and the MAP message and use this information to support the V2I safety applications. Channel 178 will be used as the control channel to inform approaching vehicles of available services through WAVE Service Advertisement (WSA) and indicating which channel and protocol should be used for the service. The other channels (174, 176, 180, and 182) will be used to support the OTA software updates, application parameter management, security credential top-off, and data collection from the in-vehicle event logs.

The NYC project will be using the City's private wireless network, New York City Wireless Network (NYCWiN), for all communications to/from the RSU as well as continuing to use this media for communications to the traffic controllers. The traffic controllers will have their firmware updated to support the CV applications; the previous procurement specification for the traffic controllers included sufficient processing power and available memory for these additional tasks; as soon as the National Transportation Communications for Intelligent Transportation Systems Protocol (NTCIP) working group finalizes the 1202 standard with the CV data elements, we will be ready to update the controller firmware.

The City is confronting a number of challenges to the deployment of the CV technology in the dense urban environment. First, the ranges of the RSU infrastructure will overlap in all directions; the block spacing is approximately 70 meters for streets and as much as 200 meters for the avenues. Since the DSRC range is approximately 300 meters and far greater ranges have been observed in some previous projects, we expect that operational adjustments will be needed such as variable power output levels. The existing communications design precludes peer-to-peer communications in order to manage security risks and provide location based configuration management (e.g. cabinet based identification enables controller replacement and database loading). This architecture is not conducive to multiple intersection controllers communicating with a shared RSU that produces MAP/SPaT messages for the multiple locations. In addition, where the density of vehicles for other projects has been very low, we are expecting that the percentage of instrumented vehicles could approach 5% or more depending on the time-of-day and location. Most of the fleets which will be participating in this project frequent the midtown and lower section of Manhattan; hence one of the goals of

the project is to foster frequent interactions amongst vehicles – all of which are to be equipped with the full complement of safety applications.

Second, NY City is known for its urban canyons which provide a challenging environment for GPS technology; as a result, additional techniques will need to be included in the positioning algorithms to provide the accuracy needed for many of the V2V and V2I safety applications. Continuous access to GPS positioning data is expected to be difficult in the urban canyons and therefore additional means of augmenting vehicle positioning are anticipated so that the safety applications can continue operating while the vehicle passes under bridges, elevated roadways, through tunnels, and navigate the typical Manhattan streetscapes and traffic environment.

Third, privacy is also a major consideration; although the vehicles involved are regulated fleet vehicles, the City will be implementing a number of measures to protect the privacy of the participants and to make sure that the data collected and used for the evaluation of the benefits and for maintenance support cannot be disaggregated and analyzed or merged with other data (e.g. police accident records) to determine the exact actions and location history of any specific operator or vehicle. The system will make use of the Security Credential Management System (SCMS) being developed by USDOT and the data will be encrypted, normalized, and obfuscated as soon as the analysis of the benefits has been determined. All communications will contain security certificates that will allow the receiver to authenticate the origin of the information.

Finally, because of the size of the system and the number of vehicles and roadside locations, a number of maintenance support functions have been added to the system and hence must be added to both the ASD and the RSU. This will allow the City to monitor the operational reliability of all components, and track the range of all transmitters. This data will be used to assist the City in identifying where both preventative maintenance and corrective maintenance may be required.

The NYC project has also modified the performance data collection approach. Previous deployments have focused on research and analysis of the technology and attempted to collect virtually every message generated, transmitted, and received by all devices; this information was collected on removable media and periodically retrieved for the data analysis. Such an approach is not practical for the New York City (NYC) deployment project; hence, the NYC system limits the data collection to short periods of time before [configurable] and after [configurable] an “event” which might be a warning, alert, or some other triggering parameter within the vehicle. This allows us to evaluate the state of the vehicle before, during, and after the “trigger” and such data is collected whenever the vehicle passes an RSU advertising the event collection service; thus, the volume of data is manageable for both the RSU processing and the backhaul bandwidth to the Transportation Management Center (TMC). The triggers will be configurable and will include BSM data, alarms and alerts, and parameters internal to the ASD.

It is our intent that the RSU (V4+ as modified) and ASD (V3 – as modified) conform to the USDOT standards where they exist as closely as reasonably possible and that all messages conform (where applicable) to the latest versions of SCMS, Society of Automotive Engineers International (SAE) J2735, SAE 2945/x, Institute of Electrical and Electronics Engineers (IEEE) 802.11p, IEEE 1609.x, NTCIP, International Organization for Standardization (ISO) 19091, and related standards. While we recognize that some of these are still being developed, all of these standards are expected to be stable by the end of the 1Q2017 which is the planned start of the production units for this project.

3 Deployment Approach

At a high level, Phase 2 tasks encompass the planning and deployment tasks while Phase 3 tasks are focused on Operations and Maintenance and the evaluation of the Performance Measures described in the Phase 1 deliverables and further elaborated throughout Phase 2.

3.1 Phase 2 Tasks

3.2 Program Management – Task 2-A

New York City Department of Transportation (NYCDOT) and their partners on this project have a long history of successfully executing transportation projects. The Connected Vehicle project is a complex one that requires strong and effective project management to ensure its success. The approach that we intend to follow is based on the tenets of the Project Management Institute. All ten knowledge areas of the PMI Book of Knowledge (PMBOK) will be addressed during the Planning, Executing, and Monitoring and Controlling phases of the Project Management Lifecycle. The NYCDOT team's Project Management Lead will be supported by a Project Manager in preparing the project management deliverables and for providing day to day oversight of project activities and to ensure a disciplined approach is followed.

3.2.1 Project Management Plan

The NYCDOT team will develop a Project Management Plan (PMP) within the first four weeks of the project which will address Scope Management, Time Management, Cost Management, Quality Management, Human Resource Management, Communications Management, Risk Management, Procurement Management, and Stakeholder Management. We will also address the important topic of Configuration Management. The initial draft of the PMP will be shared with USDOT at the Kick-off meeting.

A Risk, Action Item, Issue, Decision (RAID) log will be maintained for the project and updated at least once every two weeks. This log will be input to the Monthly Progress Reports. Many of the tasks described in this document have a requirement to track risks and issues. All these will be maintained in one log with an indicator for the area of focus e.g. performance measures.

3.2.2 Project Schedule

A baseline project schedule will be developed in Microsoft Project and presented at the project kick off meeting. This schedule will clearly identify the tasks required to complete the work, the task dependencies, task start and end dates and the name of the primary responsible individual. All project deliverables required per the Notice of Funding Opportunity (NOFO) will be incorporated. USDOT review times of these deliverables will be clearly identified. Section 4.1.1 provides details on the review cycles. A preliminary version of the project schedule has been developed for this proposal and sections are included throughout this document.

3.2.3 Kick-off Meeting, Monthly Reports & Meeting Participation

At a minimum, the three key resources from the NYCDOT team will attend a kick-off meeting in Washington DC within the first 4 weeks of the project to meet with the USDOT team.

The NYCDOT team will prepare monthly reports that include the status of each deliverable. The report will include an updated schedule and a narrative of accomplishments by task and projected activities in the next quarterly period. The monthly reports will also include a technical risk narrative, a partnership risk narrative, a retrospective cost narrative, and a projected cost-to-complete narrative.

The NYC team will organize and participate in a bi-weekly deployment coordination teleconference with the Agreement Officer Representative (AOR) and federal team members to cover work in progress, identify issues and risks, and coordinate technical assistance. We will also ensure that at least one project representative attends monthly all-site coordination teleconferences.

The core NYCDOT team will have regular internal status meetings to help ensure on time on budget deliverable. The schedule and format of these meetings will be outlined in the PMP.

3.2.4 Coordination of Schedule Updates and Progress Reports

Many of the tasks included within this report require separate schedules and separate status reports on various schedules. For efficiency and consistency, we are recommending:

- One Schedule: To ensure clear dependencies between tasks, all project tasks will be tracked in one schedule. Separate views will be available for each area where specific reports on schedule are needed. This will be updated at least once per week and provided to USDOT as part of the monthly progress report.
- One Monthly Progress Report: One monthly status report will be developed that covers the status of all project tasks as defined throughout the NOFO and this document.
- Biweekly Conference Calls: Biweekly calls with USDOT to review status of all required tasks.
- Exception Reports: If an issue occurs between monthly reports that has a significant effect on the project scope, quality, budget, or schedule, this will be communicated to USDOT within one week of the issue's identification.

3.2.5 Deliverables

The NYCDOT team will provide the following deliverables during Phase 2:

- Kick-off Meeting
- Project Management Plan (PMP)
- Revised PMP (as required)
- Project Schedules (updated monthly)
- Monthly Progress Report
- Participation in site-specific bi-weekly coordination teleconferences
- Participation monthly all-site coordination teleconferences

3.3 System Architecture and Design – Task 2-B

The objectives of this task are to develop a well-structured architecture for the New York City deployment concept and to prepare a detailed design embodying the deployment concept based on the architecture. This task builds on the Phase 1 systems engineering work documented in the Concept of Operations, System Requirements, and Comprehensive Deployment Plan.

3.3.1 Systems Architecture Document

The New York City connected vehicle pilot deployment team will develop a Systems Architecture Document (SAD) with a Standards Plan (appended to the Systems Architecture document) to describe the architecture for the system and the standards that will be used. The SAD will consist of both a physical and logical view of the system describing system functions and their distribution to the individual components. Note that this document will leverage existing CV architectures and their descriptions especially in the areas of the "field" devices (I.e. RSU, ASD) and their communications. It should be noted that the development of the SAD will lag the development of ASD and RSU procurement specifications and therefore will document many of the decisions made during the development of the specifications.

As the New York City system engineering team applies standards to the various external interfaces and selected internal interfaces, the relationships will be recorded in the Standards Plan. The project team is familiar with the use of standards and will apply them appropriately. This means taking note of the mandatory requirements as well as selecting optional requirements as necessary to fulfill data flow requirements and manage communications over the interface. The team expects to utilize existing standards and emerging standards where viable. Where standards don't exist, the team will document the gap for future standards development consideration.

The National ITS Architecture is a mature architecture that provides a common framework for the ITS community to plan, define, and integrate ITS solutions. The Connected Vehicle Reference Implementation Architecture (CVRIA) is intended to extend the National Architecture to include detailed information to support development of fully interoperable regional connected vehicle architectures at some future date. The CVRIA (and associated SET-IT tool) and the National ITS Architecture (and the associated Turbo Architecture Tool) will be considered to support systems architecture development and documentation as the New York City system engineering team deems appropriate. The NY team has a record of documenting their experiences with the tool and cooperating with the architecture and standards developers to improve the quality of these products based on lessons learned in deployment. However, it is important to note that the CVRIA represents a broad understanding of the ***potential*** for the applications – and does not necessarily represent the specific deployment concepts of the NY CV Pilot Deployment Program. As a consequence, it will be important to determine where it is appropriate to standardize the interfaces developed.

After the delivery of the draft Systems Architecture Document, the New York City system engineering team will conduct a System Architecture Walkthrough (see IEEE Standard 1028-2008) with the AOR and federal team members in the Washington DC metropolitan area to demonstrate the completeness and technical soundness of the architectural approach. A minimum of two full working days will be allocated to this Walkthrough. To facilitate the exercise, the New York City system engineering team will prepare a SAD Walkthrough Workbook to structure and expedite the Walkthrough process. The New York City system engineering team will attend the Walkthrough meeting with a maximum of four team members unless otherwise approved by the Agreement Officer (AO). New York City assumes that USDOT will make available webinar facilities for remote participation by additional New York City team members. The New York City system engineering team will

collect USDOT comments (both written comments provided prior to the Walkthrough and verbal comments provided during the Walkthrough).

The New York City system engineering team will evaluate the USDOT comments and will submit a revised System Architecture Document (version two) along with an accompanying comment resolution report. Based on USDOT review of the revised document, the NYCDOT team will deliver a final System Architecture Document (version three).

3.3.2 System Design Document

Based on the system requirements specification (SyRS) and the approved system architecture, the New York City system engineering team will prepare three versions of a System Design Document (SDD) that describes the full scope of the system. The first will be a draft submitted to USDOT for review. The second version will be an updated draft in response to USDOT's comments accompanied by a draft Comment Resolution Report addressing USDOT's comments following the System Design Walkthrough discussed below. The third and final version will complete the review cycle and meet the USDOT's Section 508 publication requirements.

The New York City system engineering team will organize the SDD similarly to the organization shown in Annex A of the IEEE Standard 1016-1998 (IEEE Recommended Practice for Software Design Descriptions). Subsystems of the system will be identified and decomposed further into components. Requirements will be allocated to the system components, and interfaces. Detailed specifications will be created for the hardware and software components to be developed, and off-the-shelf components will be identified. Design-related requirements from the Safety Management Plan will be incorporated in the SDD and explicitly marked as such. Note that the New York City system engineering team will identify interfaces and requirements for those interfaces however it will not be re-engineering the internal operations of these components.

After the delivery of the draft SDD, the New York City team will host and conduct a System Design Walkthrough with the AOR and federal team members within or near the deployment site to demonstrate the completeness and technical soundness of the system design. A minimum of two full working days shall be allocated to this Walkthrough. To facilitate the exercise, the New York City system engineering team will prepare a SDD Walkthrough Workbook to structure and expedite the Walkthrough process for USDOT. The New York City system engineering team will collect USDOT comments (both written comments provided prior to the Walkthrough and verbal comments provided during the Walkthrough).

In response to the collected USDOT comments, the New York City system engineering team will submit a revised SDD (version two) and an accompanying comment resolution report. Based on USDOT review of the revised SDD, the NYCDOT team will deliver a final SDD (version three).

When the SDD is approved, the New York City system engineering team will update the Phase 1 Concept of Operations, System Requirements Specification, and Comprehensive Pilot Deployment Plan documents for consistency with the decisions of the Phase 2 design.

3.3.3 Deliverables

- Draft Systems Architecture Document (SAD)
- Systems Architecture Walkthrough and Workbook (DC metro area)
- Revised SAD with Comment Resolution Report
- Final Systems Architecture Document
- Draft Systems Design Document (SDD)
- Systems Design Walkthrough and Workbook (deployment site)

- Revised SDD with Comment Resolution Report
- Final Systems Design Document
- Updated Phase 1 Deliverables, at a minimum
    - Revised Concept of Operations
    - Revised Systems Requirements
    - Revised Comprehensive Deployment Plan

3.4 Data Management Planning – Task 2-C

The data management plan provided in Phase 1 is preliminary and will be expanded with additional detail during the design tasks of Phase 2. The questions raised (listed below) will be answered and integrated into the requirements and design of the CV back office systems – and will affect the parameterization of the data collection "applications" being added to the RSU and ASD.

In considering the data management plan, it is important to consider the privacy needs of the project's stakeholders and hence the project approach to collecting data without compromising privacy. Keep in mind that we do not collect any PII, and that we are normalizing, obfuscating, and aggregating all of the data that could be combined with other sources (e.g. police records) and traced to individual drivers. Once this is completed, all data will be stored for our analysis and subsequently shared with the RDE[1] and the IE. It is our intent to manage the archiving of all NY data within our own TMC and simply export the data to the RDE and IE when it becomes available. However, as noted in our NOFO presentation, we encourage USDOT to have their IE work side by side with the NY team during the testing and verification to ensure that they are comfortable with the accuracy and detail of the data provided.

Note that all data associated with the maintenance (O&M) management (RF data) will be used and discarded once it has been converted to reports.

3.4.1 Data Management Plan

The data generated during the Pilot Deployment will include at least the following. Additional data types may be added during the full development of the Data Management Plan (DMP).

- Processed connected vehicle event data made available from the TMC to the Independent Evaluator (IE) and the Research Data Exchange (RDE)
- Processed traffic measurement sensor information (e.g. vehicle counts, classification, speeds) captured by devices participating in the Pilot Deployment
- Information about participating organizations
- Information about device and vehicle types

The data management plan will address all of the above data types. However, the intent of the NYC Connected Vehicle Pilot Deployment (CVPD) team is to store only the following (note that the traffic control system already stores traffic measurement data for other purposes):

- Processed data made available from the TMC to the IE and the RDE
- Information about participating organizations
- Information about device and vehicle types (note that the J2945/1 standard omits vehicle type data from the BSM content for light-duty vehicles; the project will require the DE_VehicleType in BSMs for other vehicle types)

Processing of the connected vehicle data refers to the normalization, obfuscation, and aggregation of the event data. It is the output of this processing that will be available to external organizations and systems. Representative data include the EEBL, FCW, RLVW events detected by the ASD. Processed traffic measurement data refers to the aggregated, periodic data that is augmented with meta data regarding the completeness of the data with respect to communication/device failures. This data includes traffic volumes, vehicle classifications, and vehicle speeds.

The other raw data types (i.e. raw event data prior to processing) will be recorded in the data management plan only to ensure that they are not persistently stored and to document the processes for disposing of them.

Only the data required for the analysis of the benefits (e.g. event data, weather data, traffic measurement data, performance measurement inputs) will be stored for future use since there is no other need for such data by the TMC or operation of the project.

The data management plan will follow a template developed by the New York City system engineering team and will address the following issues during Phase 2 of the project. These issues are presented as questions to be answered by the content of the plan. These questions address the basics of what data is needed, who owns and can access the data, where the data is stored, when the data becomes available, and how the data is to be managed and the procedures/processes for its management.

1. Data Types and Storage

The data management plan will identify the types of data generated by the connected vehicles and used in the performance measurement of this project. Sample questions to be considered when identifying and evaluating the data include the following:

- What type of data will be produced?
- How will this data be collected? In what formats?
- How to document data collection?
- How much data will it be, and at what growth rate? How often will it change?
- Are there tools or software needed to create/process/visualize the data?
- Will you use pre-existing data? From where? (e.g. external crash databases, traffic counts)
- Will the data be reproducible? What would happen if it got lost or became unusable later?
- What is the strategy for storing and protecting (i.e. restoring) the data?

Note that data quantity estimates will be used for initial storage estimates. Due to the fleet size and the potential for many events to be generated, estimates will have to be compared to initial actual event collections to assess whether adjustments will be necessary. This process can begin when the initial ASD prototypes are installed and begin tests in the NYC environment.

2. Data Organization, Documentation and Metadata

The plan for organizing, documenting, and using descriptive metadata to assure quality control and management of these data include:

- What standards will be used for documentation and metadata?
- Is there good project and data documentation format/standard?
- What directory and file naming convention will be used?
- What project and data identifiers will be assigned?
- Is there a community standard for metadata sharing/integration? (consider the RDE meta-data requirements based on ASTM E2468-05, Standard Practice for Metadata to Support Archived Data Management Systems)

The aggregation concept is based on using geographic and temporal bins. These initial bins will have to be established using the best available experience of the performance measurement staff. As data are collected, the project team anticipates modifying the bins to ensure that each bin contains a sufficient number of events to prevent matching the identification of any single event to an actual vehicle.

3. Data Access and Intellectual Property

The following questions will be addressed by the plan to ensure that data access and ownership concerns are addressed by the plan.

- Does the data have any access concerns? What access processes are necessary to access the data?
- What steps will be taken to protect privacy, security, confidentiality, intellectual property or other rights?
- What agreements (e.g. MOUs) must be in place to enable access to the data? What organizations would be involved (e.g. NYCDOT, USDOT, equipment suppliers, IRBs, stakeholders)
- Who controls it (e.g., PI, student, lab, University, funder)?
- Any special privacy or security requirements (e.g., personal data, high-security data)?
- Any embargo periods to uphold?

4. Data Sharing and Reuse

The process by which the data will be released for sharing will be addressed by the plan by answering the following questions.

- If you allow others to reuse your data, how will the data be discovered and shared?
- Any there organizational sharing requirements (e.g., sharing policy)?
- Who will use the data now? Who will use it later?
- Will the data be published and where?
- Are there tools/software needed to work with data? Who and how are these provided?

5. Data Preservation and Archiving

The following questions address how the data will be preserved, protected, and archived and will be addressed in the plan.

- How will the data be archived for preservation and long-term access?
- How long should it be retained (e.g., 3-5 years, 10-20 years, permanently)?
- What file formats? Are they long-lived?
- Are there external data archives that the data is appropriate for (subject-based? Or institutional)?
- Who will maintain (i.e. fund, backup, restore) the data over the long-term?

3.4.2 Data Privacy Plan

The data privacy plan will in particular address:

- Privacy risks for particular types of data
- Techniques for data anonymization before providing it to external partners (Independent Evaluator and Research Data Exchange). Note that the normalization and obfuscation described in the Concept of Operations and Performance Measurement Plan will be incorporated as another level of anonymization to address the potential of the data to become personally identifiable when combined with external data (e.g. crash records).
- Data retention policies
- Contractual relationships with other parties that have access to the data and how obligations to follow the data privacy plan will be passed on to those other parties

3.4.3 Data Sharing Framework

We plan to share the data with the RDE and the IE as described in the data management plan above and as documented in the Performance Measurement Plan. The project's Concept of Operations describes how the individual event data has the potential to become personally identifiable information and conflicts with the CV program goals.

All individual event data will be normalized, obfuscated, and aggregated in accordance with our performance plan and made available to the RDE and IE in bulk on a periodic basis. This process is preliminary and will be evaluated during the initial testing (phase 2) to ensure that the modified data cannot be used in combination with other data sources to identify a specific driver's actions.

3.4.4 Deliverables

The NYCDOT team will provide the following deliverables during Phase 2:

- Draft Data Privacy Plan (DPP)
- Revised DPP with Comment Resolution Report
- Final Data Privacy Plan (DPP)
- Notice of Privacy Management Consistency
- Draft Data Management Plan (DMP)
- Revised DMP with Comment Resolution Report
- Final Data Management Plan (DMP)

3.5 Acquisition and Installation Planning – Task 2-D

As noted in the Task 7 deliverable, *Application Deployment Plan*, New York City plans to issue a Request for Quote (RFQ), bid documents, for "turnkey" solutions for the ASD and the RSUs. This RFQ is being developed following normal NYCDOT purchasing procedures that are used to select most ITS devices and their traffic controllers. This approach avoids the contracting complexities of purchasing the platform from Vendor A and the software from Vendor B and taking responsibility for any issues with respect to their integration. Since all of the vendors interviewed during the original development of the project and during the vendor/OmniAir day on April 19 (this year) indicated they had all of the safety applications of interest, this seems like a reasonable approach. It was also obvious during the demonstrations conducted by two of the vendors in December 2015 that there were many differences in methods used to develop the applications – and apparent differences in their operation and reliability. Further, it appears that the OEM suppliers and automakers are developing their own "platform" working with one or more CV equipment vendors, but will be qualifying and testing the products

for their vehicles. Therefore, we elected to take the turnkey approach and will specify the applications and performance requirements and test for reliability and standards conformance. In the absence of any USDOT or NHTSA testing standards for the V2V safety applications, this appeared to be the most reliable approach. However, as noted in the ConOps, we are requiring that the vendors make the operation of all their applications "adjustable" so that we can tune their applications for optimal operation for NYC. While this approach may not be interoperable with the applications of others, it will provide a platform on which we can adjust for optimal application performance and test the benefits of the CV applications in the NYC environment.

The acquisition approach is to purchase 100 ASD prototypes from each of two vendors and 10 RSU prototypes from a single vendor. The project is already developing the procurement specifications for the devices and will incorporate the detailed requirements for each after review by the City's purchasing department. The line items in the RFQ will allow the vendors to identify their Non-Recurring Engineering (NRE) costs or absorb such costs when faced with an order of only 100 units. This will also identify the overall cost of using two vendors rather than a single vendor. Then depending on the budget, the city can determine and evaluate the cost benefit of using one, two, or three vendors (two ASD plus one RSU). The selected ASD vendors will be guaranteed that NYCDOT will purchase at least 4,000 ASDs in addition to the 100 prototypes units. A total of 550 RSUs will be purchased.

The expectation is that the NYCDOT will purchase 4,000 ASDs with installation kits. The fleet of 3000 vehicles will be equipped with a portion of these devices. We anticipate re-installing 600 projected vehicle turnovers of which 400 would be salvaged ASDs requiring new installation kits and 200 would require a new spare ASD with its installation kit along with 100 ASDs (with installation kits) for non-warrantee replacement needs. Therefore, NYCDOT will fund additional installation labor for 700 installations. It is unclear how the project-specific fleets chosen will be affected by vehicle turnover. A total of 700 ASDs (with installation kits) will be delivered to USDOT whereas the target fleet is unknown.

The units will be purchased with a 36-month warrantee and 24-hour depot repair; the vendor's depot must be located within the City of NY. Thereafter, the bids will seek an extended warrantee for the units on an annual basis renewable for 5 years. We are also requiring that the vendors provide services to support integration and testing and work closely with NYCDOT and its consultants to modify their applications to meet the needs of the project for data collection, OTA updates, configurable logging, channel utilization, configurable application operation, and testing.

The NYC team has considerable experience with developing and testing embedded systems and intends to make some adjustments to the RSU and ASD specification seeking to enable task management, configurable logging, process monitoring, RF health monitoring, watchdog recovery, available memory, and security.

The goal is to get to an acceptable *hardware platform* by each vendor and then focus on the firmware. The fundamentals will be tested including OTA task management, security utilities, OTA application parameter management, OTA software updates, processing speed, memory availability, packaging, and environmental reliability/operation. Then we can activate the applications and update them concurrent with the initial testing and concurrent with the deployment program which is expected to take 22 weeks.

The bid documents will require detailed submittals for the software and hardware and provide us the opportunity to review and share their submittals with USDOT. The testing (environmental and standards conformance) has yet to be determined and our policy is to set the requirements, and allow the vendor to write the test procedures based on their instrumentation and facilities. However, we will require they demonstrate conformance to all aspects of the communications including message sets, protocols, physical/RF characteristics, IPV4/IPV6 (RSU) safety and security – as well as message processing capability, and

application processing. In addition we will be testing all of the above under various environmental conditions including temperature, humidity, vibration, shock, communications loading (Ethernet), and power interruptions/restart. We are very sensitive to the issues associated with unattended operation – and will perform extensive testing to make sure that the unit always starts with all sorts of power interruptions and fluctuations without damage or corruption.

The one area where we are expecting difficulties is the attachment to the vehicle CAN or J bus for the retrieval of data. This is a common concern for all of these fleet owners, and we will be working with the existing installers and manufacturers to ensure that the detailed design does not compromise either the operation or security of the internal vehicle bus.

During the planning for operation, the project team will be developing software which resides at the TMC to monitor the operational integrity of the various elements of the system and to track the parameter and software management of the ASD and RSU.

The comprehensive acquisition plan (CAP) will deal with all of the above in the RFQ for the ASD and RSU. The bid will allow the City to select one or two vendors for the ASD and one vendor for the RSU – which may be one of the ASD vendors or a third vendor. The selection process will be determined based on budget considerations, the vendor reputation, and what is learned during the RFEI demonstrations during the week of July 11, 2016. As a matter of note, 8 potential vendors have committed to demonstrating their applications and equipment at a test facility where the city will have the opportunity to see, experience, and discuss the deployment issues with the individual vendors prior to issuance of a formal RFQ. We currently are dealing with the following potential suppliers: Cohda Wireless, Danlaw, Savari, Battelle, Denso, Lear/Arada, Dephi, Commsignia, Etrans Systems, and Wave Mobile Solutions. Their RFEI responses will be formally evaluated July 6-15.

The NY team will be working closely with USDOT as the various certification processes and certification procedures are developed. It is our hope that we will be able to reference USDOT reviewed test procedures, but absent such documents, we are prepared as indicated above. We also recognize that the cost of the certification process must be reasonable and repeatable as they modify their software. At this time, we anticipate that the certification process will address conformance with DSRC radio communication operations. We also understand that certification to IEEE 1609 security standards outside of 1609.2 will not be available and the vendors will have to self-certify their devices. Note that we anticipate vendors will perform type certification testing after prototype testing and final concurrence with New York City on the hardware platform.

As noted in the NOFO, NYCDOT will develop all of the aspects of the CAP and deliver same to USDOT for review and comment. Like most of our past experiences, we have allowed 2 intermediate reviews before production of the final version for publication.

For the site locations, the ITS engineering staff will develop “typical” site drawings which deal with the installation of the RSU and the brackets and wiring along with the Power over Ethernet (PoE) insertion and connection to both NYCWiN and the controller (Advanced Solid-State Traffic Controller (ASTC)). Separate as-built and special drawings will be developed for the installation where the site deviates from the typical plan.

A separate contract will be let with the ASTC firmware supplier to build the ASTC-RSU interface. The supplier is expected to work with both vendors to maximize the use of the NTCIP 1103 standard for this interface. Using this interface standard allows the ASTC to provide the data elements essential for the generation of the SPaT message.

Further, the ITS engineering staff will address the deployment of the PED detection equipment at ten (10) intersections where the RSU will be alerted to pedestrians in the cross walk. This will include detailed conduit, wiring, and mechanical plans for the installation of the PED detection equipment.

The CAP will include a series of procurement efforts - one for the in-vehicle equipment, one for the RSU, one for the PED detection systems, and one for the central systems. These will include communications plans, IP assignments, addressing, setup, calibration, and verification procedures for all field equipment.

The CV "back office systems" will be housed on servers purchased by and owned by NYCDOT and placed in the TMC located at 28-11 Queens Plaza North where the current traffic control and incident management systems are housed. This facility also features 24x7 operations personnel and on-call maintenance both locally and remotely by NYC TMC personnel who can log into the systems for trouble shooting purposes and who can exchange hardware and restart systems when necessary. The computers are "blades" in the various chassis which feature remote control operations to start/stop/reset etc. The procurement for this equipment will be similar to that of the traffic control servers currently in the TMC. The project team will draw up a bill of material, and the City will purchase same from either a GSA list, a state approved vendor list, or through one or more contracts already in place. This is typically equipment from HP. The additions to the TMC will include network equipment as well as severs; the detailed equipment list will be developed and will include the servers, firewall changes, network equipment and any additional displays that can be used to monitor the overall CV system. As part of the software development, we will be developing dash boards and reports that can be used to track the reliability of the CV equipment and systems.

3.5.1 CAP Components

During Phase 2, the CAP will be developed based on the above and will include:

a. A description of the item
b. Reference(s) to relevant requirements and specifications derived from the System Design Document (SDD)
c. Certification requirements
d. Describe the method of acquisition
e. Potential vendors/suppliers

As part of the installation planning, the project team will develop a comprehensive installation plan (CIP) that includes all of the technical details for the installation including antenna location, power wiring, hardware and equipment installation. As noted above, this project team is very familiar with the general requirements for the installation of ITS equipment including power, mounting, utilities, surge, and lightening protection, wiring requirements, mounting brackets etc. JHK has been providing this type of engineering support for NYCDOT for more than 30 years which has included communications system design, controller procurement, Electronic Toll Collection (ETC) reader installation, dynamic message sign (DMS) installation, power and conduit requirements, mounting and service requirements etc. This project is no different and JHK will be providing the design services necessary.

As noted in application deployment plan, we will be installing the ASD's concurrent with the RSU's and concurrent with the final software development. The schedule is a very demanding one since we will require over 69 weeks for the installation alone, and prior to that we need to go through a complete NYCDOT procurement cycle. Many of the vendors will be starting and completing their designs before they have a billable contract – which is why we separated the procurement into a prototype phase and a production phase. This allows the vendor to be paid for their NRE costs and startup costs as soon as they get a contract – as long as the prototypes have been delivered and accepted.

3.5.2 CIP Components

When the project team develops the CIP it will include the following:

- Supplier(s); (either the bidders or the selected GSA suppliers)
- Inventory control method(s); (we typically use serial numbers which are tracked in a database)
- Required configuration or pre-installation modifications; it is expected that the ASD and RSU will be delivered "ready to install" complete with their security enrollment certificate – and it will acquire operating certificates during the power-on sequence following installation
- Pre- and post-installation inspection procedures; this is typically a checklist of "things" to do or check before powering up the device
- Detailed installation procedures; These will be developed in concert with the vehicle maintenance garage and technology installers (e.g. taxi, bus, sanitation, UPS)
- QA/QC processes (with identified responsible parties)
- A preliminary, high-level installation schedule
- Hardware/software configuration control processes
- Spare parts/warranty contingency plans

NYCDOT will deliver the CIP to the USDOT for review. Any comments received from USDOT will be considered in the preparation of the revised CIP or will be the subject of a discussion with USDOT to resolve any apparent issues. Once both NYCDOT and USDOT are in agreement on the CIP, a final CIP will be delivered.

3.5.3 Deliverables

- Draft Comprehensive Acquisition Plan (CAP)
- Revised CAP with Comment Resolution Report
- Final Comprehensive Acquisition Plan
- Draft Comprehensive Installation Plan (CIP)
- Revised CIP with Comment Resolution Report
- Final Comprehensive Installation Plan

3.6 Application Development – Task 2-E

A number of indoor, outdoor, and vehicle-borne elements need to be developed during Phase 2 on a tight schedule. The tasks of development and unit testing will be assigned to separate groups, each with clear responsibilities and carefully defined interfaces. NYCDOT will monitor the progress of the teams throughout Phase 2 and facilitate communication so that they stay on schedule because a delay in one area of the system has the potential to affect other areas and the overall project schedule. Centralized management and a technical support team that understands the entire system will be able to aid the individual teams when difficulties arise, reduce conflicts between different subsystems, and enable more efficient development.

Figure 4-1 is the high-level schedule for Phase 2. Early in Phase 2, the internal milestones will be put in the schedule, including points of coordination and joint testing between the separate teams. The work of the teams will be phased so that integration testing can begin even as detailed engineering continues. Dummy signals will be sent across interfaces to show that mockups of separate modules are interoperable and to identify needs for refinement early. This fuller set of milestones and integration points will be delivered to the Federal Highway Administration (FHWA) as the first version of the Application Development Schedule (ADS). The core

team will meet at least weekly with representatives of all development teams, and progress will be tracked on the schedule. Since the application development activities are dependent on other project tasks such as the installation schedule, the ADS will be a subsection of the overall schedule. A separate view will be created within the overall project schedule that highlights the application development tasks. This view will be the ADS.

Procurement specifications will require that suppliers provide internal development milestones. Milestones will be met by component testing early in Phase 2 and by integration testing later in Phase 2. Milestones will be taken from suppliers' proposals and incorporated in the ADS. The milestones will represent approximately the 20% complete, 50% complete, 80% complete, and fully complete levels.

The Monthly Progress Report (described in Section 3.2.3) will include updates regarding the status of development activities underway, progress made since the last update, and technical issues with mitigation actions underway.

The connected vehicle applications and supporting software that will run on the Aftermarket Safety Devices (ASDs) will be procured as part of the ASD hardware. Similarly, the Roadside Units (RSUs) will be procured with their software. Additional software to enable the system to operate [i.e. CV support environment] will also be required at the TMC, traffic signal controller, and mobile PED devices. The New York City team will be employing a variety of approaches to application development, depending on the hardware where the application is to reside and the maturity of the application. The software development approach has been divided into these categories representing the approach to the procurement:

- ASD – Turnkey procurement from one or more vendors, complete with all software and security enrollment certificate embedded application software/firmware.
- RSU – Turnkey procurement from one or more vendors, complete with all software and security enrollment certificate embedded application software/firmware.
- ASTC – Software modifications contracted to a single vendor to support data export to the RSU, and changes to support the security requirements, and time management.
- TMC-CV – CV support software developed [and hardware procurement for additional servers and network equipment] based on the ConOps and requirements and detailed design developed during Phase 2 to be developed by JHK. This is all of the CV support systems and interfaces specifically related to the CV systems including interfaces to the SCMS, RDE, and IE.
- TMC-TCS – Includes minor modifications that are required to the existing traffic control system (TCS); there may be some additional data export for traffic controller status and/or software associated with time management since there are at least 4 time references used by the overall systems: Universal Time Coordinated (UTC)-line referenced for traffic control functions (e.g., offset relationships), UTC-GPS which is UTC referenced to absolute time NIST (National Institute of Standards and Technology) for the time points exported (SPaT), TAI (International Atomic Time) which is the time reference for the SCMS and all security certificates.
- PID – Personal Information Device (PID) used for the PED applications is being developed by a different NYCDOT project team in concert with the NYC CV team and it will include web applications and portable application for the implementation of the PED applications for the visually challenged.

All of the applications, whether mature, adapted, or new, will require some development work. All will be applied to vehicles on which they have not previously been deployed. All will require tuning for alert thresholds and arbitration because the high density of traffic in New York City and the high number of applications in use. A novel audio-only driver-vehicle interface will be developed. Because this deployment is larger than any previous, safety and security requirements will be more significant and will be included from the beginning.

Requirements will be flowed down from the Safety Management Plan, and new requirements will be derived as appropriate.

Furthermore, work will be necessary to ensure interoperability of the hardware and software elements in the pilot deployment with one another and with the existing New York City infrastructure. Applications that are well established may need to be modified to perform with new interfaces.

3.6.1 Development / Testing Team

At this stage of our project planning, we expect to have roughly 4 teams active in the development process:

1. One team is developing the procurement specifications and tracking the procurement process along with specification review, submittal review, analysis of bids, support to NYCDOT's procurement team, and testing. This team will consist of 2-3 engineers to support the process and to ensure that we can stay on top of the application development process for the RSU and ASD's. This same group will be working with the ASTC to ensure that we have a self consistent solution and that the ASD-RSU-ATCS all interoperate as intended.

2. A second team led by TransCore's software development group in Atlanta will deal with the CV and TCS support software development. This software team consists of 6 people including architects, developers, and testing. It is anticipated that they will work closely with the previous team (Team 1) and develop test cases, simulators etc. to facilitate testing.

3. A third team will be focused on the Field work – including vehicle installation, RSU installation, field testing, and establishing the maintenance procedures. This is expected to be 3-5 people over time – and will start with the sample devices and work closely with the stakeholders. This team will also handle the pedestrian detection at the 10 intersection locations planned; the group will use normal ITS device procurement as this is expected to approach $900K based on current estimates. Note that this team is not the actual installation crews; this team is responsible for the engineering and documentation of the procedures for installation, maintenance, and testing.

4. A fourth team will be devoted to developing and testing the Pedestrian applications. This is likely to consist of 3-4 people and a number of groups participating. The exact approach is still under development, but we have the specifications, and this team may be sole sourced with hardware procurement separate – TBD.

In addition to these four teams, our project plan (and budget) includes using selected resources (e.g. Security Innovations) and unspecified experts (e.g. GPS, RF, Vehicle Systems) where we feel it is necessary to augment the team with expertise either for review or direct input to the design and testing activities.

3.6.2 Initial Risks

The team has already identified a set of risks for Phase 2 development. The responses to the current Request for Expression of Interest (RFEI) will lead to more risks, and more will be written by NYCDOT when the ADS is developed at the beginning of Phase 2. In addition, each development team will be required to submit a list of risks. NYCDOT will scrutinize these lists for completeness and will monitor abatement activities weekly.

The technical risks that have been identified and their mitigation approaches are listed below.

- The New York City signal system needs to revert to an earlier version, interrupting development and testing.
    - Any upgrades related to the signal controllers or their software will be thoroughly tested before deployment, so that traffic is not disturbed. This is inherently on the critical path and not part of the open procurement, so this work can start sooner to avoid delays.
- The number of vehicles makes and models in any fleet is more than anticipated, so extra time and effort is required to adapt and install the ASDs.
    - As fleets and companies are enrolled, the number of makes and models and the corresponding number of unique installations will be recorded so that adequate resources can be planned. This work is being started under Phase 1 to reduce impacts on the Phase 2 schedule.
- Security system is not available for testing as scheduled, or handling certificates is more complicated than anticipated. These risks could delay testing or degrade performance.
    - This is a critical risk with dependencies outside the project and relying on the Security Credential Management System still under development. Testing will be unrealistic without a working security system, and deployment cannot begin without it.
- ASD hardware modules cannot accommodate all of the safety applications and event recording applications. This could degrade performance or restrict the number of applications that are deployed.
    - The RFEI was an advanced step in assessing the ASD capabilities, and capacity will be scrutinized throughout the acquisition and deployment.
- RSUs or backhaul systems cannot handle the volume of data in event uploads, causing at worst data to be lost.
    - The systems will be designed to accommodate peak demand. Should capacity be regularly exceeded, the simplest mitigation is to trim the amount of recording time before and after the event trigger, using configurable parameters. The extreme mitigation is to install additional RSUs on routes leading to overburdened RSUs to relieve the demand. If the backhaul is the issue, then installing an alternate media (fiber) may be possible as NYCDOT has an aggressive program of installing fiber along some areas of the City (Manhattan) typically along the avenues.
- Vehicles need hardware upgrades but cannot be located.
    - If a vehicle is known to be reporting irregular performance data and its hardware cannot be replaced, the performance data will be intercepted before the obfuscation step and discarded. If a vehicle becomes a “bad actor” or is unavailable for an extended time, its security certificate will be revoked and it will be removed from the deployment.
- Installation teams cannot be formed, trained, and equipped quickly enough to complete all of the vehicle installations for deployment.
    - Part of the fleet enrollment process will be to determine the ability of their maintenance staff (or contractor) to provide the necessary labor. Temporary labor may be an option in some cases, as is moving maintenance to other providers. Fleets’ existing maintenance agreements will preclude those options in other cases.

3.6.3 Deliverables

- Initial Application Development Schedule (ADS)
- ADS Update with Progress/Risk Summary as part of the Monthly Progress Report
- Open Source Software and Supporting Documentation (per the ADP and ADS)

3.7 Participant and Staff Training – Task 2-F

Training is an important component in the success of this pilot. The pilot participants can be loosely grouped into four main categories: Operational Support (including install and maintenance technicians), Fleet Owners/Drivers, Pedestrians, and Trainers. As described in the Participant Training and Stakeholder Education Plan (PTSEP) prepared in Phase 1 our training program is based on a train the trainer approach. The project team will train a group of fleet trainers. We anticipate training approximately 100 driver fleet trainers and approximately 20 installation fleet trainers. Each fleet owner will be responsible for providing training to their drivers and installers.

Figure 3-2 provides a high level view of our schedule for training preparation and delivery. We anticipate using a variety of training materials including hands on, manuals, checklists, videos, and online training modules. The schedule and resource assignments for the preparation of these materials will be elaborated in the Training Implementation Schedule (TIS). Since the training activities are dependent on other project tasks such as the installation schedule, the TIS will be a subsection of the overall schedule. A separate view will be created within the overall project schedule that highlights the training tasks. This view will be the TIS.

As the details of the NYCDOT Training program are finalized the training team will work closely with the IRB to ensure that any recruitment and training activities are within the guidelines provided by this board. The Participant and Staff Training Plan will be updated (as needed) to address the training-related actions in the Safety Management Plan, including the restriction that only specially trained staff be permitted to install or maintain project equipment.

3.7.1 Training Schedule

The project schedule, including the TIS, will be updated at least once per month to show progress against the plan. The details in this schedule will be progressively elaborated as more details regarding specific activities are clear. Technical risks and issues will be tracked and recorded in the project's risk and issue log. A specific category will be assigned to training risks/issues so that they can be easily extracted from the overall project's risk and issue logs.

It is important that training is timed such that it is provided as close as possible to the time that trainees will be utilizing the skills they will learn. Given this philosophy, as shown in Figure 3-2, we anticipate that all the training materials will be created during Phase 2. The installer training will be completed in Phase 2 (prior to the installation period). However, the driver and pedestrian training will be executed in the early months of Phase 3 while the 'system' is being run in a silent mode.

3.7.2 Evaluation of Training

The mechanisms used to evaluate the training received will vary based on the participant group. These are summarized in Table 3-1.

Table 3-1. Evaluation Methods by Participant Group

Participant Group	Training Evaluation Methods
Installation and Maintenance Technicians	• Tests and quizzes may be incorporated into the training materials • The QA/QC component of the installation and maintenance planning will have a feedback loop back to the training team. Patterns of installation or maintenance issues will result in an evaluation of the training program

Participant Group	Training Evaluation Methods
Fleet Drivers	• Tests and quizzes within material
Pedestrians	• Tests and quizzes within material
NYCDOT Trainers	• Training programs will be audited by project team members
Participant Group Trainers	• Tests and quizzes within material • Role Play Activities within curriculum
Training Material Developers	• No evaluation is needed as they will not receive training.
TMC Operations and Data Analysts	• No evaluation is needed as they will not receive training.
Other Stakeholders	• No evaluation is needed as they will not receive training.

3.7.3 Human Use Approval

An initial Human Use Review was completed in Phase 1 by Battelle and documented in the Phase 1 Human Use Approval Summary Report that focused on the human use components of the project including the protection of participants' Personally Identifiable Information (PII). However, Battelle's Institutional Review Board (IRB) is unable to perform these activities in Phases 2 & 3 so this role is in the process of being transferred to New York State University's (NYU) IRB. This transition is depicted in Figure 3-1 and included in the initial schedule submitted with the NOFO in Figure 3-2. Figure 3-3 shows the updated high-level training schedule as of February, 2020.

This transition has already started. As a risk mitigation strategy, the application will be submitted initially with only the vehicle component of the project. The Pedestrian component will be added as an amendment when NYU's IRB has completed their initial review. The project team chose this route as the vehicle component of the project is the largest by far (3000 vehicles vs. 100 pedestrians) and the human use impacts of the two components are quite different.

No personal data will be collected for any drivers and the project team will have no direct interaction with any drivers. The fleet owners are responsible for determining which vehicles are equipped and for training any drivers of an equipped vehicle. This approach has been discussed with the NYU IRB. Based on these discussions and the human use work conducted as part of Phase 1, the NYU IRB has indicated that they will be completing an expedited review under category 7 (Research on individual or group characteristics or behavior) of the application. As depicted in the schedule, the high-level pedestrian application component was submitted as an amendment in November, 2016. After the IRB review and document revision process, the initial IRB review was completed and approved in May, 2017.

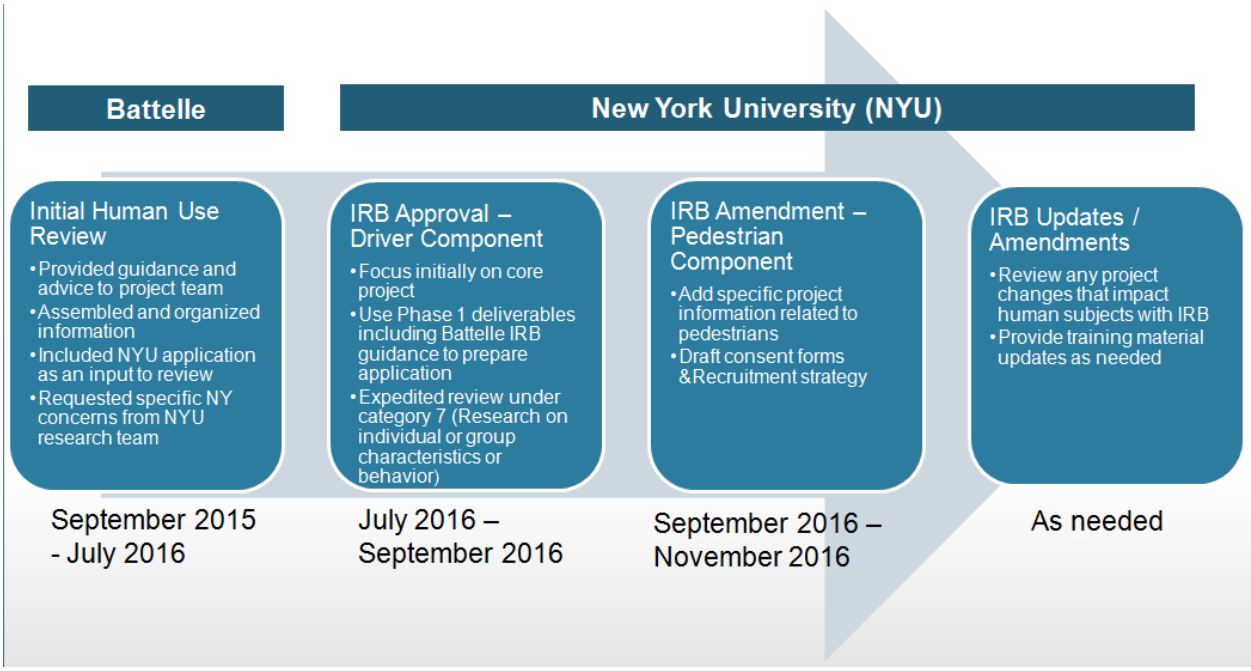


Figure 3-1. Training Tasks – IRB Transition

Pedestrian participants will be recruited and will provide informed consent. The IRB application will be amended after the initial application is approved. It is anticipated that this will be approved by the end of November 2016. Pedestrian training is not slated to begin until 2018 so this leaves adequate time to recruit and consent the 100 pedestrian participants.

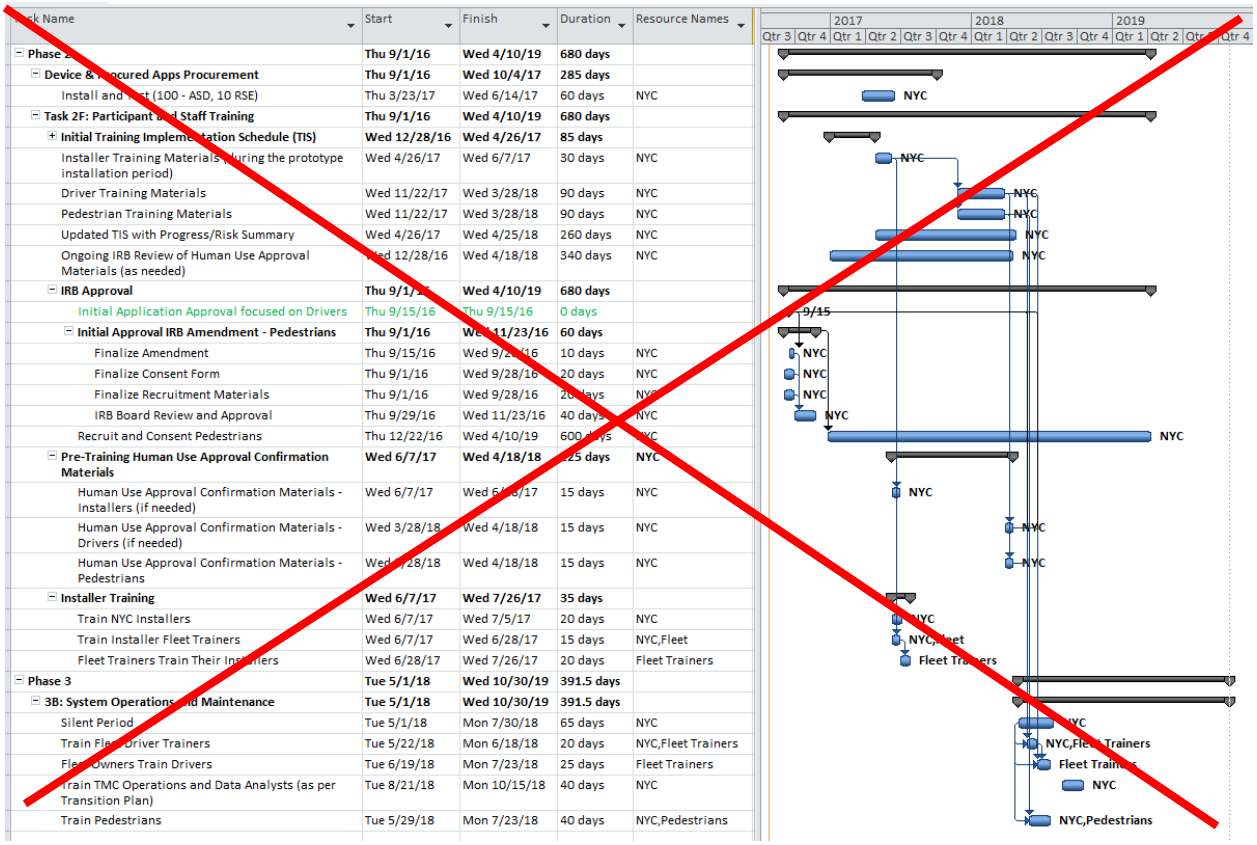
As the project advances, the IRB will be consulted on an as needed basis to review the human impacts to any project changes. If needed, training materials will be provided to the board for review.

The transition of IRB responsibility from Battelle to NYU introduced two new project risks:

- Delay in IRB approval Impacts overall project schedule/delivery
- IRB recommendation requires project changes (such as need to consent all drivers)

The primary mitigation strategy is to gain IRB approval as soon as possible so that the schedule impact can be minimized and so that there is time to address any project changes required for IRB approval without impacting the overall project schedule. The plan laid out in Figure 3-1 addresses the planned strategy to achieve this approval as quickly as possible. The NYC team put a mitigation plan in place as soon as the issue was identified. Below is a high level view of the mitigation plan. Note that many of the items are already complete.

- Identify alternate IRB to replace Battelle (complete)
- Move forward with Battelle IRB as an interim solution (complete)
- Share NY and NYU specific information with Battelle IRB (complete)
- Share Battelle IRB guidance with NYU (complete)
- Expedite NYU IRB Application (in process)
- Prioritize Vehicle Component of IRB Application (in process)



Task Name	Start	Finish	Duration	Resource Names
Phase 2	Thu 9/1/16	Wed 4/10/19	680 days	
Device & Procured Apps Procurement	Thu 9/1/16	Wed 10/4/17	285 days	
Install and Test (100 - ASD, 10 RSE)	Thu 3/23/17	Wed 6/14/17	60 days	NYC
Task 2F: Participant and Staff Training	Thu 9/1/16	Wed 4/10/19	680 days	
Initial Training Implementation Schedule (TIS)	Wed 12/28/16	Wed 4/26/17	85 days	
Installer Training Materials (during the prototype installation period)	Wed 4/26/17	Wed 6/7/17	30 days	NYC
Driver Training Materials	Wed 11/22/17	Wed 3/28/18	90 days	NYC
Pedestrian Training Materials	Wed 11/22/17	Wed 3/28/18	90 days	NYC
Updated TIS with Progress/Risk Summary	Wed 4/26/17	Wed 4/25/18	260 days	NYC
Ongoing IRB Review of Human Use Approval Materials (as needed)	Wed 12/28/16	Wed 4/18/18	340 days	NYC
IRB Approval	Thu 9/1/16	Wed 4/10/19	680 days	
Initial Application Approval focused on Drivers	Thu 9/15/16	Thu 9/15/16	0 days	
Initial Approval IRB Amendment - Pedestrians	Thu 9/1/16	Wed 11/23/16	60 days	
Finalize Amendment	Thu 9/15/16	Wed 9/28/16	10 days	NYC
Finalize Consent Form	Thu 9/1/16	Wed 9/28/16	20 days	NYC
Finalize Recruitment Materials	Thu 9/1/16	Wed 9/28/16	20 days	NYC
IRB Board Review and Approval	Thu 9/29/16	Wed 11/23/16	40 days	NYC
Recruit and Consent Pedestrians	Thu 12/22/16	Wed 4/10/19	600 days	NYC
Pre-Training Human Use Approval Confirmation Materials	Wed 6/7/17	Wed 4/18/18	225 days	NYC
Human Use Approval Confirmation Materials - Installers (if needed)	Wed 6/7/17	Wed 6/28/17	15 days	NYC
Human Use Approval Confirmation Materials - Drivers (if needed)	Wed 3/28/18	Wed 4/18/18	15 days	NYC
Human Use Approval Confirmation Materials - Pedestrians	Wed 3/28/18	Wed 4/18/18	15 days	NYC
Installer Training	Wed 6/7/17	Wed 7/26/17	35 days	
Train NYC Installers	Wed 6/7/17	Wed 7/5/17	20 days	NYC
Train Installer Fleet Trainers	Wed 6/7/17	Wed 6/28/17	15 days	NYC,Fleet
Fleet Trainers Train Their Installers	Wed 6/28/17	Wed 7/26/17	20 days	Fleet Trainers
Phase 3	Tue 5/1/18	Wed 10/30/19	391.5 days	
3B: System Operations and Maintenance	Tue 5/1/18	Wed 10/30/19	391.5 days	
Silent Period	Tue 5/1/18	Mon 7/30/18	65 days	NYC
Train Fleet Driver Trainers	Tue 5/22/18	Mon 6/18/18	20 days	NYC,Fleet Trainers
Fleet Owners Train Drivers	Tue 6/19/18	Mon 7/23/18	25 days	Fleet Trainers
Train TMC Operations and Data Analysts (as per Transition Plan)	Tue 8/21/18	Mon 10/15/18	40 days	NYC
Train Pedestrians	Tue 5/29/18	Mon 7/23/18	40 days	NYC,Pedestrians

Figure 3-2. Training Tasks - High Level Schedule (per NOFO)

Task Name	Duration	Start	Finish
Training Facility Planning	855 days	1/30/17	6/23/20
IRB Approval	999 days	9/1/16	8/25/20
Pre-Training Human Use Approval Confirmation Materials	61 days	6/1/20	8/25/20
ASD Installation Training	530 days	7/10/17	8/16/19
Prepare High-Level ASD Installer Training Plan	202 days	7/10/17	4/27/18
Prepare ASD Installer Training Materials	286 days	6/4/18	7/23/19
Train ASD Installers	156 days	1/7/19	8/16/19
RSU Installation Training	105 days	8/7/18	1/8/19
Prepare High-Level RSU Installer Training Plan	29 days	8/7/18	9/17/18
Prepare RSU Installer Training Materials	75 days	9/18/18	1/8/19
Train RSU Installers	1 day	1/8/19	1/8/19
Driver Training	80 days	4/20/20	8/11/20
Prepare Driver Training Materials	80 days	4/20/20	8/11/20
Prepare High-Level Driver Training Plan	30 days	4/20/20	6/1/20
Prepare Driver Training Materials	50 days	6/2/20	8/11/20
Pedestrian Training Materials	70 days	3/10/20	6/16/20
Prepare Pedestrian Training Plan	23 days	3/10/20	4/9/20
Prepare Pedestrian Training Materials	47 days	4/10/20	6/16/20
Pedestrian Device Distribution & Training	15 days	7/3/20	7/24/20
Train Peds	10 days	7/13/20	7/24/20
Phase 3	312 days	9/1/20	11/30/21
3B: System Operations and Maintenance	222 days	9/1/20	7/21/21
Silent Period - Initial System Operations and Maintenance Schedule (SOMS)	68 days	9/1/20	12/9/20
Train Drivers	106 days	9/23/20	2/26/21
Train Fleet Driver Trainers	20 days	9/23/20	10/21/20
Fleet Owners Train Drivers	25 days	10/22/20	11/27/20
Train TMC Operations and Data Analysts (as per Transition Plan)	40 days	12/30/20	2/26/21

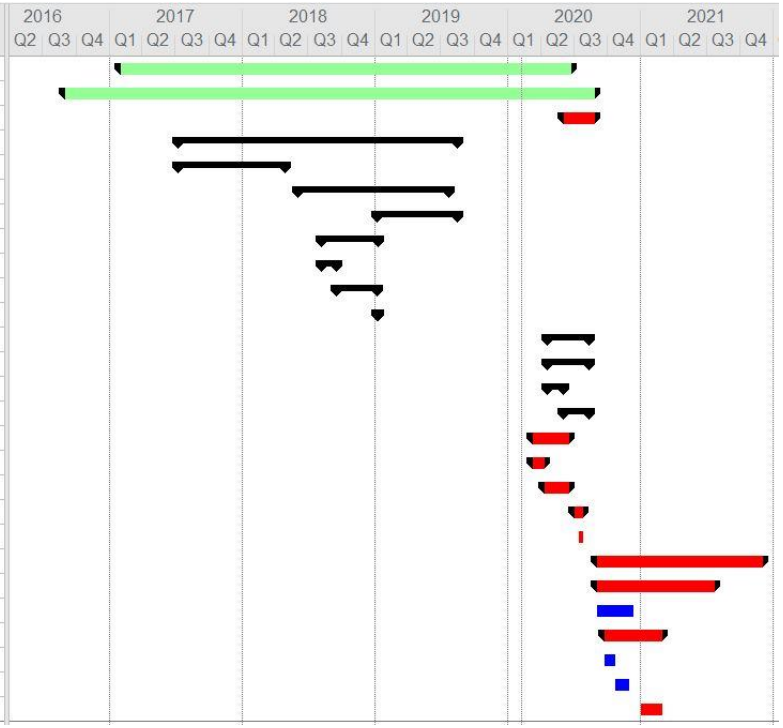


Figure 3-3. Training Tasks - High Level Schedule (Revised)

3.7.4 Deliverables

The NYCDOT team will provide the following deliverables during Phase 2:

- Initial Training Implementation Schedule (TIS)
- Training Materials (Initial and Updates, as specified in the PTSEP and TIS)
- Updated TIS with Progress/Risk Summary (monthly)
- Human Use Approval Confirmation Materials (per the Human Use Approval Schedule (HUAS))

3.8 Operational Readiness Test and Demonstration Planning – Task 2-G

The Operational Readiness Test and Demonstration will be a significant milestone for the NYCDOT Pilot project. This milestone of tests and demonstrations will be the culmination of months of preparation work that encompass procurement, design, installation, and testing. In this task, the NYCDOT team will prepare the plan for this series of coordinated tests and demonstrations that will demonstrate our preparedness to move to Phase 3 and the overall operational readiness of the system. The plans will be built with the objectives to demonstrate the deployed system operates as designed in a safe and secure manner. However, the demonstration of readiness expands beyond system readiness. Our plan will also provide a plan for demonstrating an institutional and financial framework that supports, finances, and governs the deployed system. The work on this task will begin with the preparation and presentation of an Operational Readiness Concept Briefing. Figure 3-4 provides a high level view of the schedule for this task submitted with the NOFO, and Figure 3-5 shows the updated high-level Operational Readiness Planning schedule as of February, 2020

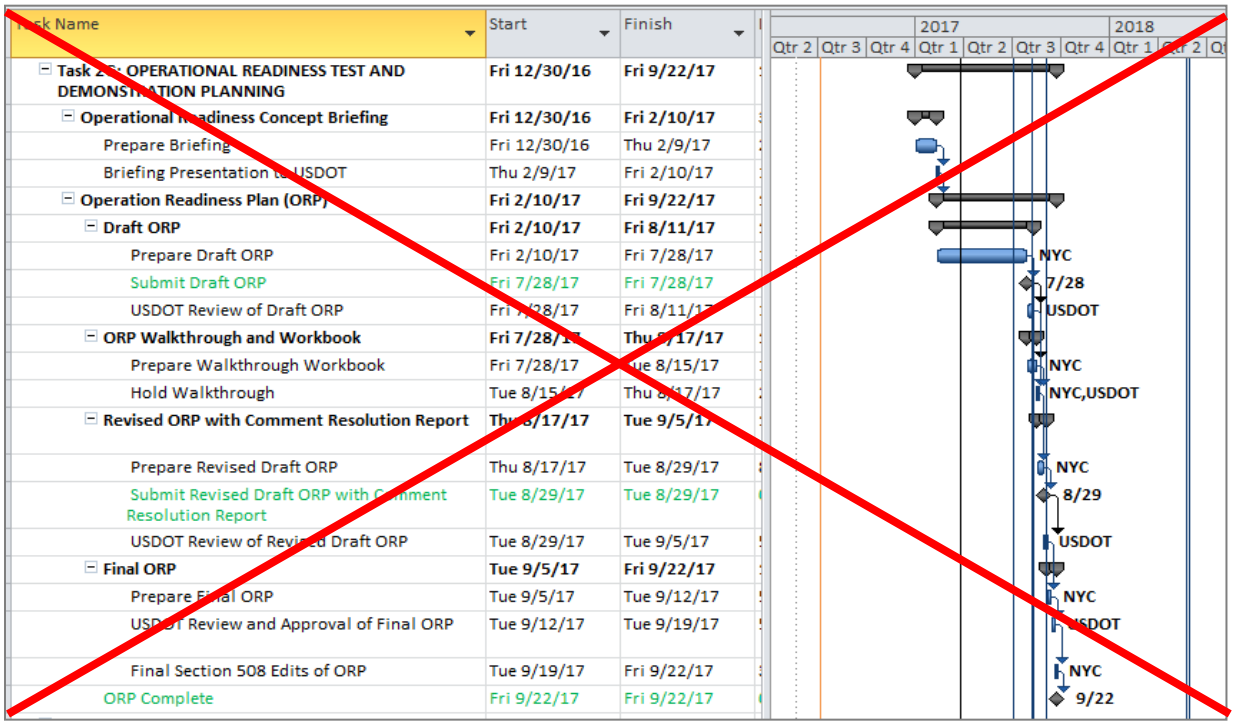


Figure 3-4. Operational Readiness Planning Tasks - High Level Schedule (per NOFO)

Task Name	Duration	Start	Finish
Phase 2	**1064 days**	**9/1/16**	**11/30/20**
Task 2G: Operational Readiness Test and Demonstration Planning	**856 days**	**1/9/17**	**6/4/20**
Operational Readiness Concept Briefing	**71 days**	**1/9/17**	**4/19/17**
Operation Readiness Plan (ORP)	**825.5 days**	**2/22/17**	**6/4/20**
Draft Operation Readiness Plan (ORP)	**118 days**	**2/22/17**	**8/9/17**
Refine Test Design Documents & Finalize Operation Readiness Plan (ORP)	**70 days**	**12/3/18**	**3/14/19**
Operation Readiness Plan (ORP) - Test Procedures and Scripts	**406 days**	**9/29/17**	**5/14/19**
Operation Readiness Plan (ORP) Walkthrough and Workbook	**10 days**	**5/21/19**	**6/4/19**
Revised Operation Readiness Plan (ORP) with Comment Resolution Report	**48 days**	**6/4/19**	**8/12/19**
Final Operation Readiness Plan (ORP)	**28 days**	**4/27/20**	**6/4/20**
Prepare Final Operation Readiness Plan (ORP)	15 days	4/27/20	5/15/20
USDOT Review and Approval of Final Operation Readiness Plan (ORP)	10 days	5/18/20	6/1/20
Operation Readiness Plan (ORP) Approved	0 days	6/1/20	6/1/20
Final Section 508 Edits of Operation Readiness Plan (ORP)	3 days	6/2/20	6/4/20
Operation Readiness Plan (ORP) Complete	0 days	6/4/20	6/4/20

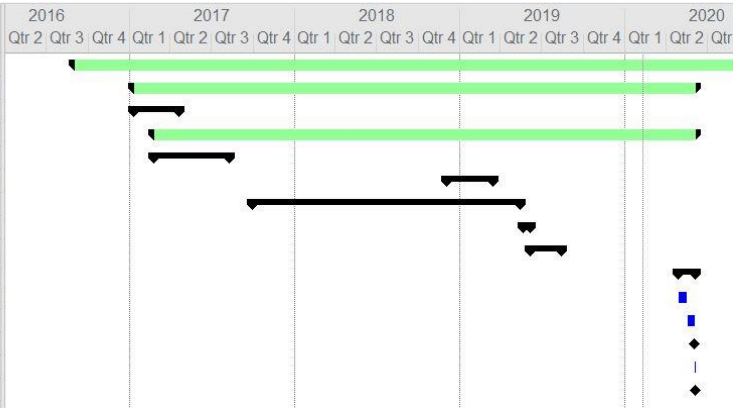


Figure 3-5. Operational Readiness Planning Tasks - High Level Schedule (Revised)

3.8.1 Operational Readiness Concept Briefing

The NYCDOT team will develop an Operational Readiness Concept Briefing, which outlines the aspects of the deployment that will be considered in the assessment of operational readiness. This includes comprehensive systems engineering considerations (i.e., unit, subsystem and system testing identified in the System Requirements) as well as assessments of whether the NYC deployment can operate safely and securely, whether staff and participants are suitably trained, human use approval has been obtained for all deployment participants, institutional and financial arrangements have been finalized, and whether the impact of the deployment can be discerned, measured, and reported. Additionally, the information lists for managing data access controls, PII access, installation and maintenance training, and other management controls will be reviewed. The briefing will also include a preliminary list of proposed demonstrations.

3.8.2 Operational Readiness Plan

After the completion of the Briefing, the NYCDOT team will prepare an Operational Readiness Plan that details the plans for executing readiness testing and demonstrations. The discussion and/or written comments from the USDOT regarding the briefing will be incorporated into this draft Operational Readiness Plan (ORP), with one section regarding tests (Operational Readiness Test Plan (ORTP)) and a second section describing demonstrations (Operational Readiness Demonstration Plan (ORDP)).

3.8.3 Operational Readiness Testing vs. Demonstrations

The NYCDOT will plan to conduct a series of tests prior to the live demonstrations with the AOR and federal team. The test results will be documented and reported to USDOT prior to holding the demonstrations. The operational tests will include a set of selected integrated, end-to-end system capabilities central to the deployment concept of operations. The operational demonstration will be a live, real-time activity for the AOR and federal team wherein success and failure of the demonstration are directly observable.

3.8.4 Operational Testing

The testing program will be coordinated between the NYC team members - developing test procedures for, data collection testing, performance testing, and services testing (OTA updates, SCMS, Maintenance tracking), end-to-end system testing and overseeing vendor test procedures for the applications – both in-vehicle and RSU that connect to the back office CV systems. The ASD and RSU test procedures will be developed by the vendors, reviewed by the project team, and then conducted by the vendor (witnessed by the NYC team) based on the approved test procedures at a facility agreed to by the City. Note that NYCDOT plans to require all “active” testing be done at a location within the City such as that used for the RFEI demonstration with appropriate simulated curves, speed zones, and crash scenarios. Some of the testing may be conducted at the vendor’s facility or a third party facility to verify requirements such as the following:

- Temp, humidity, vibration, voltage variations, power interruptions and noise, ESD, etc.
  - Use automotive standards and NEMA references
- Verify the RF output levels for various antenna placements etc.
- Verify HSM
- Verify [secure] Boot
- Verify Watchdog features
- Verify sample installations (vendor provided)
  - Speakers, sound, PoE,
- Verify all I/O features

- GPS accuracy and time to connect (preliminary – inspection and demonstration)
- Location accuracy (ASD)
- Crystal clock accuracy
- CAN/J-bus interface
- Memory and Processor capabilities and "head room" for future additions and to meet our logging requirements.

In all cases, the test procedures will be developed to demonstrate the requirements based on the final requirements document and/or the procurement specifications. Our intent is to construct a master testing plan that deals with evaluating conformance to the relevant standards and compliance with the relevant procurement and requirements documents. This is the same process we have followed for the City of NY for their central systems and field ITS hardware for NYC over the past 25 years – which has included their traffic controllers (12,700), their wireless communications (to all controllers), their central systems (full featured adaptive system), variable message signs, RFID readers, TMC systems (video, audio, telephone, networks), and their Manhattan communications network. In all of these projects, test cases were established and documented to demonstrate compliance with all aspects of the specifications. Each test is evaluated based on pass fail criteria; when failures did occur, a change control board determined what regression testing was required depending on the nature of the failure and the corrective action. All testing is fully documented and cross checked to ensure that all requirements are verified.

Once the testing described above is completed, we will be performing rigorous evaluation of the ASD and RSU "platforms" to ensure that they always start, continue, and that the watch dog mechanism and process management meet the requirements. This is essential since once we start the installation, it is no longer practical to "push a reset" button on each unit or to visit each unit to update firmware. The goal of the "factory" and preliminary system testing is to ensure that OTA software updates and process management is "solid" and not affected by any power interruptions, faulty application software, or communications "anomalies" of any sort. This will require both positive and negative testing as well as adverse and "loaded" condition testing (flooded communications, OTA updates, all applications active, and maximum event and normal data recording – plus uploading – all with security fully active). In addition to testing of the individual application's performance, we will have tests with many vehicles concurrently interacting to address requirements related to threat arbitration, BSM scheduling and congestion control, and location accuracy in a multi-lane environment.

We expect this round of testing to include the following:

For the RSU	For the ASD
Boot process Process Management MIB elements Data collection Parameters & Control OTA updates Overall Reliability IP support IPv4-IPv6 exchanges Security for RSU-TMC exchanges Channel congestion control	Boot process Process Management MIB elements Data collection Parameters & Control Mobility, performance, maintenance OTA updates Overall Reliability IP support Security for ASD-TMC exchanges Channel Congestion Control CAN/J-Bus interface Accelerometers

As noted above, the test procedures will be developed – by the vendor – during the procurement process for the ASD and RSU. The NY team will review and modify or required adjustments to ensure a thorough testing of the safety applications under both "lab" conditions and actual field conditions, and may (depending on schedule and costs) use institutional testing for verifying DSRC PHY, MAC layer, message content (J2945/1, J2735), and security (SCMS) where appropriate depending on schedule. Our testing program is focused first on ensuring a reliable and updatable field platform (RSU & ASD) then verifying the accuracy and reliability of the various applications. This is essential such that we can continue application evaluation, testing, and tuning concurrent with the production installation program expected to require 22 weeks. The last 8.5 weeks prior to Phase 3 will be spent tuning and working with the application developers, the IE, and our own evaluators to ensure we are collecting the right, accurate data and tuning the applications (with sample subjects) to minimize the false alarms without compromising the benefits intended.

3.8.4.1 Test Descriptions & Requirements Matrix

Each test case will have a written description that includes a description of the individual verification and validation processes that will occur as part of the effort to ensure that the system was built correctly and that the correct system was built. Safety and security requirements, clearly marked as such, will be among those tested. A requirements-test matrix will be developed to link each test descriptions to the related System Requirement(s). This matrix will depict the test coverage relationship among the tests and the requirements. Every requirement will have at least one test case associated with it and each test case will have at least one requirement associated with it.

3.8.4.2 Test Cases, Procedures & Results

Each test case will include a set of test inputs, execution conditions, and expected results developed for a particular objective. Test procedures will describe the verification and validation process used to determine that the system functions as intended. If it is determined that test data will be used as part of the verification and validation process in this step, the test procedures will also spell out how one will determine that the system actually performed the correct transformations on the data entered. The verification method will be identified for each test.

The ORP will also describe how test results will be summarized and documented across all test and the remediation procedures that will be employed for any failed tests.

3.8.5 Operational Demonstrations

Operational Demonstrations will cover:

- Key use cases illustrating the capability of the system to perform in accordance with the Phase 1 Concept of Operations.
- Safety-focused demonstration elements illustrating the capability of the system to address key scenarios identified in the Phase 1 Safety Management Plan.
- Security-focused demonstration elements illustrating the capability of the system to successfully interact with the SCMS and carry out key security-related capabilities identified in the Phase 1 SMOC. One or more demonstration elements will explicitly consider misbehavior detection.
- Privacy-focused demonstration elements illustrating key aspects of the Phase 1 Privacy Operational Concept and the Phase 2 Privacy Management Plan.

- Performance measurement and evaluation support demonstration elements (e.g., a dry run) illustrating key aspects of the Phase 1 Performance Measurement Plan, including data collection and processing.
- Institutional coordination and successful execution of governance frameworks, management processes, and financial arrangements, illustrating key aspects of the Phase 1 Partnership Status Summary.
- Maintenance-oriented demonstration elements related to the management concepts for over-the-air management of data and firmware updates, as well as radio frequency range monitoring

The ORP will describe the objective, general location, participants, equipment, and actions to be taken within the demonstration to illustrate the successful deployment of key use cases. It will also detail the sequence of events expected to be demonstrated and observable validation criteria associated with the overall purpose of the demonstration. The plan will describe how data will be collected before, during, or after the demonstration to support the observable demonstration validation criteria related to demonstration success (e.g., pass or fail). The ORP describe how demonstration results will be summarized and documented across all demonstrations.

3.8.6 Walk-Through

After the delivery of the draft ORP, an Operational Readiness Plan Walkthrough will be held in the Washington DC metropolitan area to demonstrate the completeness and technical soundness of the test plan. A Walkthrough Workbook will be prepared in advance to structure and expedite the Walkthrough process. In response to USDOT comments (both written comments provided prior to the Walkthrough and verbal comments provided during the Walkthrough), a revised ORP, and an accompanying comment resolution report will be submitted. Based on USDOT review of the revised ORP, the NYCDOT team will deliver a final ORP.

3.8.7 Deliverables

The NYCDOT team will provide the following deliverables during Phase 2:

- Operational Readiness Concept Briefing (DC metro area)
- Draft Operational Readiness Plan (ORP)
- ORP Walkthrough and Workbook (DC metro area)
- Revised ORP with Comment Resolution Report
- Final Operational Readiness Plan (ORP)

3.9 Installation and Operational Readiness Testing

This task will use documents created earlier in the project to guide installation and readiness testing activities. The equipment shall be installed according to the Comprehensive Installation Plan (CIP) and operational readiness will be established as described in the Operational Readiness Plan (ORP).

3.9.1 Operational Readiness Schedule

The NYCDOT team will create and document in an Installation and Operational Readiness Schedule (IORS), a work breakdown structure of activities (and dependencies) required to implement the CIP and ORP. Since these activities are dependent on other project tasks, the IORS will be a subsection of the overall schedule. A separate view will be created within the overall project schedule that highlights the installation and testing tasks. This view will be the IORS.

The project schedule, including the IORS, will be updated at least once per month to show progress against the plan. The details in this schedule will be progressively elaborated as more details regarding specific activities are clear. Technical risks and issues will be tracked and recorded in the project's risk and issue log. A specific category will be assigned to installation and training risks/issues so that they can be easily extracted from the overall project's risk and issue logs. In addition, during the 9 month install/test period, a weekly email will be sent regarding any significant schedule variances or issues. Institutional and organizational issues will be tracked.

As a part of the monthly IORS update, an appendix will be include that summarizes the number of DSRC-equipped devices installed and an operational status indicator (e.g., installed, installed and tested, operational, under repair/not in operation), categorized by type, with their physical locations where appropriate. Device types include: vehicle and in-vehicle equipment, roadside equipment, mobile devices, management center equipment, and any other equipment equipped with a DSRC transmitter or receiver.

Test results will be documented and reported according to the processes identified in the ORP. Demonstrations will be scheduled in conjunction with the AOR and key federal staff. Demonstrations will be conducted and documented per the processes identified in the ORP.

3.9.2 Deliverables

The NYCDOT team will provide the following deliverables during Phase 2:

- Installation and Operational Readiness Testing Schedule (IORS)
- Updated IORS with Progress/Risk Summary
- Test Results Summary Documentation (per the ORP)
- Operational Readiness Demonstrations (per the ORP)

3.10 Maintenance and Operations Planning – Task 2-I

As Phase 2 progresses, the focus of the team will begin to shift to Maintenance and Operations. Plans need to be in place before the start of Phase 3 to cover the operations and maintenance of all in-vehicle, roadside, mobile device, center, and other equipment and supporting capabilities that will be deployed in Phase 2.

The NYCDOT team will develop a Comprehensive Maintenance and Operations Plan (CMOP) that identifies the types and number of equipment required to be maintained. This document will summarize key operational methods and procedures that ensure safe and efficient operations in Phase 3 and will be broken into separate sections for operations and maintenance. The maintenance section will include the following subsections:

- Vehicles
- In-vehicle equipment
- Roadside equipment
- Mobile devices
- Management center equipment
- Other equipment and supporting capabilities
- Maintenance inventory control procedures and security

The CMOP will provide an overview of the proposed operational methods and processes, a high-level maintenance approach, as well as a high-level plan for inventory and configuration management. This plan will

be in input to the ORP. It will include a description of the maintenance-focused demonstration that will be part of the ORP. A number of requirements of security, privacy, and safety management will be implemented as maintenance or operational policies in the CMOP and the documents that result from it. As these documents are developed, the requirements will themselves mature, with new provisions being identified and incorporated in the CMOP.

In addition, for each identified type of equipment, the CMOP will identify:

- Routine maintenance requirements/schedules
- Inspection procedures
- Maintenance/replacement procedures (and responsible entities)
- QA/QC processes
- Hardware/software configuration control processes
- Recall processes
- Spare parts/warranty contingency plans

The NYCDOT will deliver a draft CMOP to the USDOT for review. A revised CMOP will be developed in response to USDOT comments and submitted with an accompanying Comment Resolution Report. Based on USDOT review of the revised CMOP, the NYCDOT team will then deliver a final CMOP.

Figure 3-6 provides the high-level schedule for the CMOP submitted in the NOFO, while Figure 3-7 shows the updated high-level schedule for the CMOP.

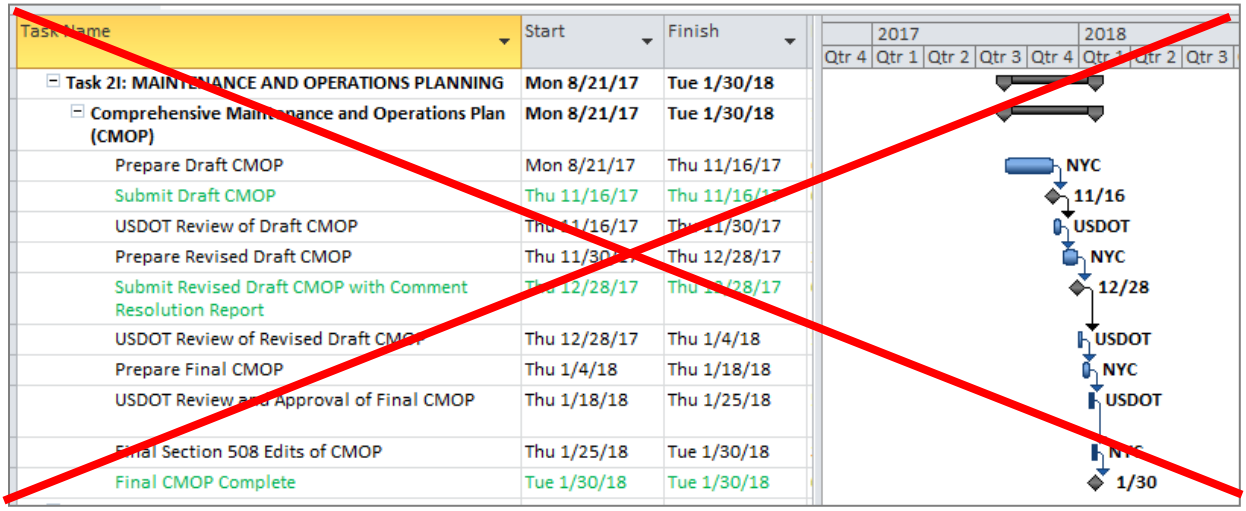


Figure 3-6. Maintenance and Operations Tasks - High Level Schedule (per NOFO)

Task Name	Duration	Start	Finish
Task 2I: Maintenance and Operations Planning	**143.5 days**	**12/5/17**	**6/29/18**
Comprehensive Maintenance and Operations Plan (CMOP)	**143.5 days**	**12/5/17**	**6/29/18**
Prepare RACI Chart	5.5 days	12/5/17	12/12/17
Prepare Draft CMOP for Internal Review	39 days	12/12/17	2/8/18
Review Draft CMOP	9 days	2/8/18	2/22/18
Make final updates to Draft CMOP	5 days	2/22/18	3/1/18
Submit Draft CMOP	0 days	3/1/18	3/1/18
USDOT Review of Draft CMOP	14 days	3/1/18	3/21/18
Prepare Revised Draft CMOP	8 days	3/21/18	4/2/18
Editor Review of Revised Draft CMOP	2 days	4/2/18	4/4/18
Submit Revised Draft CMOP with Comment Resolution Report	0 days	4/4/18	4/4/18
USDOT Review of Revised Draft CMOP	22 days	4/4/18	5/4/18
Prepare Final CMOP	11 days	5/4/18	5/21/18
USDOT Review and Approval of Final CMOP	3 days	5/21/18	5/24/18
Final Section 508 Edits of CMOP	25 days	5/24/18	6/29/18
Final CMOP Complete	0 days	6/29/18	6/29/18

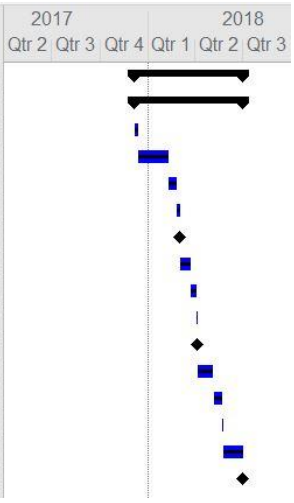


Figure 3-7. Maintenance and Operations Planning Tasks - High Level Schedule (Revised)

3.10.1 Deliverables

- Draft Comprehensive Maintenance and Operations Plan (CMOP)
- Revised CMOP with Comment Resolution Report
- Final CMOP

3.11 Stakeholder Outreach – Task 2-J

Outreach is an important component to the success of this pilot project to ensure the engagement of stakeholders, and others throughout the twenty months of deployment activities in Phase 2. As described in the Deployment Outreach Plan (DOP) prepared in Phase 1 our outreach program is a broad and diverse plan that will effectively utilize the skills on the NYCDOT staff with experience with Outreach on similarly sized transportation-focused initiatives.

Figure 3-8 provides a high level view of our plan/schedule for Outreach-focused tasks submitted with the NOFO. The updated high-level schedule for this task is shown in Figure 3-9. We anticipate using a variety of outreach materials including a project website, a video, public meetings, press releases, and a project brochure. The schedule and resource assignments for the preparation of these materials will be elaborated in the Outreach Implementation Schedule (OIS). Since the outreach activities are interrelated with other project tasks such as the installation schedule, the OIS will be a subsection of the overall schedule. A separate view will be created within the overall project schedule that highlights the Outreach tasks. This view will be the OIS.

The project schedule, including the OIS, will be updated at least once per month to show progress against the plan. The details in this schedule will be progressively elaborated as more details regarding specific activities are clear. Outreach related risks and issues will be tracked and recorded in the project's risk and issue log. The risks and issues logs will be organized such that items specific to Outreach risks/issues can be easily extracted.

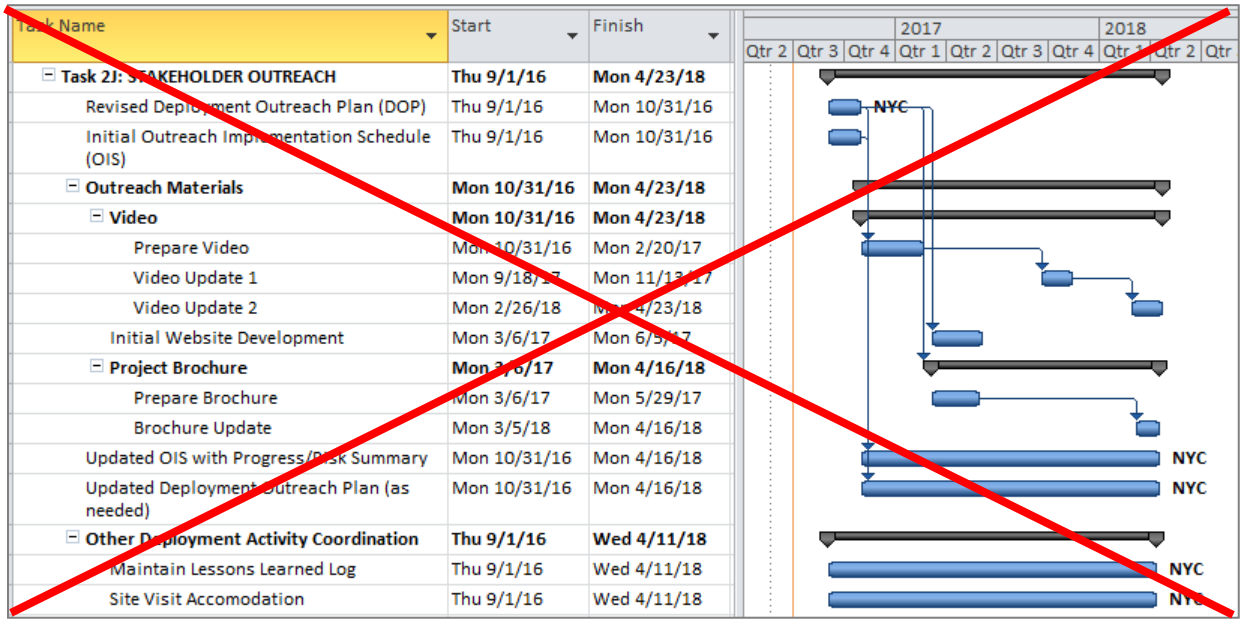


Figure 3-8. Phase 2 Outreach Tasks - High Level Schedule (per NOFO)

Task Name	Duration	Start	Finish
Task 2J/3C: Stakeholder Outreach	1300 days	9/1/16	11/5/21
DOP and OIS	1300 days	9/1/16	11/5/21
Outreach Materials	1086 days	9/29/16	1/29/21
Press Conference (One per year)	30 days	4/27/20	6/8/20
Video	335 days	10/31/16	3/5/18
Website	1061 days	10/13/16	1/6/21
Project Brochure	259 days	3/6/17	3/15/18
One Page Fact Sheet	1055 days	11/15/16	1/29/21
Press Releases	952 days	9/29/16	7/16/20
NYCDOT Newsletter Articles	359 days	11/18/16	4/25/18
Social Media Posts	904 days	10/24/16	6/1/20
Public Meetings within Boroughs (On Hold at this time)	0 days	9/6/18	9/6/18
Trade Journal Articles	793 days	10/17/16	12/13/19
Operational Capability Showcase	175 days	9/2/20	5/14/21
Trade Shows and Conferences	654 days	10/28/16	6/7/19
UTRC Symposium	29 days	10/28/16	12/9/16
TRB 2017 Annual Meeting	49.9 days	10/31/16	1/12/17
2017 SXSW Interactive Festival	59 days	12/7/16	3/3/17
ITE Annual Meeting 2017	68.9 days	4/26/17	8/2/17
24th World Congress on ITS	83 days	7/5/17	11/1/17
TRB 2018 Annual Meeting	35.9 days	11/13/17	1/4/18
ITS America Annual Meeting & Expo	47 days	4/2/18	6/6/18
SXSW 2018	15 days	2/19/18	3/12/18
ITS NY - 2018	97 days	1/30/18	6/15/18
ITE Annual Meeting 2018	48 days	6/18/18	8/23/18
NYU CAV Symposium 2018	58 days	8/6/18	10/24/18
TRB 2019 Annual Meeting	29 days	12/6/18	1/17/19
ITS America Annual Meeting & Expo 2019 (Actual date of conference is	30 days	4/26/19	6/7/19
Webinars	759 days	8/24/17	9/1/20
USDOT Visits to NYC	292 days	1/30/17	3/28/18
Other Deployment Activity Coordination	986 days	12/9/16	11/12/20
Maintain Lessons Learned Log	964 days	1/12/17	11/12/20
Site Visit Accomodation (LOE)	737 days	12/9/16	11/15/19

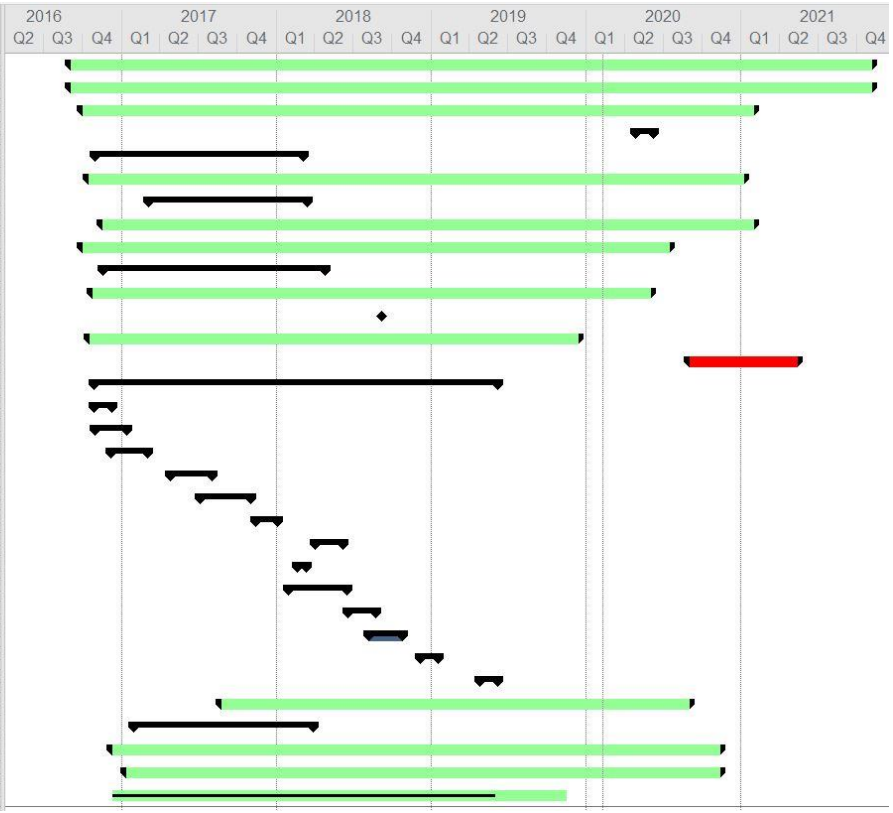


Figure 3-9. Phase 2 Outreach Tasks - High Level Schedule (Revised)

3.11.1 Trade Show/Conference Plan

As described in the Phase 1 Outreach Plan, at least one person from the NYCDOT Project team will travel and participate in three workshops, conferences, and or trade shows each year and participate in two USDOT-organized webinars a year regarding pilot deployment progress/performance during Phases 2 and 3. Table 3-2 lists the anticipated conference/trade show events. Table 3-3 provides information on the anticipated webinar schedule for Phases 2 and 3.

Table 3-2. Workshops/Conference/Tradeshows for Phases 2&3

Year	Event	Organizer	Date	Location	Activities
Agreement Year 1 9/16 - 8/17	TRB 2017 Annual Meeting	TRB	01/08/17 - 01/12/17	Washington, DC	Presentations at USDOT sessions and workshops Outreach materials at USDOT booth
	2017 SXSW Interactive Festival	SXSW	03/13/17 – 03/19/17	Austin, TX	Exhibit (Video and outreach materials)
	ITE Annual Meeting 2017	ITE	07/30/17 - 08/02/17	Toronto, Ontario	Handouts in attendees' bags Outreach Materials at USDOT booth Possible CV pilots panel
Agreement Year 2 9/17 - 8/18	24th World Congress on ITS	ITS America	10/29/17 - 11/02/17	Montreal, Québec	Exhibit (Video and outreach materials)
	TRB 2018 Annual Meeting	TRB	01/07/18 – 01/11/18	Washington, DC	Presentations at USDOT sessions and workshops Outreach materials at USDOT booth
	2018 SXSW Interactive Festival	SXSW	03/09/18 – 03/18/18	Austin, TX	CV pilots panel/presentation
	ITS America Annual Meeting & Expo	ITS America	06/04/18 – 06/07/18	Detroit, MI	Exhibit (Video and outreach materials) Possible CV pilots panel
	ITE Annual Meeting 2018	ITE	08/20/18- 08/23/18	Minneapolis, MN	Outreach Materials at USDOT booth CV pilots panel/presentation
Agreement Year 3 9/18 - 8/19	25th World Congress on ITS	ITS America	09/17/18 – 09/21/18	Copenhagen, Denmark	CV pilots panel/presentation
	TRB 2019 Annual Meeting	TRB	1/13/19 – 1/17/19	Washington, DC	Presentations at USDOT sessions and workshops Outreach materials at USDOT booth

Year	Event	Organizer	Date	Location	Activities
	ITS America Annual Meeting & Expo	ITS America	06/04/19 – 06/07/19	Washington, DC	Outreach materials
	ITE Annual Meeting 2019	ITE	07/21/19 – 07/24/19	Austin , TX	CV pilots panel/presentation
Agreement Year 4 9/19 – 7/20	26th World Congress on ITS	ITS America	10/21/19 – 10/25/19	Singapore	CV pilots panel/presentation
	TRB 2020 Annual Meeting	TRB	1/12/20 – 1/16/20	Washington, DC	CV pilots panel/presentation
	ITS America Annual Meeting & Expo	ITS America	TBD (June, 2020)	TBD	TBD: Trade Show (Highlights from Operational Capability Showcase)

Table 3-3. Anticipated Webinar Topics/Timing for Phases 2&3

Contract Year	Webinar Topic	Timeline	Relevant Task Areas
Year 1 9/16 - 8/17	System Architecture/Design	Aug – Sep 2017	2-B: Systems Architecture 2-B: Systems Design
Year 2 9/17 - 8/18	Application Development and Deployment Progress	Mar – Jun 2018	2-E: Application Development 2-E: Application Deployment Plan
	Acquisition and Installation	Jun – July, 2018	2-D: Comprehensive Acquisition 2-D: Comprehensive Installation
Year 3 9/18 - 8/19; Year 4 9/19 - 7/20	Operational Readiness/ Baseline Data Collection Plan, Results of Readiness Test and Baseline Performance	Apr – Nov 2019	2-G: Operational Readiness and Demonstration Plan 2-H: Operational Readiness Testing Results 2-K: Pre-Deployment Performance Plan
Year 5 8/20 - 7/21	Highlights of the Operational Capability Showcase (after the OCS)	TBD	3C: Operational Capability Showcase
Year 6 8/21 - 12/21	Performance Measurement/Transition Plan	TBD	3-D: Performance Measurement 3-E: Post-Deployment Transition Plan

3.11.2 Lessons Learned Logbook (LLL)

A Lessons Learned Logbook (LLL) that incorporates a brief summary of any issues identified throughout the Phase 2 deployment. This will include documentation on the potential impacts, mitigating actions taken, and results identified (to date). This logbook will be an input to the Phase 3 Transition Planning tasks. It will also provide a vehicle to share insights and lessons learned with peers considering or actively deploying connected vehicle technologies.

3.11.3 International Collaboration

We understand that the USDOT is interested in sharing lessons learned from the Smart City Demonstration with its international partners and that the USDOT currently has memorandums of understanding (MOUs) with the European Commission, Japan, Korea, Canada, and Mexico. We will support this initiative by collaborating with international partners with which USDOT has research coordination agreements for the purpose of expanded learning. We do not anticipate any additional costs to the NYCDOT related to these collaboration initiatives.

3.11.4 Deliverables

The NYCDOT team will provide the following Outreach deliverables during Phase 2:

- Revised Deployment Outreach Plan (DOP)
- Initial Outreach Implementation Schedule (OIS)
- Outreach Materials (as specified in the DOP and OIS)
- Updated OIS with Progress/Risk Summary (monthly)
- Updated Deployment Outreach Plan (minimum one update)

NYCDOT will not purchase any booths or trade show space related to the Outreach Activities for this project.

3.12 Performance Measurement and Independent Evaluation Support – Task 2-K

The overall goals of the Performance Measurement and Independent Evaluation Support are to collect, process, and distribute data and performance reports in accordance to the Phase 1 Performance Measurement and Evaluation Support Plan (PMESP). The plan lays out methods to measure the impacts of the CV deployment on the primary objective of improving safety on NYC streets and on the secondary objectives of improving mobility and reliability and reducing tailpipe environmental pollutants. The PMESP also provides support to the broader independent evaluation effort being undertaken by USDOT.

As documented in the Phase 1 PMESP, the evaluation of the CV deployment will use a Before and After experimental design utilizing the data collected from the CV equipped vehicles operating in a silent operation mode (the without CV or before data where drivers do not receive the ASD warnings) and in an active operation mode (the with CV or after data where drivers do receive the ASD warnings). Other field data not collected from the deployed CV technology (e.g., crash records) will also be collected and used in the evaluation. To assess the impacts on changes in confounding factors on the before and after period data, a control group of taxis will also be included throughout the Before and After periods. In addition to examining the driver responses to warnings, an empirical analysis of crash data will be conducted to assess the impacts of the CV deployment on the number and severity of crashes. Additionally, the evaluation of the CV

deployment will also include simulation model analysis in order to estimate impacts that cannot easily be measured in the field, to minimize the impact of confounding factors on field observations, and to help assess impacts beyond what may not be statistically significant findings in analysis of the field observations.

The specific goals and objectives of the Phase 2 Performance Measurement and Independent Evaluation Support task are to develop, test, refine, and finalize the data collection details, data processing methods, and performance measurement calculation and reporting protocols described in the NYC CVPD Phase 1 Performance Measurement and Evaluation Support Plan (PMESP). In summary, the activities in this Phase 2 task relate to establishing working end-to-end data collection, processing, and analysis capabilities and to coordinate with the independent evaluator to ensure that the data collection and performance measurement to be completed during the Phase 3 deployment period will fully meet the needs of the CVPD PMESP and the needs of the independent evaluator.

The collection, processing, quality control, and transfer of data from the NYC CVPD site in support of performance measurement and evaluation will be documented and consistent with the Phase 2 Data Management Plan (which will be consistent with the PMESP).

The PMESP Phase 2 work can be divided into three main categories; a) the data collection, handling, and storage; b) the data analysis procedures and tools to calculate the performance metrics; and c) the data sharing and support for the independent evaluator.

3.12.1 Data Collection, Handling, and Storage Methods

The cornerstone of the NYC CVPD PMESP is the data that will be collected in the field, both from the deployed CV devices and from the traditional non-CV data sources. Since it is upon this data that the remaining components of the NYC CVPD PMESP will be built, the assurance of quality data is paramount. Specific related activities to be completed in Phase 2 included the following:

- Collection of action log data from pre-deployment testing to validate assumptions of the data quality and quantity to be collected.
- Development of the automated process of obfuscation (or normalization) of the detailed ASD action log event data to prevent the inclusion of specific time and location details of the data in order to prevent the later matching of this data to other databases or records which contain Personally Identifiable Information (PII) (e.g., crash records).
- Establish the degree to which the action log obfuscation must be completed to minimize the loss of details while still ensuring the privacy needs of the stakeholders and participants.
- Develop procedures for automated processing of the ASD breadcrumb mobility data sets from raw BSM recordings to a database of time-dependent travel times and speed data on roadways.
- Finalize methods and protocols for collecting the identified confounding data sets and other traditional non-CV ‘field data’ performance metrics.
- Develop processing, data storage, and data quality control protocols for the fusion of the obfuscated action log data sets to real-time confounding data sets.
- Design and deploy the data processing and warehouse storage environment in the NYCDOT TMC.
- Develop the qualitative anonymous user feedback surveys and finalize the collection methods for which the surveys will be conducted.

3.12.2 Analysis Procedures and Tools

In addition to the above data collection and data handling tasks, the Phase 2 PMESP task will prepare additional Analytical, Modeling, and Simulation (AMS) tools and procedures as described in the Phase 1 PMESP. The following tasks will be completed within Phase 2:

- Finalize the details of the experimental design summarized in Figure 5 of the Phase 1 PMESP, including determination of appropriate control group sizes for taxis and the required length of the before data period collection to be completed in the initial stages of Phase 3.
- Develop detailed performance measurement calculation methods and procedures using real-world ASD action log data collected from the CVPD test vehicles in Phase 2 during the testing and/or shakedown period.
- Develop an analysis plan for the Before and After crash database records.
- Update and recalibrate the existing Manhattan Traffic Model (MTM) midtown microsimulation model to current conditions.
- Develop a simulation analysis plan for the use of the updated MTM in the performance assessments of the mobility, reliability, and environmental impacts of the CVPD that will be completed in Phase 3.
- Develop a simulation analysis plan for the use of Safety Surrogate Measure (SSM) simulation modeling efforts that will be completed in Phase 3.

3.12.3 Data Reporting, Sharing, and IE Support

The third component of the PMESP work to be completed in Phase 2 involves the data reporting, data sharing, and the support from the CVPD team to the USDOT's Independent Evaluator (IE) in the assessment of the overall CV initiative. Specific items to be completed in Phase 2 include:

- Develop the design of and reporting specifics (frequency, stakeholder rights to information, etc.) for the performance reporting dashboards.
- Finalize data sharing protocols for and share with the independent evaluator preliminary pre-deployment data as available; including, but not limited to:
    - The transmission of the privacy-obfuscated participant action logs
    - Performance measure calculation procedures
    - A summary of relevant analytical tools available to assist in evaluation, as well as access to and use of relevant analytical models), observed data for model calibration, existing calibration/validation documents, and the final calibrated tools and simulation models themselves for the purpose of supporting independent evaluation
    - Data related to the mitigation of confounding factors, including factors tracked, sources of available information utilized to track these factors, and mitigation approaches (if any) utilized
    - Facilitation of independent evaluator access to site staff and stakeholders
    - Institutional and organizational elements and analysis
    - Informational assistance supporting the independent evaluator in identifying and recruiting participants related to key evaluation use cases
- Develop the detailed plan for data components (including segmentation or sampling rates) of the NYC CVPD data to be posted and protocols for sharing data with the RDE.
- Share the preliminary data collected during the testing and shakedown periods with the IE and work with the IE to ensure that the preliminary data collected during the pre-deployment Phase 2 period is sufficient for their needs.

3.12.4 Performance Measurement and Evaluation Support Schedule

In order to ensure that all Phase 2 PMESP work is progressing towards a deployment-ready state for the initiation of Phase 3, the NYC CVPD team will prepare a Performance Measurement and Evaluation Support Schedule (PMESS) that includes a work breakdown structure of activities (and dependencies) required to implement the PMESP for the specific purposes of the performance measurement and evaluation. The PMESS will identify milestones and performance summary reports for coordination with USDOT and the USDOT-identified independent evaluator.

It is noted that consistent performance in Phase 2 is critical in measuring and assessing the impacts of the deployment prior to making the system fully operational in Phase 3. The PMESS shall also outline key elements of a performance measurement focused dry-run demonstration or 'shakedown' period for the purposes of ensuring that data collection and processing capabilities are in place and functioning properly prior to the commencement of the official before CV data collection period at the onset of Phase 3.

Since the performance measurement activities are dependent on other project tasks such as the installation schedule and testing, the PMESS will be a subsection of the overall schedule. A separate view will be created within the overall project schedule that highlights the performance measurements related tasks. This view will be the PMESP.

The project schedule, including the PMESS, will be updated at least once per month to show progress against the plan. The details in this schedule will be progressively elaborated as more details regarding specific activities are clear. Technical risks and issues will be tracked and recorded in the project's risk and issue log. A specific category will be assigned to performance measurement related risks/issues so that they can be easily extracted from the overall project's risk and issue logs. Figure 3-10 provides a high level view of the preliminary schedule for the Performance Measurement tasks submitted with the NOFO. The updated high-level schedule for this task is shown in Figure 3-11.

Periodically as needed (but no less than once) the NYC CVPD team will update the PMESP in Phase 2. The update(s) will document within the PMESS the analytical models and algorithmic methodologies that will be utilized in performance measure calculation.

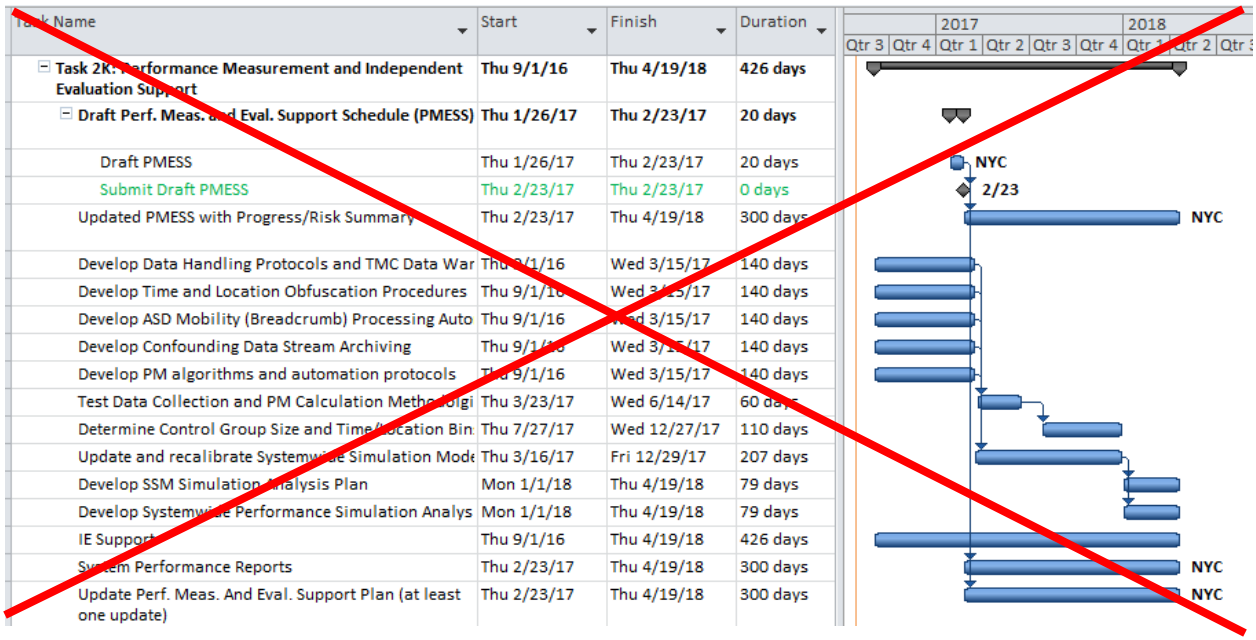


Figure 3-10. Performance Measurement & Evaluation - High Level Schedule (per NOFO)

Task Name	Duration	Start	Finish
Task 2K: Performance Measurement and Independent Evaluation Suppor	1045 days	9/1/16	10/30/20
Draft Perf. Meas. and Eval. Support Schedule (PMESS)	946 days	1/27/17	10/30/20
PM Roundtable Presentation	9 days	2/1/18	2/13/18
Obfuscation Strategy Presentation	9 days	2/1/18	2/13/18
Data Collection	339 days	10/9/18	2/14/20
Early Data Collection	278 days	10/9/18	11/15/19
Pre-Install Data Collection with Vehicle Obfuscation Operational	134 days	8/2/19	2/14/20
Develop PM Algorithms & System Reports	872 days	2/27/17	8/13/20
Test & Configure PM Algorithms	51 days	5/19/20	7/30/20
Preparation for Simulation Evaluation	411 days	8/15/17	4/5/19
AMS (Non-Safety) Plan	283 days	8/15/17	9/30/18
AMS (Safety) Simulation Plan	113 days	4/10/18	9/18/18
Update and recalibrate Systemwide Simulation Model (MTM) AMS Safety	128 days	10/1/18	4/5/19
Survey Development	646 days	4/18/17	11/12/19
Driver Survey Development	152 days	4/8/19	11/12/19
Pedestrian Survey Development	646 days	4/18/17	11/12/19
IE Support	1045 days	9/1/16	10/30/20
Update Phase 1 Perf. Meas. And Eval. Support Plan	745 days	3/15/17	3/3/20

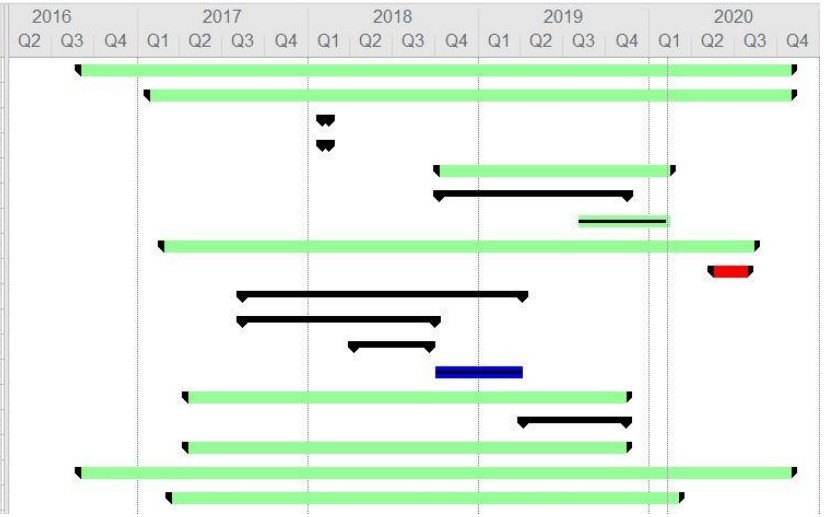


Figure 3-11. Performance Measurement & Evaluation - High Level Schedule (Revised)

3.12.5 Deliverables

- Baseline Performance Measurement and Evaluation Support Schedule (PMESS) and monthly updates with Progress/Risk Summary (monthly)
- Pre-Deployment Performance Data, logbooks, analytical models, simulation models, and other supporting information (per the PMESS)
- System Performance Reports (per the PMESS)
- Updated PMESP (minimum of one update)

3.13 Participation in Standards Development – Task 2-L

The impact of the CV Pilot projects extends beyond the scope of the three site deployments. The participants in this pilot project will possess key knowledge that will assist the USDOT in improving and expanding ITS architecture and standards to support ITS deployments based on experiences and lessons learned as a part of the deployment activity. This support will include participation in relevant standards development activities including participation at select Standards Development Organization (SDO) working group/committee meetings, providing input to the SDO working group in the form of technical information (e.g., objectives, user needs, data requirements, and review and contribution to relevant standards documentation. The NYCDOT team shall provide appropriate input to expand, correct, or otherwise improve ITS architecture(s) based on experiences in executing the Connected Vehicle Pilot Deployment Program.

As described in our Staffing Plan and summarized in Section 5, our key staff on this project are already active participants in Standards-based initiatives and welcome the opportunity to continue/expand these activities. The NYC team will document our experiences to improve current standards and/or influence SDOs in one or more Standards Technical Memoranda organized in a format appropriate as input to SDO working groups/committees.

3.13.1 Participate in SDO Working Group/Committee Meetings

We understand that the AOR may request that a subject matter expert (SME) participate in SDO Working Group/Committee Meetings where the significance of the content in relevant Technical Memoranda is essential to expedite connected vehicle deployment nationwide. The SME is expected to participate in technical discussions and provide program needs, use cases, and requirements to the appropriate SDOs.

Several members of our team are currently active through FHWA contracts and as volunteers on the essential working groups which are the likely ones to work with the project lessons learned. This includes the SAE DSRC technical committee which already includes two members from the NYC project team; the NTCIP working groups – specifically the 1202 (ASC), 1103 (BSP), and 1211 (TSP) plus 1201 (BSP) – which the NYC team is already working with to develop the objects for interfacing to the CV projects; The TMDD Steering Committee which members of the Team are active with; the ATC and NEMA cabinet working groups in which the NY team is active to support the interfaces and cabinet additions to support DSRC and the various priority, pedestrian and safety applications, and the IEEE working groups for security and protocols – which includes members of the NY team. Members of the NYC team are also active with the Connected Vehicle Deployment Coalition and will bring these issues to that group for further investigation by USDOT.

3.13.2 Support ITS Architecture Evolution.

To the extent that during execution of the deployment effort opportunities to expand or improve USDOT architectures or tools are identified, the NYCDOT team will provide appropriate feedback to the Government and/or Government-designated architecture contractors.

3.13.3 Deliverables

The NYCDOT team will provide the following deliverables during Phase 2:

- SDO-specific Technical Memoranda (as defined in the Standards Plan)
- Participation in SDO working group or committee meetings/activities (as required)

3.14 Phase 3 Tasks

Below is a high level description of the Phase 3 activities. We understand that work shall not begin on Phase 3 without the written approval from the Agreement Officer (AO).

3.15 Program Management – Task 3-A

During Phase 3, the Project Management activities will continue as the project focus shifts from planning and execution to Operations and Maintenance.

3.15.1 Project Management Plan

We will revise the Project Management Plan (PMP) to reflect the Phase 3 focus within the first 4 weeks of the project. The initial draft of the updated PMP will be shared with USDOT at the Phase 3 Kick-off meeting.

3.15.2 Project Schedule

A baseline project schedule with a Phase 3 focus will be developed in MS Project and presented at the project kick off meeting. This schedule will clearly identify the tasks required to complete the work, the task dependencies, task start and end dates and the name of the primary responsible individual. All project deliverables required per the Notice of Funding Opportunity (NOFO) will be incorporated. USDOT review times of these deliverables will be clearly identified.

3.15.3 Kick-off Meeting, Monthly Reports & Meeting Participation

At a minimum, the three key resources from the NYCDOT team will attend a kick-off meeting in Washington DC within the first 4 weeks of Phase 3 to meet with the USDOT team.

The NYCDOT team will prepare monthly reports that include the status of each deliverable. The report will include an updated schedule and a narrative of accomplishments by task and projected activities in the next quarterly period. The monthly reports will also include a technical risk narrative, a partnership risk narrative, a retrospective cost narrative, and a projected cost-to-complete narrative.

The NYC team will organize and participate in bi-weekly deployment coordination teleconference with the AOR and federal team members to cover work in progress, identify issues and risks, and coordinate technical

assistance. We will also ensure that at least one project representative attends monthly all-site coordination teleconferences.

3.15.4 Deliverables

The NYCDOT team will provide the following deliverables during Phase 3:

- Kick-off Meeting
- Project Management Plan (PMP)
- Revised PMP (as required)
- Project Schedules (updated monthly) and Monthly Progress Reports
- Participation in site-specific bi-weekly coordination teleconferences and monthly all-site coordination teleconferences

3.16 System Operations and Maintenance – Task 3-B

The start of Phase 3 represents a shift from planning and deployment to operations and maintenance. In this task, the NYCDOT team will operate and maintain the system according to the Comprehensive Maintenance and Operations Plan (CMOP). Early in Phase 3, a work breakdown structure of activities (and dependencies) required to operate and maintain the will be developed and documented in a System Operations and Maintenance Schedule (SOMS).

3.16.1 System Operations and Maintenance Schedule

Since the Operations and Maintenance activities are interrelated with other project tasks, the SOMS will be a subsection of the overall schedule. A separate view will be created within the overall project schedule that highlights the Maintenance tasks. This view will be the SOMS.

The project schedule, including the SOMS, will be updated at least once per month to show progress against the plan. The details in this schedule will be progressively elaborated as more details regarding specific activities are clear. Operations and Maintenance related risks and issues will be tracked and recorded in the project's risk and issue log. A specific category will be assigned to Operations and Maintenance risks/issues so that they can be easily extracted from the overall project's risk and issue logs. The updated SOMS will be accompanied by a concise summary of activities underway, progress made since the last update, and any/all technical issues/risks/incidents with any/all mitigation actions taken since the last update.

As a part of the monthly SOMS update, the NYCDOT will prepare a report that depicts the number of DSRC-equipped devices installed and an operational status indicator (e.g., installed, installed and tested, operational, under repair/not in operation), categorized by type, with their physical locations where appropriate. Device types include: vehicle and in-vehicle equipment, roadside equipment, mobile devices, management center equipment, and any other equipment equipped with a DSRC transmitter or receiver.

The draft SOMS will be prepared early in Phase 3 and provided to the AOR for review. Figure 3-12 is the draft SOMS schedule that was submitted with the NOFO, and Figure 3-13 shows the updated high-level SOMS schedule. Monthly updates will continue through the end of the 18 month Phase 3 period. As described in Section 3.7 much of the participant training will occur during this Operations and Maintenance period.

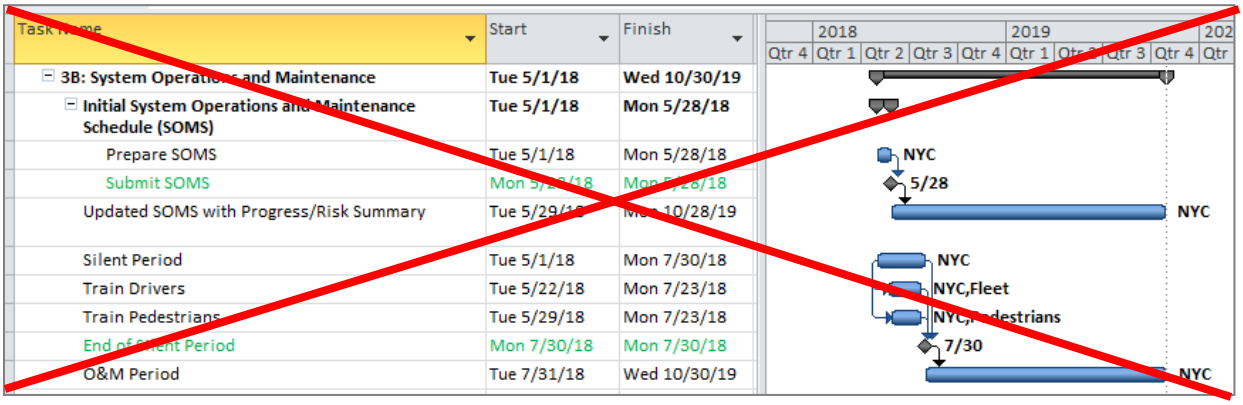


Figure 3-12. System Operations and Maintenance - High Level Schedule (per NOFO)

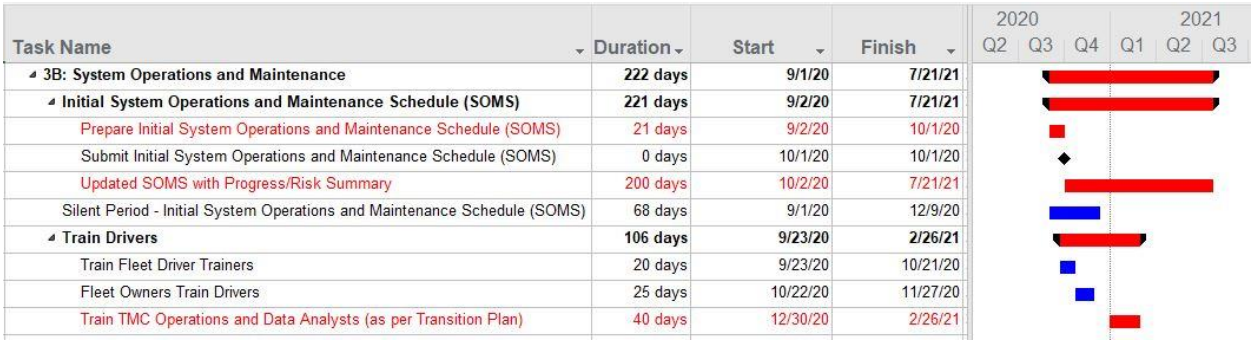


Figure 3-13. System Operations and Maintenance - High Level Schedule (Revised)

3.16.2 Required Deliverables

The NYCDOT team will provide the following deliverables during Phase 3:

- Initial System Operations and Maintenance Schedule (SOMS)
- Updated SOMS with Progress/Risk Summary (monthly)

3.17 Stakeholder Outreach – Task 3-C

The NYCDOT Outreach team will continue with the Outreach Activities outlined in the DOP that were started in Phase 2.

Figure 3-14 provides a high level view of the Phase 3 plan/schedule for Outreach-focused tasks submitted in the NOFO. The updated high-level schedule for Phase 3 Outreach tasks is shown in Figure 3-15. We will continue to utilize a variety of outreach materials including a project website, a video, public meetings, press releases, and a project brochure. The schedule and resource assignments for the preparation of these materials will be elaborated in the updated Outreach Implementation Schedule (OIS). Since the outreach activities are interrelated with other project tasks such as the installation schedule, the OIS will be a subsection of the overall schedule. A separate view will be created within the overall project schedule that highlights the Outreach tasks. This view will be the OIS.

The project schedule, including the OIS, will be updated at least once per month to show progress against the plan. The details in this schedule will be progressively elaborated as more details regarding specific activities are clear. Outreach related risks and issues will be tracked and recorded in the project's risk and issue log. A specific category will be assigned to Outreach risks/issues so that they can be easily extracted from the overall project's risk and issue logs.

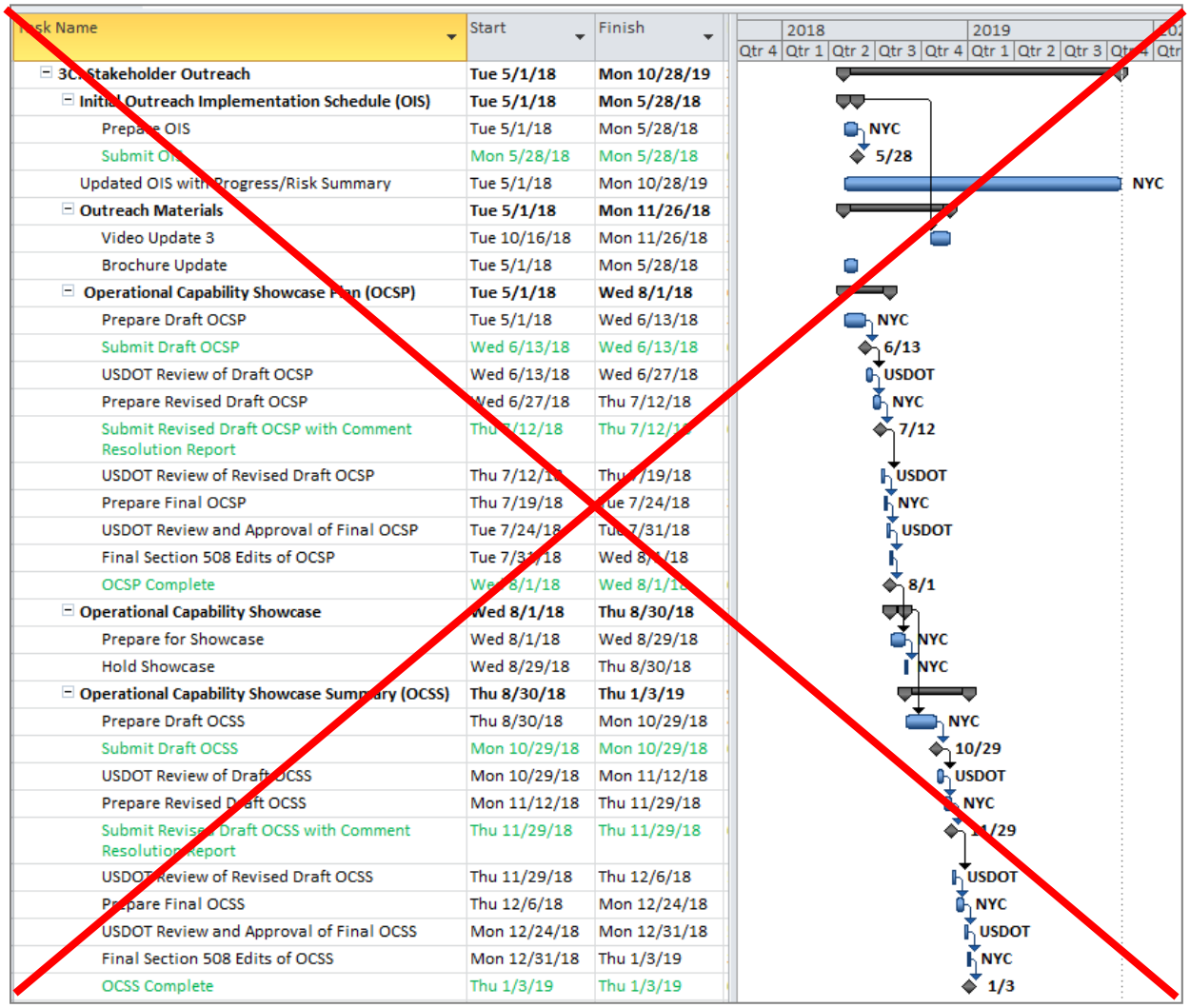


Figure 3-14. Phase 3 Outreach Tasks - High Level Schedule (per NOFO)

Task Name	Duration	Start	Finish
Task 2J/3C: Stakeholder Outreach	1300 days	9/1/16	11/5/21
DOP and OIS	1300 days	9/1/16	11/5/21
Initial Outreach Implementation Schedule (OIS)	82 days	9/1/16	12/30/16
Outreach Materials	1086 days	9/29/16	1/29/21
Press Conference (One per year)	30 days	4/27/20	6/8/20
Video	335 days	10/31/16	3/5/18
Website	1061 days	10/13/16	1/6/21
Project Brochure	259 days	3/6/17	3/15/18
One Page Fact Sheet	1055 days	11/15/16	1/29/21
Press Releases	952 days	9/29/16	7/16/20
NYCDOT Newsletter Articles	359 days	11/18/16	4/25/18
Social Media Posts	904 days	10/24/16	6/1/20
Public Meetings within Boroughs (On Hold at this time)	0 days	9/6/18	9/6/18
Trade Journal Articles	793 days	10/17/16	12/13/19
Operational Capability Showcase	175 days	9/2/20	5/14/21
Operational Capability Showcase Plan (OCSP)	67 days	9/2/20	12/9/20
Operational Capability Showcase	21 days	12/10/20	1/11/21
Prepare for Operational Capability Showcase	20 days	12/10/20	1/8/21
Hold Operational Capability Showcase	1 day	1/11/21	1/11/21
Operational Capability Showcase Summary (OCSS)	87 days	1/12/21	5/14/21
Prepare Draft OCSS	42 days	1/12/21	3/12/21
Submit Draft OCSS	0 days	3/12/21	3/12/21
USDOT Review of Draft OCSS	10 days	3/15/21	3/26/21
Prepare Revised Draft OCSS	12 days	3/29/21	4/13/21
Submit Revised Draft OCSS with Comment Resolution Report	0 days	4/13/21	4/13/21
USDOT Review of Revised Draft OCSS	5 days	4/14/21	4/20/21
Prepare Final OCSS	10 days	4/21/21	5/4/21
USDOT Review and Approval of Final OCSS	5 days	5/5/21	5/11/21
Final Section 508 Edits of OCSS	3 days	5/12/21	5/14/21
OCSS Complete	0 days	5/14/21	5/14/21

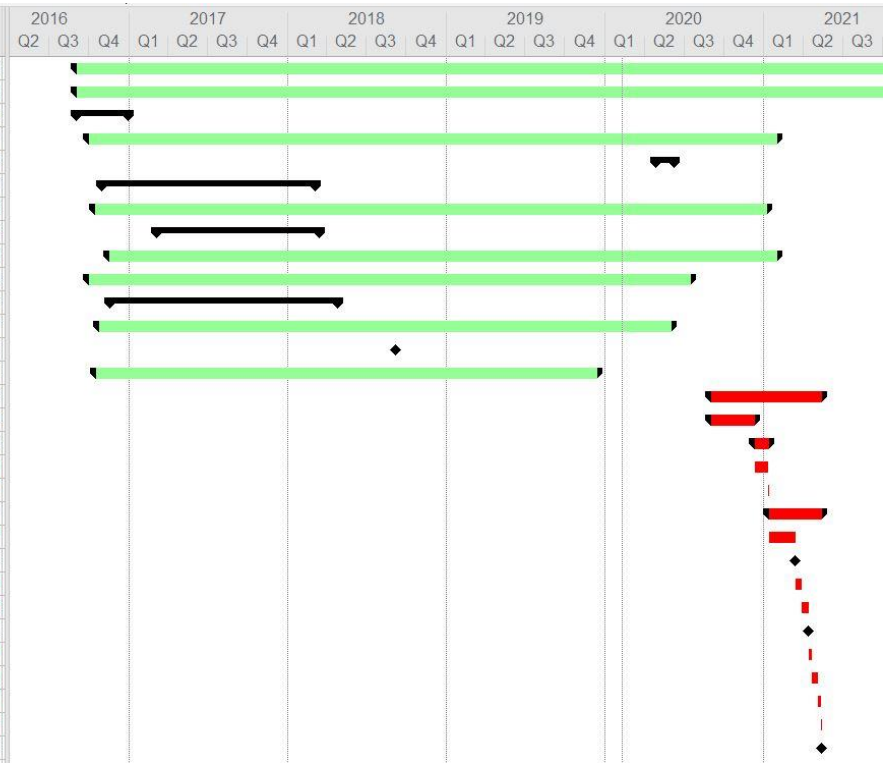


Figure 3-15. Phase 3 Outreach Tasks - High Level Schedule (Revised)

3.17.1 Operational Capability Showcase

The NYCDOT will host an Operational Capability Showcase (OCS) within the first year of Phase 3. This will be a media event to show the capabilities, intent, and value of the deployment. The showcase will also include an interoperability activity, wherein one or more in-vehicle or mobile device from a different CV Pilot Deployment site is shown to be interacting successfully with the local deployment. As listed in Figure 3-15 above, the OCS is expected to occur towards the beginning part of Phase 3. Due to differences in how applications are deployed at the different sites, full interoperability may not be feasible. The exact details for capability showcase including the interoperability demo will be detailed in the Operational Capability Showcase Plan (OCSP).

An Operational Capability Showcase plan will be developed and approved by USDOT. The document will provide the guidance of the execution of this showcase.

The Operational Capability Showcase will be coordinated with the AOR and federal outreach activity. The NYCDOT Outreach team will document the results of the showcase in an Operational Capability Showcase Summary (OCSS) indicating how the results/products of the showcase will be integrated into site outreach materials and interactions in workshops, conferences, and trade shows.

3.17.2 Interoperability Demonstration

Due to differences in how applications are deployed at the different sites, full interoperability may not be feasible. The NYC CVPD plans to employ the adopted standards (latest as of 9/1/2016 or the end of 2016 – whichever comes first) for the following:

J2735, J2945/1, 1609.x, 802.11p
BSM, MAP, SPaT and BIM, TIM, and the PED applications where used (Likely based on 2945/9)
SCMS – for access to certificates for all devices and communications
V4.1 of the RSU specifications – but this will be modified
The SAE channel utilization plan (using Channels 172, 174, 176, 178, 180, 182)
PSID assignments and SSP assignments - - **TBD**

Applications built to work with the above standards will do what was intended by the vendor that developed the application – and may work differently than the NYC implementation of the same application. It has become evident that different vendors utilize different algorithms for their applications, and the NYC CVPD needs to be able to "tune" these applications based on vehicle types, traffic conditions, time-of-day, and roadway type/conditions. During our RFEI demonstrations, the same application from different vendors behaved quite differently; some were so loose that the "danger" situation was signaled so far in advance as to be too much warning – while some were a "hair raising" experience. Some operated on adjacent lanes while others did not; and the location tracking mechanisms were radically different. Each vendor explained that they had "tuned" their demonstration to operate on our test track – and we expect to need to do that for the optimal operation in Manhattan. It is important to note that the speed limit within NYC is 25 MPH (on surface streets) and some of the applications demonstrated did not even become "active" until the vehicle reached 35 MPH – but we need these applications to be operational at lower speeds. Some of the applications became active at 35 MPH and then continued to operate to a much lower threshold before becoming inactive. We expect to work with the vendors to tune the applications to minimize the false alerts while still preserving useful protection. In addition, the data collection schemes used in the safety pilot are simply not practical for NYC – or any large scale deployment. The data collection for NYC is being tuned to meet our needs and will capture "events" in an effort to collect performance data without flooding our networks with BSMs. Note that 50 vehicles within a

small area "heard" by each other, and several RSU's (70 M spacing) all trying to capture all of the BSM's available creates The safety pilot and RSU/ASD specifications simply collected "tons" of data on a 10 Hz basis and stored it on removable media that was examined periodically (month+). This is not practical for NYC – with a population of thousands of vehicles. Thus, we will be collecting data OTA and limit the data collection to events and be able to configure what is collected, from which devices, and the criteria for "triggers" and when from the TMC. Such "control" of both the operational parameters and the data collection has not been included in the other sites' applications – hence, "visitors" will not respond to our attempts to adjust their parameters or to upload or download data.

Until such time as USDOT or NHTSA or some other group establish standard algorithms for the operation of each safety application and agree on the allowed adjustments, the applications will work, but interoperability within a region is questionable. This will rely on a proprietary mechanism for each vendor to update its product, and there is likely to be no standardized way of the agency to tune the applications. Thus, the project is dependent on the vendor and their willingness and ability to work with the NYCDOT to tune their applications; vehicles visiting from other locations will need to be prepared for different environments – and our experiences in NYC will provide insight into this process and the extent that this is true.

Interoperability Demonstrations will be part of the Operational Capability Showcase. However, we intend to include some interoperability testing during the Shakedown Period late in Phase 2.

3.17.3 Trade Show/Conference Plan

Section 3.11.1 provides an overview of the Phase 2&3 trade show and conference plan

3.17.4 Lessons Learned Logbook (LLL)

The LLL that was initiated in Phase 2 will continue to incorporate a brief summary of any issues identified throughout the Phase 3 deployment. This will include documentation on the potential impacts, mitigating actions taken, and results identified (to date). This logbook will be an input to the Phase 3 Transition Planning tasks. It will also provide a vehicle to share insights and lessons learned with peers considering or actively deploying connected vehicle technologies.

3.17.5 Deliverables

The NYCDOT team will provide the following deliverables:

- Outreach Implementation Schedule (OIS) and monthly updates including Progress/Risk Summary
- Outreach Materials (as specified in the DOP and OIS)
- Operational Capability Showcase Plan (OCSP) – Draft and Final
- Revised OCSP with Comment Resolution Report
- Operational Capability Showcase
- Operational Capability Showcase Summary (OCSS) – Draft and Final
- Revised OCSS with Comment Resolution Report
- Final Operational Capability Showcase Summary

NYCDOT will not purchase any booths or trade show space related to the Outreach Activities for this project.

3.18 Performance Measurement and Independent Evaluation Support – Task 3-D

In this task, the NYC CVPD team will collect, process, and distribute data according to the Performance Measurement Evaluation and Support Plan (PMESP) as updated in Phase 2 in order to measure the impacts of the CV deployment on key safety, mobility, reliability, and environmental measures during the Phase 3 deployment in NYC and to support broader independent evaluation effort. The collection, processing, and transfer of data from the NYC CVPD site in support of performance measurement and evaluation will be documented within the Data Management Plan (itself consistent with the PMESP).

In addition to the collection of action logs from ASDs surrounding the warning events and the ASD breadcrumb mobility data, and other performance measurement and confounding factor data collection efforts documented in the updated Phase 2 PMESP, Phase 3 will see the completion of the simulation based assessments of those performance metrics which cannot readily be measured in the field.

3.18.1 Without and With CV Data Collection and Performance Measurement

In Phase 3, the focus of the PMESP task is measuring the impact of CV applications and the overall impact of the deployment on the key performance measures and supporting an independent evaluation effort. This work will be completed for the two distinct periods of Phase 3; the initial Before or Without CV period, where all ASDs operate in silent mode; and the After or With CV period, where all ASDs operate in active mode (except for vehicles assigned to the control group).

All work done in this activity will proceed using the methods, procedures, and protocols developed and tested in the shakedown period late in Phase 2 and documented in the Phase 2 PMESP.

The length of time required for an effective silent period will be determined in Phase 2 under a review of the warning frequencies for the various different CV applications that will be deployed. This will help to design a before period that will capture enough data to allow for a statistically sound assessment of driver reactions under the warning events (but without warnings being issued). A silent period of 3 months was assumed for the preliminary schedule included as part of this document. It is noted that the collection of before data not collected through CV devices may extend back into Phase 2 to increase the duration of the before period capture period. In particular, crash records and institutional data representative of the before or without CV period maybe be collected throughout phase 2 or possibly even earlier if archived records are available.

While a longer before period would be preferred, the scheduling of the collection of the CV-based before data at the beginning of Phase 3 is anticipated as the procurement, installation, testing, and tuning of the CV applications is expected to take the entirety of the Phase 2 period. If the tuning of the CV application parameters are completed and locked-down and a sufficient number of CV units are deployed in all stakeholder fleets, the beginning of the before or silent ASD data can be accelerated and begin prior to the beginning of Phase 3.

Following the conclusion of the before period, all ASDs (expect control vehicles) will be turned to active mode, and the remainder of Phase 3 will be dedicated to the collection of the after or active ASD data.

3.18.2 Surrogate Safety Measure Simulations for Safety Benefits

Surrogate safety measures (SSMs) will be obtained from simulated vehicle trajectories as indicators of safety improvement under the CV deployment. The SSM simulations will be conducted in accordance with the simulation plan to be developed in Phase 2 after a review of the real-world data seen during the testing and shakedown periods in Phase 2.

For the safety evaluation, simple simulation models that range from a single intersection to relatively small corridors of a few intersections will be developed and well calibrated for both the without and with CV condition trajectory data from the action logs. It is noted that to properly model the CV influences in the simulation models, a modification to the model's car following and/or lane changing logic may be required to properly replicate both the without and with CV conditions.

Each scenario will be tested under a range of realistic demand and environmental conditions that account for the varying confounding factors present in the field and in the collected ASD action log data. The definition of what scenarios are most appropriate to be simulated will be determined by a cluster analysis of the collected ASD action log data. The goal is to simulate a variety of conditions that see frequent warnings issued from each of the CV applications on the ASDs under the most frequently seen combinations of confounding factor conditions.

It is noted that since the SSM simulations will require the detailed action log data from both the before (without CV) period and the after (with CV) period, the SSM simulation scenario modeling will commence after sufficient data has been collected with which to calibrate the SSM models.

3.18.3 System-wide Performance Simulations

While the changes in mobility, reliability, and tailpipe environmental emissions are not the primary focus of the NYC CVPD, it is noted that the CV deployment could have impacts on the system-wide performance for the NYC system resulting from prevented crashes or crashes with a reduced severity. The system-wide performance simulations will be conducted in accordance with the simulation plan to be developed in Phase 2 and will use the MTM model which will be updated and recalibrated to current without CV conditions during Phase 2.

For the non-safety related performance evaluation of metrics that cannot easily be collected in the field, a variety of crash scenarios will be simulated. Representing the 'without CV' conditions, each scenario will simulate a typical crash that was seen to occur in the before period in the crash database. The impacts of that crash on the system-wide performance in terms of increased travel times and increased variability in travel time can be extracted from the simulation models. The same crash scenario can then be repeated (which excludes any input from confounding factors) under the 'with CV' conditions, whereby the crash is either prevented (and normal operations continue), or is replaced with a reduced severity crash (which is likely to see a faster incident clearance time), and similar to the previous simulation, the travel time average and variances can be computed. Additionally in the 'with CV' simulations, any observed changes in the distribution of vehicle speeds on the study roadways from the deployment of the speed compliance applications can also be incorporated. The differences between these findings on the overall system performance under the crash scenarios for both without and with CV deployment can determine the secondary mobility, reliability, and emission benefits of the NYC CV deployment. When combined with the safety performance measures of the number of prevented and number of reduced severity crashes, annual improvements in system-wide performance metrics can be estimated.

It is noted that since the system-wide performance simulations will require the summary changes in mobility seen on the study roadways from both the before (without CV) period and the after (with CV) period, the system-wide performance simulation scenarios modeling will commence after sufficient after data has been collected to calibrate the model. This includes after data to assess the changes in the observed speed profiles of drivers under the influence of the CV deployed devices.

3.18.4 Independent Evaluator Support

In addition to the activities described above, in this task the NYC CVPD team will support the USDOT's independent evaluation effort as outlined in the PMESP, including but not limited to:

- The provision of privacy-obfuscated participant action logs
- Performance measure calculation procedures
- A summary of the application of the developed analytical tools and simulation models used in the performance evaluation
- Data related to the mitigation of confounding factors, including factors tracked, sources of available information utilized to track these factors, and mitigation approaches (if any) utilized
- Facilitation of independent evaluator access to NYC CVPD team and stakeholders for the purposes of supporting surveys and interviews
- Data related to institutional and organizational elements and analysis
- Informational assistance supporting the independent evaluator in identifying and recruiting participants related to key evaluation use cases

3.18.5 Performance Measurement and Evaluation Support Schedule

The project schedule will be updated to include the specific tasks related to the Phase 3 performance measurements activities. A view of the schedule focused on these tasks will be created and this will be the PMESS for Phase 3. The NYC CVPD team will deliver the products (identified in the PMESP) of these activities (such as data, logbooks, analytical models, system performance reports, and other supporting information) on or before delivery dates identified in the PMESS.

In particular, the PMESS will identify milestones, performance summary reports, and the delivery of both pre-deployment ('Before' or 'without CV') and post-deployment ('After' or 'with CV') data for coordination with USDOT and the USDOT-identified independent evaluator. This will include reports for not only the treatment group of vehicles but for the control group vehicles as well.

The project schedule, including the PMESS, will be updated at least once per month to show progress against the plan. The details in this schedule will be progressively elaborated as more details regarding specific activities are clear. Technical risks and issues will be tracked and recorded in the project's risk and issue log. A specific category will be assigned to performance measurement related risks/issues so that they can be easily extracted from the overall project's risk and issue logs.

Periodically as needed (but no less than once) the NYC CVPD team will update the PMESP in Phase 3. The update(s) will document within the updated PMESP the analytical models and algorithmic methodologies utilized in performance measure calculation and in the simulation based assessments of the CV deployment impacts.

3.18.6 Deliverables

- Draft Performance Measurement and Evaluation Support Schedule (PMESS) and monthly updates including Progress/Risk Summary (monthly)
- Post-Deployment Performance Data, logbooks, analytical models and other supporting information (per the PMESS)
- System Performance Reports (per the PMESS)
- Updated PMESP and DMP documents (as required)

3.19 Post-Pilot Deployment Transition Planning – Task 3-E

One of the final tasks in Phase 3, as shown in **Error! Reference source not found.**, will be to create a Comprehensive Transition Plan (CTP) so that the maintenance and operations activities planned and executed throughout the project will transition seamlessly to ongoing city operations.

3.19.1 Transition Plan

The transition plan will identify the concepts, applications, governance framework, agreements, key documents, and equipment to be maintained as elements of routine operational practice after the completion of Phase 3. The CTP will draw on the lesson learned log that will be developed and maintained as part of the Outreach tasks in Phase 2 & 3. We anticipate that the CTP will include the following:

- Concepts and applications found to be successful and included in continuing operations
- Concepts and applications found to be unsuccessful and to be removed from continuing operations.
- Rationale for each successful and unsuccessful element
- Financial resources and agreements required to ensure financial sustainability in the post-deployment period for all continuing elements.
- Business plan containing standard elements
- Dependencies on external organizations
- Contingency plans with respect to identified uncertainties and other potential post-deployment issues posing a risk to successful post-deployment operations.
- Governance framework and processes and the expected operational changes

3.19.2 Deliverables

The NYCDOT team will provide the following deliverables during Phase 3:

- Comprehensive Transition Plan – Draft and Final

3.20 Participation in Standards Development – Task 3-F

The NYCDOT team, particularly the Site Deployment Lead and Systems Engineering Lead, will continue to assist the USDOT in improving and expanding ITS architecture and standards to support ITS deployments based on experiences and lessons learned as a part of the deployment activity.

3.20.1 Deliverables

The NYCDOT team will provide the following deliverables during Phase 3:

- SDO-specific Technical Memoranda (as defined in the Standards Plan)
- Participation in SDO working group or committee meetings/activities (as required)

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3.21 Deliver ASDs to USDOT – Task 3-G

NYCDOT will deliver 700 ASDs with Installation Kits to a location chosen by USDOT in the Washington DC area by May 31, 2020 to become Federal property. USDOT will take title to NYC DOT's unused ASDs purchased under the agreement. It is expected that the city will retain 3,300 production ASDs for installation and spares. Title of these units will transfer to USDOT upon receipt.

3.22 Spectrum Research Support – Task 3-H

Utilizing the existing network, NYCDOT and USDOT plan to assess the impact of unlicensed and Cellular Vehicle to Everything (C-V2X) devices operating in the 5.9 GHz Spectrum (i.e., "Safety Band"). This will be done by providing access to the normal operations and maintenance reports and data collected routinely as part of the CV pilot operation. This will be accomplished by providing access to the existing NYCDOT CV network.

Background: The tasks listed above are to support the following USDOT goals:

a) In an urban environment, there is a need to understand the impacts of unlicensed devices and C-V2X devices operating in the DSRC band.

b) There is a need to understand the impact of potential interference and/or sharing Radio Frequency (RF) spectrum.

c) There is a need to define requirements necessary for avoiding interference with and ensuring reliable operations of devices in 5.9 GHz Safety Band.

Tasks: Subject to the assumptions below, USDOT and NYCDOT shall:

a) Collaborate to develop the capability to evaluate interference affecting 5.9 GHz devices.

b) Characterize the existing RF signal environment in and near the CV Pilot deployment.

c) Measure the effect of unlicensed and C-V2X devices on the background noise level.

d) Measure the impact unlicensed and C-V2X device transmissions have on receiving CV Pilot deployment.

e) Measure RF suppression caused by the Clear Channel Assessment (CCA) mechanism.

f) Measure other impacts on 5.9 GHz channel quality caused by unlicensed and C-V2X device transmissions.

g) Determine the minimum received power at which 5.9 GHz devices can sense each other.

h) Investigate how the bandwidth of other signals changes how they affect CV Pilot deployment.

i) Understand how 5.9 GHz operations can affect potential interference from unlicensed and C-V2X devices.

j) Investigate mitigation possibilities due to potential interference of unlicensed C-V2X devices.

Assumptions: The following assumptions are included in the definition of this task:

a) NYCDOT will provide access to data from existing production ASDs and RSUs installed and operational in the existing format and USDOT will provide all additional equipment and systems needed to conduct the testing.

b) NYCDOT will not be provide hardware or software.

c) NYCDOT will provide staff members as needed from the existing CV team to send the data to USDOT.

d) USDOT is responsible for driving the CV2X vehicles.

e) NYC is not required to modify the daily travel activities of CV equipped vehicles that participate in this project.

3.23 PARTICIPATION IN USDOT'S CD FOR ADVANCED CONNECTED VEHICLE PILOT FOR URBAN ENVIRONMENT – Task 3-I

NYCDOT shall assist the USDOT in understanding and enabling Cooperative Driving (CD FOR ACV) in New York City. Working with the USDOT, NYCDOT shall identify an area in the CV Pilot site as a location to support Advanced Connected Vehicles (ACVs) to better understand the role of infrastructure in supporting and enabling connected driving in an urban environment. Working with the USDOT, NYCDOT shall predefine an area of the NYCDOT CV Pilot site that can be used to support CD FOR ACV.

Subject to the assumptions below, NYCDOT will provide assistance to leverage their existing network(s) and technical staff in retrieving the existing data to support the following technical areas:

Technical Area #1: The USDOT is seeking to implement CD FOR ACV at intersections to improve safety of road users such as pedestrian and bicyclist. NYCDOT shall provide existing data for three intersections as CD FOR ACV. The data from infrastructure may include detected objects at the intersection as contact closures in the detection zone for connected vehicle use to improve situational awareness at the intersection. This technical area will support the new and emerging area of shared perception.

NYCDOT has instrumented intersections with FLIR pedestrian detection equipment which can detect objects in the configured zones and provide an input to the traffic controller which is currently used for the *Pedestrian in Crosswalk* application to provide information in the SPaT message indicating the presence of a pedestrian in the crosswalk. NYCDOT will provide USDOT with access to the data for their use in this program. NYCDOT assistance does not include software modifications to the traffic controller (ASTC), or the RSU. Any additional vehicles or equipment needed for this testing shall be provided by USDOT.

Technical Area #2: The USDOT is seeking to analyze CD FOR ACV at intersections to improve traffic operations of traffic signal control to improve safety and efficiency. NYCDOT and USDOT, shall collaborate to conduct a research report white paper on the applicability of CD FOR ACV and the urban challenges based on the feedback and the collected data.

Assumptions: the following assumption is included in the definition of this task.

a) NYCDOT will provide technical staff to work with USDOT to analyze the collected data. Such

assistance shall be limited to resources within the NYC CV team; City staff time and consultant time as needed and not to exceed $200,000 within the CV budget. This cost is included in Phase 3 estimate for subcontractor costs in Figure 6-2 and Performance Measurement Labor and Hardware expense category in Figure 6-4.

3.24 Fleet Evaluation – Task 3-J

The new fleet activities are different than the original scope with taxis participation. Therefore, we expect less V2V messages per VMT but the same V21 messages per vehicle. The 3,000 vehicles will have substantial activity in this pilot area and we will have more control of the fleets since the City owns and operates almost all of these vehicles. We also expect more data collection per vehicle per mile since the our RSU can communicate beyond the original 300 meters and as tested to 800 meters which introduces additional data for driver behavior and mobility assessment. The selected vehicle profile information will include the following:

1) Drivers of the selected fleet vehicles reflect behaviors of normal driving population of the total representative of those of similar driving populations and have mixed patterns·of safe and unsafe driving behaviors;

   Our participating fleet are estimated 47% passenger type, 23% busses and 30% light duty vehicles and it is representative of the vehicle population from various agencies.

2) The control group as mentioned can be 5% of the total fleet and can be selected to represent similar characteristics and travel patterns as the treatment group;

   Our fleet's travel patterns of vehicle groups/types will be submitted to the US DOT and with more detailed data of activities in the project area.

3) The new size of the control group will submitted for pre-approval by the AOR to ensure impact of the deployment can be measured;

4) We will provide travel time estimates for all roadway segments within the deployment area

5) Upon signing this Amendment Agreement, all further CV installations will be submitted for pre-approval to the AOR.

We believe strongly in achieving the 3,000 vehicles goal and will provide the intended need for the analysis in this urban environment.

4 Deployment Schedule

The high level project schedule for Phase 2 and 3 has been largely overcome by events. At the time of this document update (February 2020), the prototype and production RSUs and ASDs have all been delivered to NYCDOT and the deployment program is well underway. The updated schedule shown in Appendix C is therefore focused on the ongoing installation, testing, data collection, system operation, and performance analysis. The schedule will show those activities from January 1, 2020 through the end of the project December 31, 2021.

4.1 Schedule Description

A high level view of the initial project schedule for Phase 2 and 3 is provided below. Figure 4-1 provides the high-level schedule submitted in the NOFO, while Figure 4-2 shows the updated high-level schedule for Phase 3. This preliminary version of this schedule includes all the deliverables outlined in the NOFO with each of their required iterations and reviews.

Phase 2 spans twenty months and Phase 3 spans eighteen months. For the purposes of this proposal, we assumed that USDOT will provide Notice to Proceed (NTP) for Phase 2 on 9/1/2016 and for Phase 3 on 5/1/2018. We plan to use progressive elaboration techniques to add more details and refinements to this schedule as they are available for each of the task areas. For example, when the TIS is developed, the details related to the training schedule will be added.

The project schedule is an invaluable tool when it is used actively to track the project's progress and to reflect changes that occur along the path of project completion. The team will rely heavily on this schedule to ensure that everyone is focused on the right tasks at the right time.

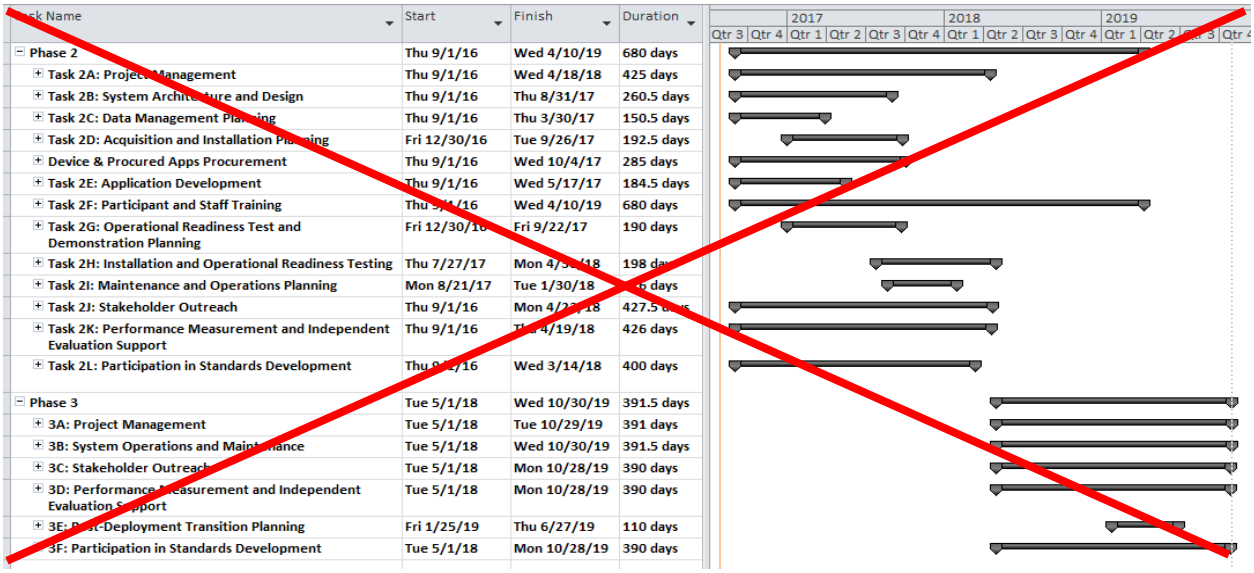


Figure 4-1. Schedule: High Level (per NOFO)

Task Name	Duration	Start	Finish
Key Milestone	1315 days	9/1/16	11/30/21
Task 2A/3A: Project Management	1098 days	9/1/16	1/20/21
Task 2J/3C: Stakeholder Outreach	1300 days	9/1/16	11/5/21
Task 2L/3F: Participation in Standards Development	1044 days	9/1/16	10/29/20
Phase 2	1064 days	9/1/16	11/30/20
Task 2B: System Architecture and Design	955 days	9/26/16	7/16/20
Task 2C: Data Management Planning	288 days	9/1/16	10/25/17
Task 2D: Acquisition and Installation Planning	920 days	9/1/16	5/4/20
Task 2E: Application Development	1026 days	10/24/16	11/24/20
Task 2F: Participant and Staff Training	999 days	9/1/16	8/25/20
Task 2G: Operational Readiness Test and Demonstration Planning	856 days	1/9/17	6/4/20
Task 2H: Installation and Operational Readiness Testing	1064 days	9/1/16	11/30/20
Task 2I: Maintenance and Operations Planning	143.5 days	12/5/17	6/29/18
Task 2K: Performance Measurement and Independent Evaluation Suppor	1045 days	9/1/16	10/30/20
Phase 3	312 days	9/1/20	11/30/21
Operations at 80% - 1 Year Data Collection Period (ASD)	365 edays	9/1/20	9/1/21
Operations at 80% - 1 Year Data Collection Period (PID)	365 edays	9/1/20	9/1/21
3B: System Operations and Maintenance	222 days	9/1/20	7/21/21
3D: Performance Measurement and Independent Evaluation Support	311 days	9/2/20	11/30/21

Figure 4-2. Schedule: High Level (Revised)

4.1.1 Review Cycles

Most project deliverables will follow a similar set of tasks that take a document from initiation through approval. A view of the schedule for the DPP is provided in Figure 4-3 as an example of this flow. Note that Figure 4-3 was the schedule submitted in the NOFO. This has been updated as shown in Figure 4-4 below. Resource Names are provided for each task. At this time, the designation is either NYC or USDOT. However, as this proposal schedule is converted to an operational schedule, the primary person responsible for each task will be designated.

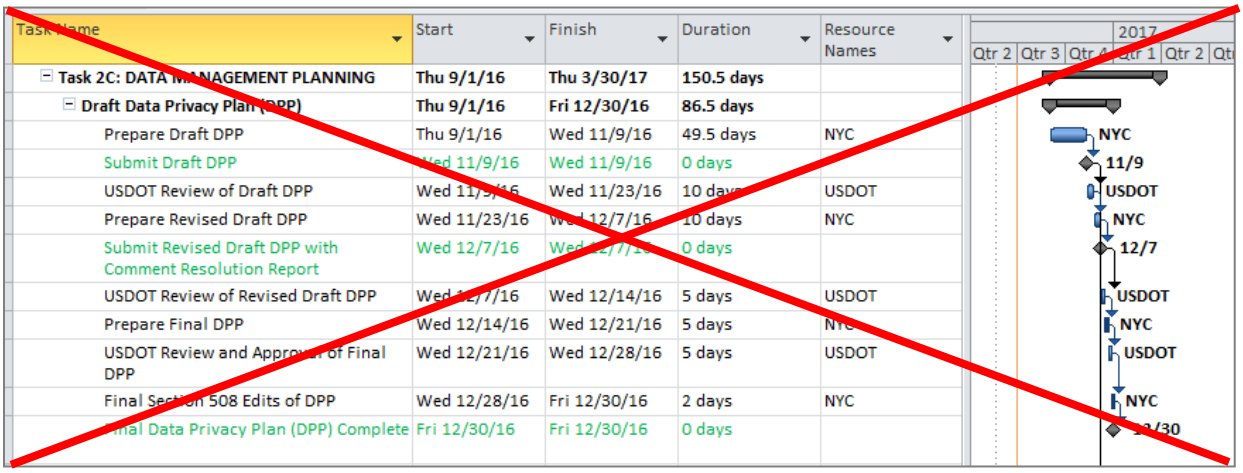


Figure 4-3. Schedule: Review Cycle Example (per NOFO)

Task Name	Duration	Start	Finish
Task 2C: Data Management Planning	**288 days**	**9/1/16**	**10/25/17**
Data Privacy Plan (DPP)	**80 days**	**9/1/16**	**12/28/16**
Data Privacy Plan (DPP) - Draft	**71 days**	**9/1/16**	**12/14/16**
Prepare Draft - Data Privacy Plan (DPP)	42.5 days	9/1/16	11/2/16
Install and Test Sample Devices - Data Privacy Plan (DPP)	0 days	11/2/16	11/2/16
Internal Review - Data Privacy Plan (DPP)	4 days	11/2/16	11/8/16
Final Updates to Draft - Data Privacy Plan (DPP)	1 day	11/8/16	11/9/16
Submit Draft - Data Privacy Plan (DPP)	0 days	11/9/16	11/9/16
USDOT Review of - Data Privacy Plan (DPP)	9 days	11/9/16	11/23/16
Prepare Revised - Data Privacy Plan (DPP)	7 days	11/23/16	12/5/16
Editor Review of Revised Draft DPP	2 days	12/5/16	12/7/16
Submit Revised Draft DPP with Comment Resolution Report	0 days	12/8/16	12/8/16
USDOT Review of Revised Draft DPP	5 days	12/8/16	12/14/16
Data Privacy Plan (DPP) - Final	**9 days**	**12/15/16**	**12/28/16**
Prepare Final DPP	5 days	12/15/16	12/21/16
Submit Final DPP	0 days	12/21/16	12/21/16
USDOT Review and Approval of Final DPP	2 days	12/22/16	12/23/16
Final Section 508 Edits of Final DPP	2 days	12/26/16	12/28/16
Submit 508 Compliant Version of Approved DPP	0 days	12/28/16	12/28/16
Final Data Privacy Plan (DPP) Complete	0 days	12/28/16	12/28/16

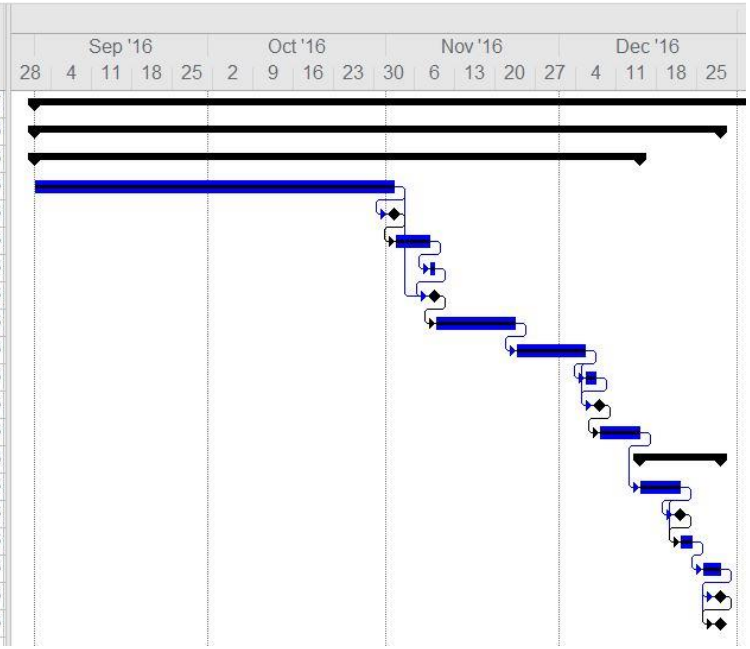


Figure 4-4. Schedule: Review Cycle Example (Revised)

4.1.2 Key Milestones

This section describes the key milestones for Phases 2&3. Table 4-1 provides a list of these key milestones submitted in the NOFO, while Table 4-2 shows the updated dates for these key milestones.

Table 4-1. Key Schedule Milestones (per NOFO)

Key Milestone	Date
Award Date	Thu 9/1/16
SAD Complete	Tue 2/28/17
SDD Complete	Thu 8/31/17
DMP Complete	Thu 3/30/17
CAP Complete	Tue 6/13/17
CIP Complete	Tue 9/26/17
Device Procurement Started	Thu 9/1/16
Device Procurement Complete	Wed 5/31/17
Prototype Installation Started	Thu 3/23/17
Installation Started	Thu 7/27/17
Phase 2 Installation Complete	Wed 12/27/17
Operational Readiness Demonstrations Complete	Mon 4/30/18
NTP for Phase 3	Tue 5/1/18
Silent Period Start	Tue 5/1/18
Operations & Maintenance (O&M) Period Start	Tue 7/31/18
Phase 3 Complete	Thu 10/31/19

Table 4-2. Key Schedule Milestones (Revised)

Task Name	Finish
Key Milestone	**11/30/21**
Award Date	9/1/16
System Architecture Document (SAD) Complete	3/7/17
System Design Document (SDD) Complete	10/6/17
Data Privacy Plan (DPP) Complete	12/28/16
Data Management Plan (DMP) Complete	10/25/17
Comprehensive Acquisition Plan (CAP) - Initial Version Complete	7/13/17
Comprehensive Acquisition Plan (CAP) Updated with HSM Complete	6/29/18
Comprehensive Maintenance and Operations Plan (CMOP) Complete	6/29/18
Device Procurement Started	12/30/16
Operation Readiness Plan (ORP) Complete	6/4/20
Operational Readiness Demonstrations Complete	4/24/20
Phase 2 Complete - 100% Entire Scope	11/30/20
Phase 3 Start (Overlaps Phase 2; Begins upon Operational Readiness Demo)	9/1/20
Phase 3 Complete - 100%	11/30/21

4.1.3 Critical Path

This section provides a graphical representation of the critical path for the NYCDOT Pilot project. Figure 4-5 provides the critical path schedule view that was submitted in the NOFO, while Figure 4-6 shows the updated critical path schedule view. The critical path starts on Day 1 with the start of the procurement cycle and extends through installation and commences with the Operational Readiness Demonstrations. NYCDOT procurement rules and processes necessitate an extended procurement period. The team will be highly focused on these tasks from Day 1 with a focus on finding opportunities to shorten task durations so that the schedule risk is reduced.

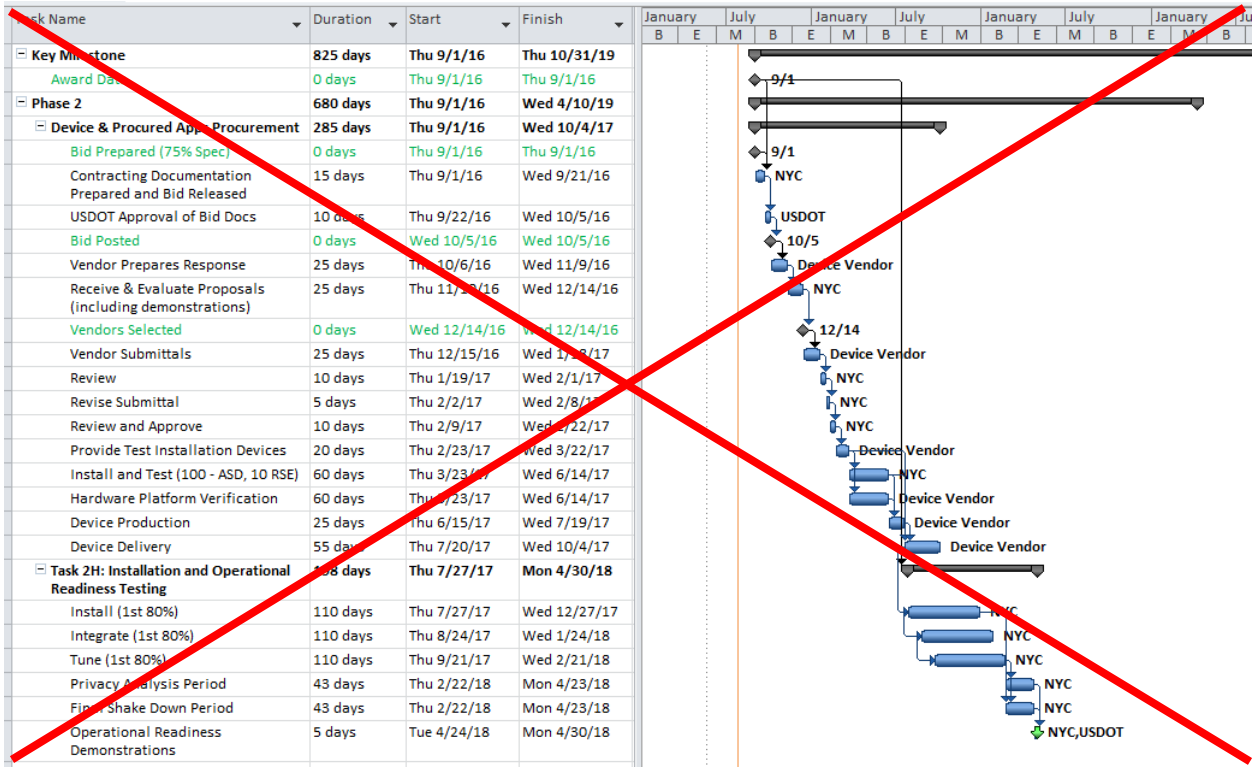


Figure 4-5. Schedule: Critical Path (per NOFO)

Task Name	Duration	Start	Finish
Key Milestone	**1315 days**	**9/1/16**	**11/30/21**
Phase 3 Start (Overlaps Phase 2; Begins upon Operational Readiness Demo)	0 days	9/1/20	9/1/20
Phase 3 Complete - 100%	0 days	11/30/21	11/30/21
Phase 2	**1064 days**	**9/1/16**	**11/30/20**
Task 2H: Installation and Operational Readiness Testing	**1064 days**	**9/1/16**	**11/30/20**
Key Installation Milestones	**847 days**	**7/17/17**	**11/30/20**
Installation Milestones	**480 days**	**1/2/19**	**11/30/20**
Milestone: Installation Complete - 80% ASDs	0 days	8/31/20	8/31/20
Install, Integrate, Test & Tune ASDs	**351 days**	**7/9/19**	**11/30/20**
Install ASDs (80%)	**169 days**	**1/1/20**	**8/31/20**
Install ASDs in MTA Buses (80%)	148 days	2/3/20	8/31/20
ASD Installation Complete (80%)	0 days	8/31/20	8/31/20
Integrate, Tune & Test as installed - ASDs (80%)	20 days	8/4/20	8/31/20
Installation Testing/Verification/Risk Mitigation/Weather - ASDs (80%)	0 days	8/31/20	8/31/20
Phase 3	**312 days**	**9/1/20**	**11/30/21**
3D: Performance Measurement and Independent Evaluation Support	**311 days**	**9/2/20**	**11/30/21**
CV Data Collection	**311 days**	**9/2/20**	**11/30/21**
CV (Before) Data Collection - Silent Mode	91 days	9/2/20	1/14/21
CV Data Collection - Transition from Silent Mode to Treatment Period	33 days	1/15/21	3/4/21
With CV (After) Data Collection & Evaluation (Treatment Period)	271 days	3/5/21	11/30/21
Prepare/Submit Performance Measurement and Independent Evaluation Report	25 days	10/25/21	11/30/21

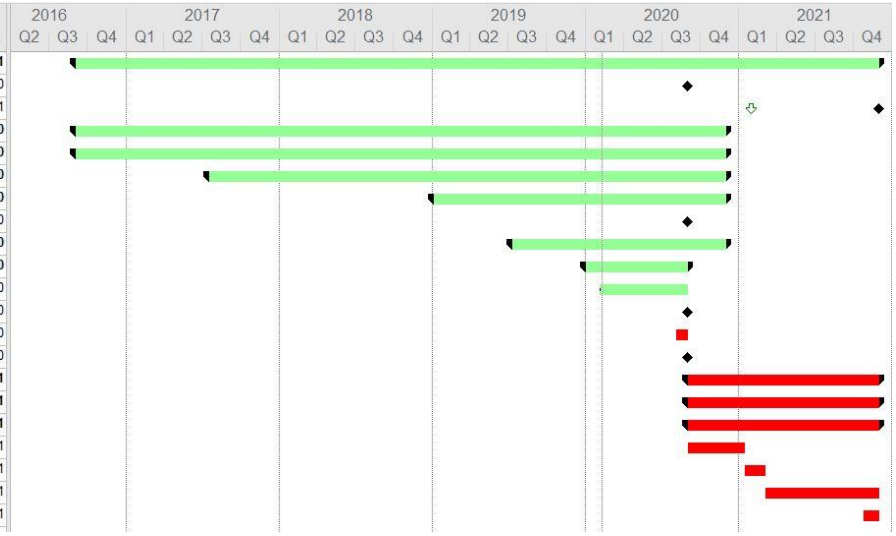


Figure 4-6. Schedule: Critical Path (Revised)

4.2 Supporting Information on Current Acquisition and Installation Planning

This section provides an overview of the current plan regarding the acquisition and installation of the CV pilot devices and applications. Figure 4-7 provides the acquisition, development, and installation schedule view that was submitted in the NOFO, while Figure 4-8 shows the updated schedule view.

4.2.1 Acquisition, Development and Install Schedule

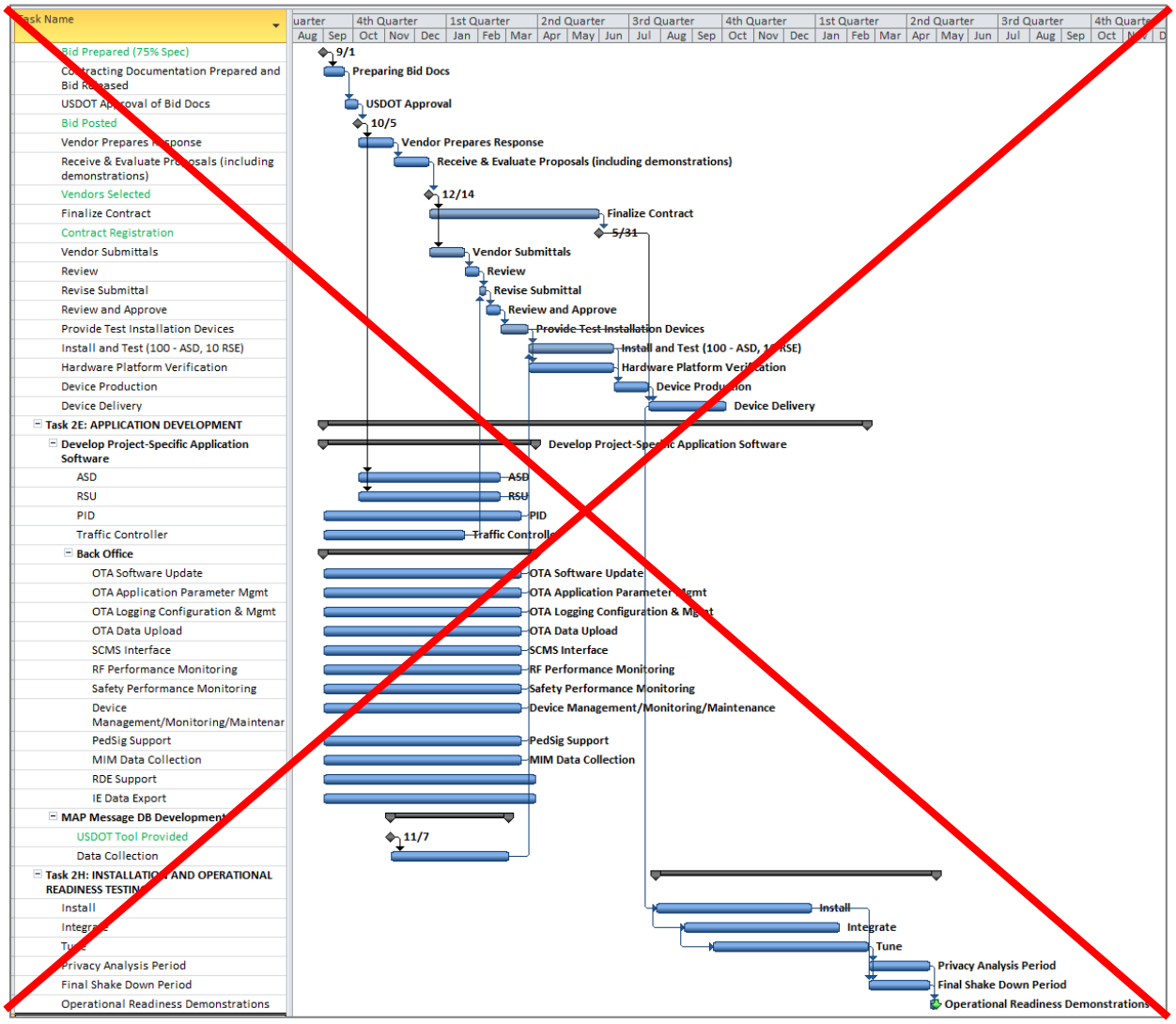


Figure 4-7. Schedule: Acquisition, Development, and Procurement (per NOFO)

Task Name	Duration	Start	Finish
Task 2D: Acquisition and Installation Planning	920 days	9/1/16	5/4/20
Procurement	920 days	9/1/16	5/4/20
DSRC License Registration	476 days	9/1/16	7/26/18
Inventory Tracking Planning	31 days	4/19/17	6/1/17
Installation Procedures	434 days	11/3/17	7/29/19
ASD Installation Procedures	434 days	11/3/17	7/29/19
RSU Installation Procedures	39 days	8/7/18	10/1/18
Task 2E: Application Development	1026 days	10/24/16	11/24/20
Application Development Schedule (ADS)	1002 days	11/2/16	10/30/20
ASTC Vendor (PEEK) Updates the ASTC Interface	317 days	8/24/17	11/30/18
Develop Back Office/TMC Application Software (TransCore)	979 days	1/3/17	11/24/20
MAP Message DB Development (TransCore)	889 days	10/24/16	5/8/20
Task 2H: Installation and Operational Readiness Testing	1064 days	9/1/16	11/30/20
Install Sample Devices	171 days	1/22/18	9/21/18
Install Prototype Devices	177 days	10/2/18	6/17/19
Install ASD Prototype Devices	116 days	1/2/19	6/17/19
Install Prototype RSU Devices (10) - Siemens	22 days	10/2/18	11/1/18
Test Prototype Devices	345 days	11/20/18	4/6/20
Execute Prototype Test	162 days	11/20/18	7/12/19
Prototype Test Phase 1 - Install Procedure Verification, HW, Start Ven	162 days	11/20/18	7/12/19
Prototype Test Phase 2-Validate Safety Apps, OTA, Data Collection	50 days	4/23/19	7/2/19
Obfuscation Test	15 days	3/17/20	4/6/20
TMC Installation	261 days	6/12/17	6/25/18
Interoperability Test	163 days	11/6/17	6/29/18
Production Certificate Validation	139 days	12/14/18	7/3/19
Install, Integrate, Test & Tune RSUs	372 days	1/9/19	6/30/20
Install, Integrate, Test & Tune ASDs	351 days	7/9/19	11/30/20
Install, Integrate, Test & Tune - PED and PID	187 days	6/24/19	3/23/20
Operational Readiness Testing (After Prototype ASD Installs)	32 days	7/3/19	8/19/19
Operational Readiness Demonstration (After 20% ASD Installs)	176 days	8/13/19	4/24/20
Operational Readiness Demonstration - Part 1	7 days	8/13/19	8/21/19
Operational Readiness Demonstration - Part 2 (ASD RF Monitoring/PEDx)	6 days	4/7/20	4/14/20
Operational Readiness Demonstration - Part 3 (PID/PED)	8 days	4/15/20	4/24/20
Operational Readiness Demonstration Complete	0 days	4/24/20	4/24/20
Final Shake Down Period (RSU/ASD/PID/PED) (After 50% ASD Installs)	68 days	5/18/20	8/24/20

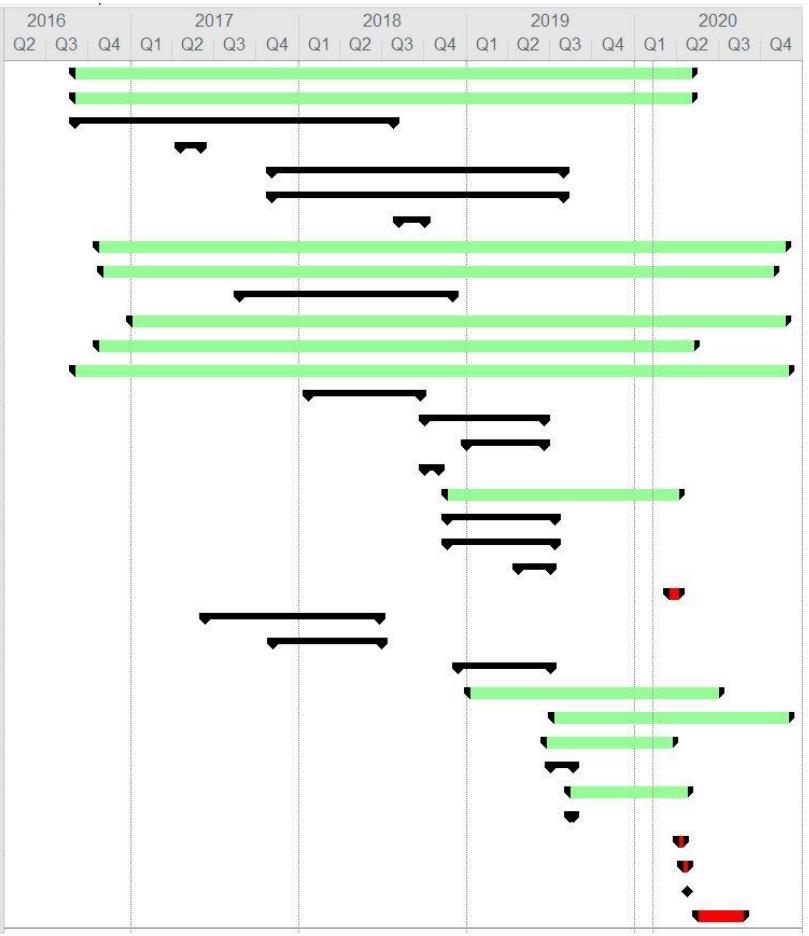


Figure 4-8. Schedule: Acquisition, Development, and Procurement (Revised)

The schedule view shown in Figure 4-8 depicts the key tasks needed for the procurement, development and deployment of the applications and devices (ASD and RSU) required for the CV pilot project. This schedule represents a compression to what is typically needed for a development effort, and is dependent on cooperation from the vendor(s) for the equipment. Based on the general survey of the marketplace, most of the vendors have developed virtually some form of all of our safety applications; hence, the software development and testing phases are shown above. It is assumed that the vendors have a commitment to this market place, and will continue to develop their products and that the NYC Connected Vehicle Pilot Deployment (CVPD) is the first opportunity to provide a significant quantity of both ASDs and RSUs. The schedule shown above assumes a September 1 start data – with the preparation of the final bid documents (15 days[2]) followed by a 10 day approval cycle with USDOT. The vendors will have 25 days to prepare their final bid documents including pre-bid conference and questions – no extensions. The schedule allows 25 days for review of bids and selection and notification of award. The project team expects to collaborate with USDOT and then notify the apparent one or two low bidders (at risk) within the first week following the receipt of the bids; the official notification will be provided after the 5 week evaluation period. At that point contract office begins the arduous process of developing a contract – allocated to take 6 months. Armed with the knowledge that they have been selected, the vendors are expected to start their schedule immediately and prepare their submittals and designs and submit same to the project team and USDOT at the same time. Note that the NYCDOT will issue a notice of award and a notice to proceed at risk. Within 25 days of the formal notification to proceed at risk, the vendor is expected to provide the first submittals; the schedule allows 10 days for review and we have assumed that a revision may be required (5 days) and resubmit and review cycle is likely (10 days). USDOT and NYCDOT will be involved in all reviews and will receive the documents at the same time. 10 days is allowed for concurrent reviews by both parties.

At this point, the vendor's submittals have been approved, and we have allowed 20 days for the vendor to deliver and install (with City assistance) the prototypes (or at least a few) to be used for early testing and demonstrations of any issues. The project team will then work through a 60 day hardware and software testing and review period – including integration and testing of the back-office systems, SCMS, etc.

Our schedule for the back office software development will follow the processes indicated herein and has been allocated 140 days for the development and installation of all of the software except the actual evaluation software. This same software will be used during the initial prototype testing; what is critical is the management of the security aspects and the OTA process and application updates and loading. With these operational, and proven, both the application developers (RSU and ASD) and the back office developers can continue their testing and debugging and evaluation development throughout the 60 day platform testing and the following 110 day deployment program as the field equipment (ASD and RSU) is installed and tested. We have allocated a final 43 day shakedown period for the total system testing for the applications and management systems as well as the database systems.

4.2.2 Number of Units

The exact number of units that will be installed to start the Phase 3 operation and evaluation period has been revised. The current numbers of devices purchased and to be installed (based on current cost, vendor production rate and installation rate estimates) are provided in the two sub-sections below.

4.2.2.1 RSUs

[2] Business days

The NYCDOT team currently plans to purchase and install 450 RSU devices. All these devices will be installed in NYC during Phase 2. The details of this installation plan will be developed during Phase 2 and documented in the Comprehensive Installation Plan (CIP).

4.2.2.2 ASDs

Table 4-3 provides the current estimate of the number of devices that will be installed in each fleet. The details of this installation plan will be developed during Phase 2 and documented in the Comprehensive Installation Plan (CIP). Installation will be coordinated with the group responsible with the Performance Measurement evaluations.

Table 4-3. ASD Installations by Phase

Fleet Owner	Total
MTA	700
NYCDOT	1359
DCAS	941
Total	3000

In addition to the number of devices in Table 4-3, 600 spares will be purchased. We also anticipate about 900 re-installations due to vehicle turnover.

4.2.2.3 Other Devices

The NYCDOT will be purchasing other devices to support the CV Pilot Deployment such as Vulnerable Road User (VRU) Devices (100 devices) and PED Detection Systems (10 systems plus one spare) and Volume Monitoring Stations (30 stations). These will go through the same procurement and installation steps as depicted above. Device numbers may be adjusted as the design is finalized. At this time it is anticipated that all these 'other' devices will be installed during Phase 2.

5 Team Organizational Summary

NYCDOT will be the prime contractor for the NYC CV Pilot project Phase 2&3. NYCDOT has integrated industry leading and locally well-known companies who possess the experience and track record of numerous CV and NYCDOT ITS successful project deliveries. This team consists of several partners who provided support throughout the first phase of this engagement. This partnering approach is one that the NYCDOT has used on many successful transportation projects. Table 5-1 provides an overview of the expertise and project role for the key partners in this endeavor.

Table 5-1. NYCDOT Team

Firm	Expertise	Primary Project Role
NYCDOT	• Operations and integration of the NYC traffic signal and traveler information systems with NYCWiN • Proven "real world" test bed expertise and capabilities • Use of travel time, video and the MTM to support day-to-day operations	• Overall Project Leadership • Project Management Lead • Stakeholder Coordination • Training Lead • Outreach Leads • Website Development • Procurement • Safety Management
JHK Engineering	• NYC Traffic Control System (TCS) and NYCWiN integration • Systems engineering • FHWA Standards development	• Oversight for all Subcontractors & Tasks • Site Delivery Lead • System Engineering Lead • Design • Installation Planning • Procurement Support • Testing
Cambridge Systematics	• Performance measures • NYC simulation modeling • Industry leader in commercial vehicle and freight-related CV development	• Performance Measurement
KLD Engineering	• NYC adaptive TCS • NYC simulation modeling	• Design Support • Architecture Support • NYC Infrastructure Integration
Security Innovations (SI) *Note that SI has been acquired by Qualcomm and is providing consultant services*	• Industry leader in CV security issues including SCMS	• Security • Data Privacy

Firm	Expertise	Primary Project Role
University Transportation Research Center (UTRC)* *represents State University of NY (SUNY)	• Performance measures and evaluations using multi-data collection methodology • Accredited Institutional Review Board (IRB) • Outreach and training	• IRB • Training • Outreach • Performance Measurement Support
New York University (NYU) NYU C2SMART Center 15 MetroTech Center Brooklyn, NY 11201	• Performance measures management for the pedestrian application • Personal Information Device (PID) procurement and management • Outreach and training for the visually-impaired pedestrian users • Database, hardware, software management, and implementation of the server and PIDs	• Performance Measurement • IRB • Consent Form • Training Material Development • Outreach Material Development

5.1 Key Staff

The proposed key staff for this important project are three leading industry experts who led the design and integration of the NYC TCS, Advanced Transportation Controller (ATC), and MIM adaptive signal system with the NYCWiN. Dr. Talas, Mr. Benevelli, and Mr. Rausch possess more than 50 combined years of experience in working together to integrate ITS in NYC. They will lead the NYC CV Pilot – the next generation of technology to be integrated in NYC.

Table 5-2. Key Staff

Name	Role
Mohamad Talas, Ph.D., P.E., P.T.O.E.	Project Management Lead
David A. Benevelli, P.E.	Systems Engineering Lead
Robert G. Rausch, P.E.	Site Deployment Lead

5.1.1 Mohamad Talas, Ph.D., P.E., P.T.O.E., Project Management Lead

Dr. Talas is the Deputy Director for the System Engineering Division for the New York City DOT and supervises 80 staff members in two units that oversee the development of ITS projects and initiatives currently in progress in New York City. These projects include the NYC Connected Vehicle Pilot Deployment (Phase 1), the Vehicular Traffic Computerization System (VTCS), the NYC Advanced Solid-State Traffic Controller (ASTC) for 12,000 intersections, and the NYC Midtown in Motion Project- Smart Lights and the NYC.

Dr. Talas currently manages the Phase 1 Connected Vehicle Project in NYC with the goal to deploy this cutting edge technology to improve traffic safety in line with NYC Vision Zero mission. He also manages the annual federal grants of $60M used for the operation and NYC capital ITS projects deployment. Additionally he directs the operation of the NYC Traffic Management Center, supervises the traffic improvements study for ITS

projects, and serves as agency representative with NYC metropolitan transportation agencies. He also supervises NYC ITS strategic plan research project with NY UTRC-CUNY University and NYC Adaptive Control Research with MIT - Massachusetts Institute of Technology.

5.1.2 Robert G. Rausch, P.E., Site Deployment Lead

Mr. Rausch is a Vice President and Chief ITS Systems Engineer with JHK with more than 40 years experience in the design, development, and deployment of ITS devices and systems. He is also a Registered Professional Engineer (P.E.) in 22 states. He was the Concept Development Lead for New York City's Connected Vehicle Deployment Project (Phase 1) and Technical Program Manager and Lead Designer for the deployment of ITS systems for New York City. As Chief Engineer for JHK's ITS division, Mr. Rausch is responsible for technical reviews and audits of projects and products throughout the company.

Mr. Rausch has been active in the standards arena both nationally and internationally and is currently one of the instructors for the International Road Federation. He provides technical oversight / management to a number of projects and has been participating in the "Connected Vehicle" program through JHK's role with DSRC, ISO's cooperative ITS working group (18) and active participation in USDOT sponsored workshops and standards development programs. Mr. Rausch is also active in the development of the NTCIP standards, the Advanced Transportation Controller (ATC) Steering Committee, DSRC standards development, Traffic Management Data Dictionary, center-to-center communications, and developer and participant in ISO TC204 developing international standards for ITS and CV integration. Additionally, he is subcontractor to various USDOT efforts including International Harmonization task Group 6 dealing with security and privacy standards for the CV infrastructure.

5.1.3 David A. Benevelli, P.E., Systems Engineering Lead

Mr. Benevelli's unique and diverse background brings the broad knowledge base necessary to successfully build and operate today's Advanced Traffic Management Systems (ATMS). This substantial experience spans the project life cycle starting with initial concept and application of the National ITS Architecture through system design and implementation concluding with system operations. It also encompasses a variety of project roles from team member to project manager including advisory roles. Because of this diverse background, he is a key contributor to JHK's Intelligent Transportation Systems (ITS) practice.

Mr. Benevelli is an Associate Vice President with over 38 years experience in traffic management planning, development, design, deployment, and operation and over 30 years experience with New York City's traffic signal control system. He was the lead system engineer for New York City's CV pilot deployment project (Phase 1). In addition, he is a member of the DSRC Technical Committee, contributing to development and maintenance of the DSRC standards and a member of ISO 19091 development team, working with the DSRC technical committee updating the SAE International's J2735™ Data Dictionary standard (the basis for the 19091).

6 Cost Summary

Volume 2 – Budget Application provides detailed information on the proposed budget for Phase 2 & 3 NYCDOT CV Pilot project. This section provides a high-level summary of the anticipated 3 of the NYCDOT pilot project by phase. Figure 6-1 provides the high-level summary of the costs by phase and type.

Summary of Costs by Phase							
	Phase 2		Phase 3 (Estimate)		Total		Total
	Federal Funding	Site Match	Federal Funding	Site Match	Federal Funding	Site Match	
Direct Labor	$ -	$ 1,680,553	$ -	$ 511,547	$ -	$ 2,192,100	$ 2,192,100
Indirect Labor Costs	$ -	$ 1,381,038	$ -	$ 424,163	$ -	$ 1,805,200	$ 1,805,200
Other Direct Costs	$ 5,652,034	$ 1,043,777	$ 243,350	$ 576,500	$ 5,895,384	$ 1,620,277	$ 7,515,661
Subcontractor Costs	$ 10,208,248	$ -	$ 1,037,929	$ 576,620	$ 11,246,177	$ 576,620	$ 11,822,797
Total	**$ 15,860,283**	**$ 4,105,368**	**$ 1,281,279**	**$ 2,088,830**	**$ 17,141,561**	**$ 6,194,198**	**$ 23,335,759**

Figure 6-2 shows the revised summary of costs by phase and type as of February, 2020. These costs are summarized by direct and indirect labor costs, other direct costs and subcontractor costs. This summary also depicts the anticipated distribution of costs between the Federal Share and the Site Match.

With an anticipated 3,000 equipped vehicles, this represents a cost of ~$2,938 per vehicle.

Summary of Costs by Phase							
	Phase 2		Phase 3		Total		Total
	Federal Funding	Site Match	Federal Funding	Site Match	Federal Funding	Site Match	
Direct Labor	$ -	$ 1,305,460	$	$ 1,347,172	$ -	$ 2,652,632	$ 2,652,632
Indirect Labor Costs	$ -	$ 1,052,398	$ -	$ 1,086,002	$ -	$ 2,138,400	$ 2,138,400
Other Direct Costs	$ 10,045,000	$ 17,500	$ 493,500	$ 10,500	$ 10,538,500	$ 28,000	$ 10,566,500
Subcontractor Cost	$ 5,704,691	$ -	$ 2,438,663	$ -	$ 8,143,354	$ -	$ 8,143,354
Total	$ 15,749,691	$ 2,375,359	$ 2,932,163	$ 2,443,673	$ 18,681,854	$ 4,819,032	$ 23,500,887

Figure 6-1. High Level Costs by Phase (per the NOFO)

Summary of Costs by Phase							
	Phase 2		Phase 3 (Estimate)		Total		Total
	Federal Funding	Site Match	Federal Funding	Site Match	Federal Funding	Site Match	
Direct Labor	$ -	$ 1,680,553	$ -	$ 511,547	$ -	$ 2,192,100	$ 2,192,100
Indirect Labor Costs	$ -	$ 1,381,038	$ -	$ 424,163	$ -	$ 1,805,200	$ 1,805,200
Other Direct Costs	$ 5,652,034	$ 1,043,777	$ 243,350	$ 576,500	$ 5,895,384	$ 1,620,277	$ 7,515,661
Subcontractor Costs	$ 10,208,248	$ -	$ 1,037,929	$ 576,620	$ 11,246,177	$ 576,620	$ 11,822,797
Total	**$ 15,860,283**	**$ 4,105,368**	**$ 1,281,279**	**$ 2,088,830**	**$ 17,141,561**	**$ 6,194,198**	**$ 23,335,759**

Figure 6-2. High Level Costs by Phase (Revised)

In order to provide a bit more insight into the types of costs anticipated for this project, these costs are broken into the following broad categories:. The top four categories based on anticipated cost volume are:

1. Labor costs associated with the design, planning, management, procurement, and general oversight for the project. This includes the labor expense for the three key resources, labor expense related to Project Management and labor associated with the project deliverables (excluding time specifically spent on performance measurements, outreach, and training deliverables).
2. Costs associated with installation, testing, integration, maintenance, and operations of the in-vehicle devices, roadside devices, pedestrian devices, and supporting infrastructure.
3. Cost for procuring the in vehicle, roadside, and pedestrian devices.
4. Equipment and labor focused on meeting the Performance Measurement reporting requirements and deliverables.
5. Labor costs and other direct costs associated with software development and support for the back office and security/SCMS.
6. Travel and other direct costs incurred by NYCDOT and subcontractor.
7. Labor costs and other direct costs associated with outreach efforts.
8. Labor costs and other direct costs associated with training efforts.
9. Costs for procuring additional equipment based on needs for adapting to changes in NYC CV Pilot requirements and/or the existing NYCDOT TMC and NYC network backhaul.

Figure 6-3 provides the high-level costs by expense category submitted in the NOFO, while Figure 6-4 shows the updated high-level costs based on the revised budget. Note that the expense categories have been modified from the original for clarification.

Expense Category	Amt
Design/Planning/PM/Procurement/Oversight	$ 5,826,216
Install/integrate/Maintain	$ 5,649,982
In Vehicle and Roadside Devices	$ 6,276,000
Performance Measurement Labor and Hardware	$ 2,690,003
Software Development and Support	$ 1,510,065
Travel & ODC	$ 389,900
Outreach	$ 327,458
Training	$ 139,002
Infrastructure Adaptions	$ 692,862

Figure 6-3. High Level Costs by Expense Category (per NOFO)

Expense Category	Amt
Design/Planning/PM/Procurement/Oversight	$ 8,087,417
Install/Test/Integrate/Maintain/Operate	$ 6,422,170
In Vehicle, Roadside, and Pedestrian Devices	$ 4,664,510
Performance Measurement Labor and Hardware	$ 1,702,199
Software Development and Support	$ 806,428
Travel & ODC	$ 414,222
Outreach	$ 332,212
Training	$ 103,410
Infrastructure Adaptions	$ 803,191
Total	$ 23,335,759

Figure 6-4. High Level Costs by Expense Category (Revised)

Appendix A – List of Acronyms

Acronym / Abbreviation	Definition
ADS	Application Development Schedule
AMS	Analysis, Modeling, and Simulation
AO	Agreement Officer
AOR	Agreement Officer Representative
ASD	Aftermarket Safety Devices
ASTC	Advanced Solid-State Traffic Controller
ATC	Advanced Transportation Controller
ATMS	Advanced Traffic Management Systems
BSM	Basic Safety Message
BSW	Blind Spot Warning
CAP	Comprehensive Acquisition Plan
CIP	Comprehensive Installation Plan
CMOP	Comprehensive Maintenance and Operations Plan
ConOps	Concept of Operations
CTP	Comprehensive Transition Plan
CV	Connected Vehicle
CVPD	Connected Vehicle Pilot Deployment
CVRIA	Connected Vehicle Reference Implementation Architecture
DMP	Data Management Plan
DMS	Dynamic Message Sign
DoITT	New York City Department of Information Technology and Telecommunications (DoITT)
DOP	Deployment Outreach Plan
DPP	Data Privacy Plan
DSNY	City of New York Department of Sanitation
DSRC	Dedicated Short Range Communications
EEBL	Emergency Electronics Brake Light
ETC	Electronic Toll Collection
FCC	Federal Communications Commission
FCW	Forward Crash Warning
FHWA	Federal Highway Administration

Acronym / Abbreviation	Definition
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HUAS	Human Use Approval Schedule
I2V	Infrastructure-to-Vehicle
IE	Independent Evaluator
IEEE	Institute of Electrical and Electronics Engineers
IMA	Intersection Movement Assist
IORS	Installation and Operational Readiness Schedule
IRB	Institutional Review Board
I-SIGCVDATA	Intelligent Signal System CV Data
ISO	International Organization for Standardization
ITS	Intelligent Transportation Systems
LCA	Lane Change Warning/Assist
LLL	Lessons Learned Logbook
MAP	Map Data Message
MIM	Midtown In Motion
MOU	Memorandums of Understanding
MTA	Metropolitan Transportation Authority
MTM	Manhattan Traffic Model
NIST	National Institute of Standards and Technology
NOFO	Notice of Funding Opportunity
NRE	Non-Recurring Engineering
NTCIP	National Transportation Communications for Intelligent Transportation Systems Protocol
NTP	Notice to Proceed
NYC	New York City
NYCDOT	New York City Department of Transportation
NYCWiN	New York City Wireless Network
NYSMTA	New York State Motor Truck Association
O&M	Operations and Maintenance
OCSP	Operational Capability Showcase Plan
OCSS	Operational Capability Showcase Summary
OIS	Outreach Implementation Schedule
ORDP	Operational Readiness Demonstration Plan
ORP	Operational Readiness Plan
ORTP	Operational Readiness Test Plan
OTA	Over-the-Air

Acronym / Abbreviation	Definition
PASS	Pedestrians for Accessible and Safe Streets
PED	Pedestrian
PED-SIG	Pedestrian Signal System
PID	Personal Information Device
PII	Personally Identifiable Information
PMBOK	PMI Book of Knowledge
PMESP	Performance Measurement and Evaluation Support Plan
PMESS	Performance Measurement and Evaluation Support Schedule
PMI	Project Management Institute
PMP	Project Management Plan
PoE	Power over Ethernet
PTSEP	Participant Training and Stakeholder Education Plan
RAID	Risk, Action Item, Issue, Decision
RDE	Research Data Exchange
RFEI	Request for Expression of Interest
RFQ	Request for Quote
RSU	Roadside Unit
SAD	Systems Architecture Document
SAE	Society of Automotive Engineers International
SCMS	Security Credential Management System
SDD	System Design Document
SDO	Standards Development Organization
SME	Subject Matter Expert
SMOC	Security Management Operational Concept
SOMS	System Operations and Maintenance Schedule
SPaT	Signal Phase and Timing
SSM	Safety Surrogate Measure
SyRS	System Requirements Specification
TAI	International Atomic Time
TCS	Traffic Control System
TIS	Training Implementation Schedule
TLC	Taxi & Limousine Commission
TMC	Transportation Management Center
UPS	United Parcel Service
USDOT	United States Department of Transportation
UTC	Universal Time Coordinated

Acronym / Abbreviation	Definition
UTRC	University Transportation Research Center
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
VRU	Vulnerable Road User
VTCS	Vehicular Traffic Computerization System
WSA	WAVE Service Advertisement
WAVE	Wireless Access in Vehicular Environment

Appendix B – Project Schedule

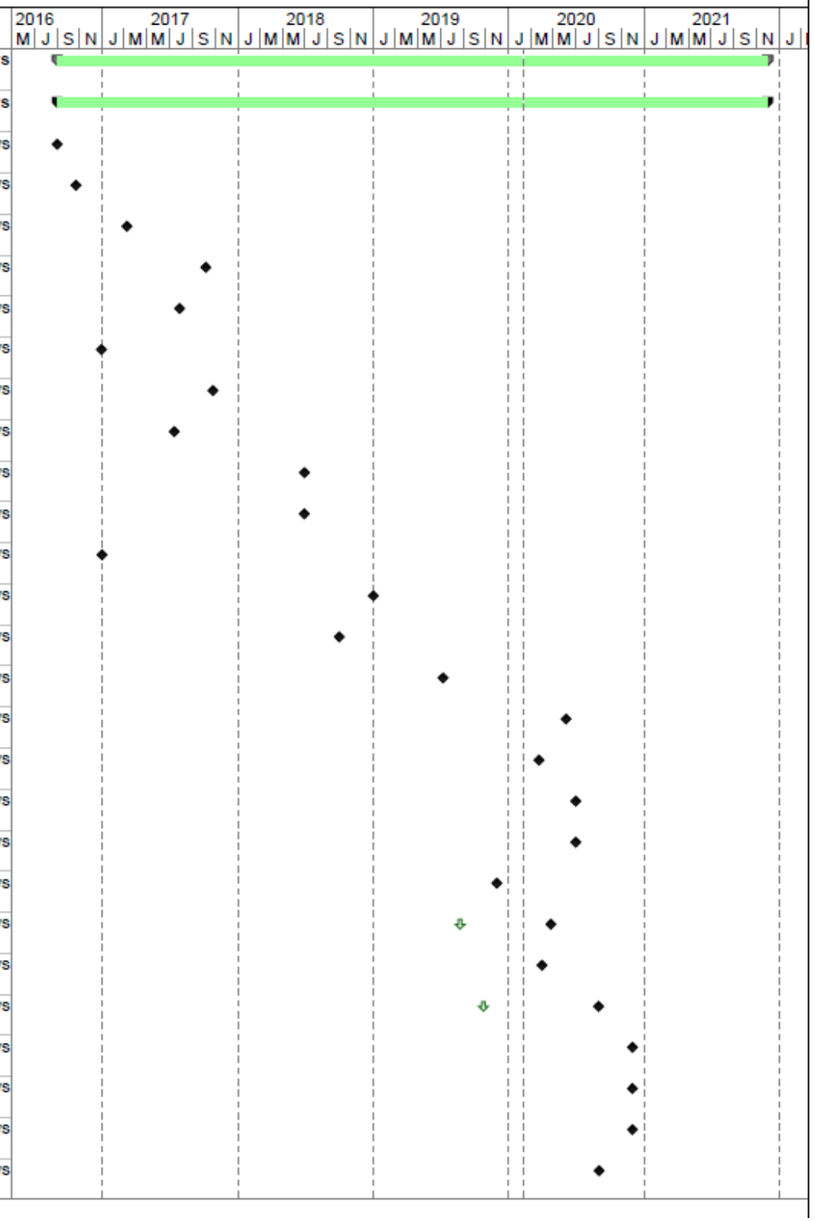
An MS Project Version of the initial schedule is included as an attachment with the application. This schedule will be updated and become the Baseline schedule as described above. A view of this schedule is also provided on the subsequent pages of this document.

Note that this document is being updated in February 2020 and at which point the project is actively deploying ASDs and RSUs with over 350 RSUs and 1400 ASDs already deployed. All the early tasks, meetings, workshops, etc. have been completed and the project is now dealing with the challenges uncovered during the integration at scale; this includes ASD performance, RSU performance, communications performance, data collection and analysis, troubleshooting, application testing, location accuracy testing, and the development of project documentation.

Update Note Feb 2020: While it was the City's intent to purchase ASDs from 2 vendors, and 2 vendors were selected to provide ASDs, one of the vendors (Savari) withdrew for supplying ASDs for the project because they did not want to make the changes needed for data collection and operation and could not meet the required location accuracy within the urban canyons; this same vendor has not been able to have their equipment certified by Omniair as of this update. In this case, the City proceeded with a single ASD vendor.

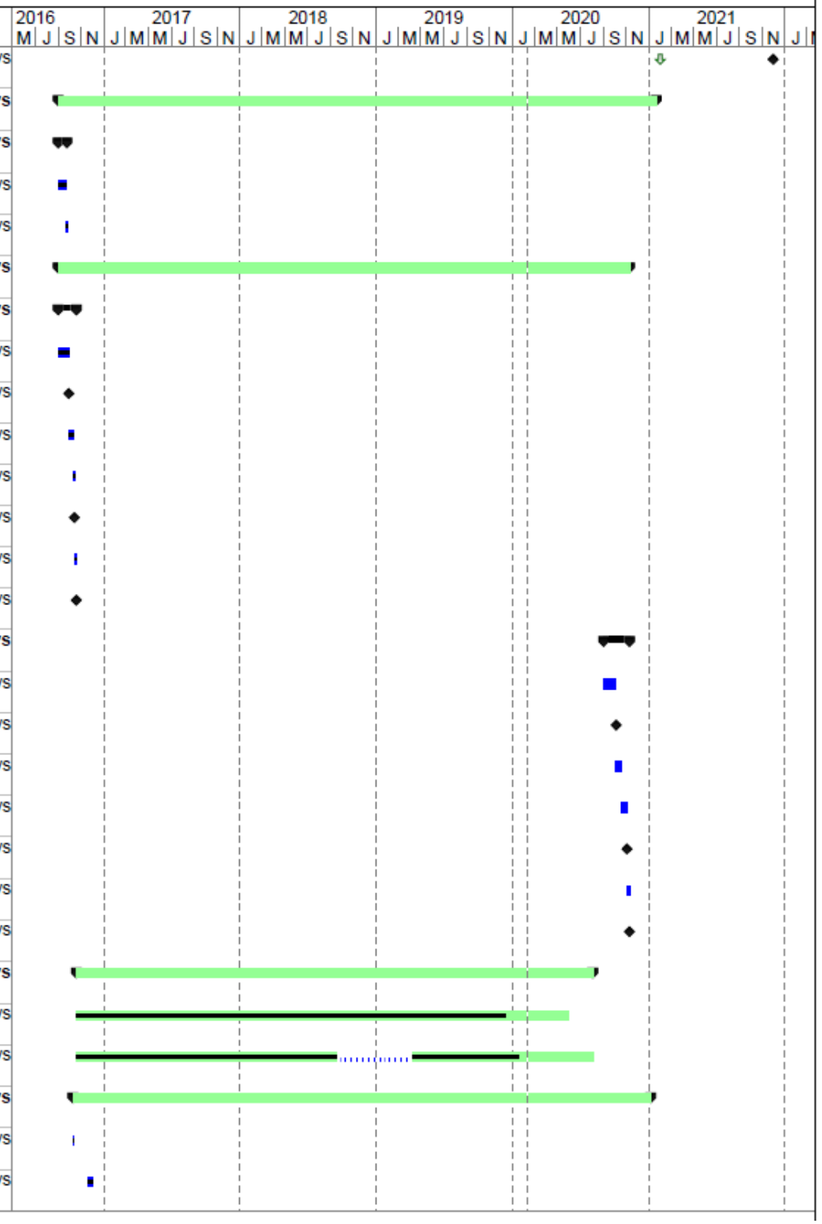
NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
0	0	**NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL with Planned Amendment 6**	75%	1315 days	9/1/16	11/30/21	0 days
1	91	**Key Milestone**	0%	1315 days	9/1/16	11/30/21	-210 days
2	90	Award Date	100%	0 days	9/1/16	9/1/16	0 days
3	753	Baseline Project Management Plan (PMP) Approved	100%	0 days	10/21/16	10/21/16	0 days
4	479	System Architecture Document (SAD) Complete	100%	0 days	3/7/17	3/7/17	0 days
5	480	System Design Document (SDD) Complete	100%	0 days	10/6/17	10/6/17	0 days
6	754	Phase 1 Deliverables Updated	100%	0 days	7/27/17	7/27/17	0 days
7	755	Data Privacy Plan (DPP) Complete	100%	0 days	12/28/16	12/28/16	0 days
8	481	Data Management Plan (DMP) Complete	100%	0 days	10/25/17	10/25/17	0 days
9	482	Comprehensive Acquisition Plan (CAP) - Initial Version Complete	100%	0 days	7/13/17	7/13/17	0 days
10	483	Comprehensive Acquisition Plan (CAP) Updated with HSM Complete	100%	0 days	6/29/18	6/29/18	0 days
11	757	Comprehensive Maintenance and Operations Plan (CMOP) Complete	100%	0 days	6/29/18	6/29/18	0 days
12	485	Device Procurement Started	100%	0 days	12/30/16	12/30/16	0 days
13	3068	Milestone: Prototype Devices Installation Started - ASD	100%	0 days	1/2/19	1/2/19	0 days
14	487	Milestone: Prototype Devices Installation Started - RSU	100%	0 days	10/2/18	10/2/18	0 days
15	489	Milestone: Production Installation Started (Earliest 20%)	100%	0 days	7/9/19	7/9/19	0 days
16	756	Operation Readiness Plan (ORP) Complete	0%	0 days	6/4/20	6/4/20	163 days
17	2903	Phase 2 Installation Complete - PEDs	0%	0 days	3/23/20	3/23/20	215 days
18	3050	Phase 2 Installation Complete - 80% RSUs	0%	0 days	6/30/20	6/30/20	145 days
19	3051	Phase 2 Installation Complete - 100% RSUs	0%	0 days	6/30/20	6/30/20	145 days
20	3048	Phase 2 Installation Complete - 20% ASDs	0%	0 days	11/30/19	11/30/19	292 days
21	490	Operational Readiness Demonstrations Complete	0%	0 days	4/24/20	4/24/20	-245 days
22	3049	Phase 2 Installation Complete - 50% ASDs	0%	0 days	3/31/20	3/31/20	209 days
23	488	Phase 2 Installation Complete - 80% ASDs	0%	0 days	8/31/20	8/31/20	-311 days
24	3052	Phase 2 Installation Complete - 100% ASDs	0%	0 days	11/30/20	11/30/20	41 days
25	1540	Phase 2 Complete - 100% Entire Scope	0%	0 days	11/30/20	11/30/20	62 days
26	1544	Phase 2 Contractual End Date (max 6 months of overlap with Phase 3 Start)	0%	0 days	11/30/20	11/30/20	41 days
27	2442	Phase 3 Start (Overlaps Phase 2; Begins upon Operational Readiness Demo)	0%	0 days	9/1/20	9/1/20	-210 days



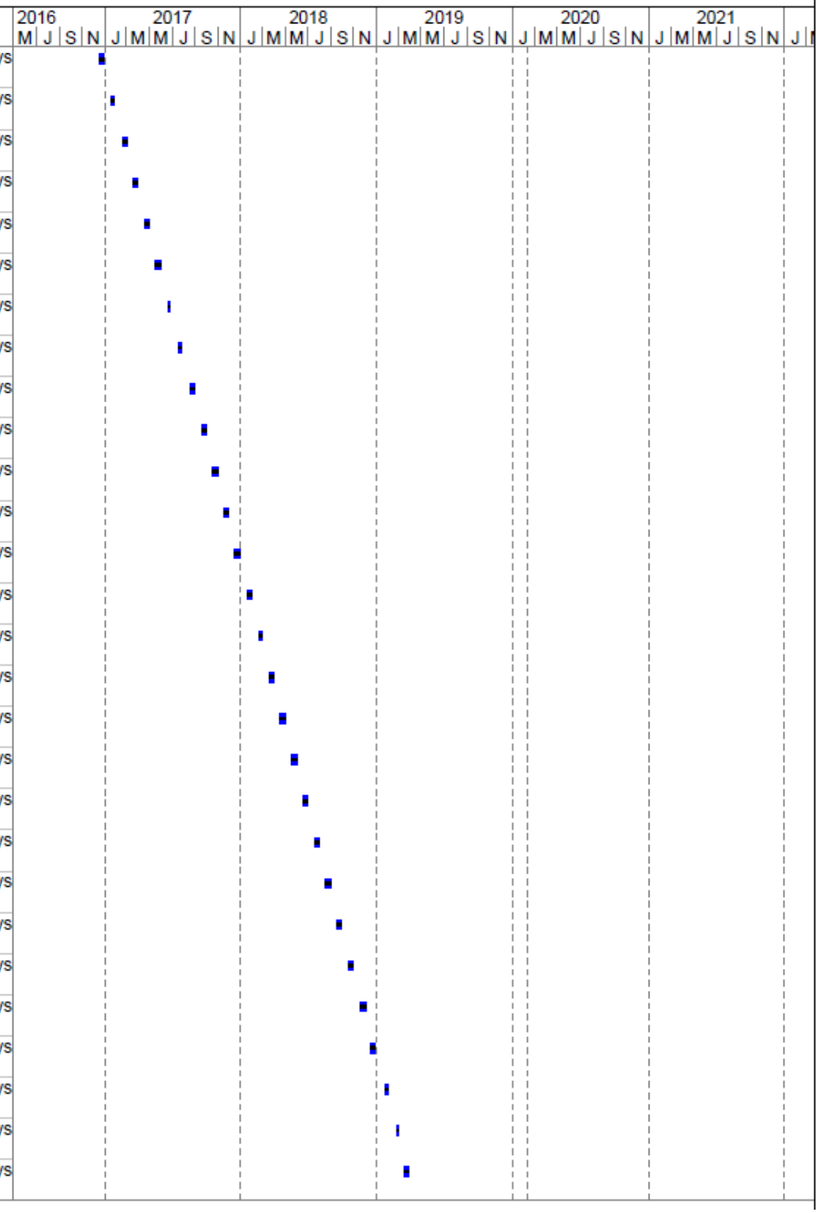
NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
28	2414	Phase 3 Complete - 100%	0%	0 days	11/30/21	11/30/21	-303 days
29	92	**Task 2A/3A: Project Management**	70%	1098 days	9/1/16	1/20/21	7 days
30	1	**Kick-off Meeting**	100%	16 days	9/1/16	9/23/16	0 days
31	126	Prep for Kick Off Meeting	100%	14 days	9/1/16	9/21/16	0 days
32	127	Kick-off Meeting	100%	2 days	9/22/16	9/23/16	0 days
33	2907	**Project Management Plan (PMP)**	83%	1051.5 days	9/1/16	11/10/20	53.5 days
34	2	**Project Management Plan (PMP) - Phase 2**	100%	32.5 days	9/1/16	10/19/16	0 days
35	119	Develop Baseline PMP	100%	19.5 days	9/1/16	9/29/16	0 days
36	120	Submit Draft Baseline PMP to USDOT for review	100%	0 days	9/29/16	9/29/16	0 days
37	121	Baseline PMP Review	100%	8 days	9/29/16	10/12/16	0 days
38	122	Incorporate USDOT Comments Baseline PMP	100%	2 days	10/12/16	10/14/16	0 days
39	123	Submit Final Baseline PMP to USDOT for review	100%	0 days	10/14/16	10/14/16	0 days
40	124	USDOT Review & Approval of Baseline PMP	100%	3 days	10/14/16	10/19/16	0 days
41	125	Baseline PMP Approved	100%	0 days	10/19/16	10/19/16	0 days
42	2434	**Updated Project Management Plan (PMP) - Phase 3**	0%	47.5 days	9/2/20	11/10/20	53.5 days
43	2435	Develop Baseline PMP	0%	22.5 days	9/2/20	10/5/20	53.5 days
44	2436	Submit Draft Baseline PMO to USDOT for review	0%	0 days	10/5/20	10/5/20	53.5 days
45	2437	Baseline PMP Review	0%	10 days	10/5/20	10/20/20	53.5 days
46	2438	Incorporate USDOT Comments Baseline PMP	0%	10 days	10/20/20	11/3/20	53.5 days
47	2439	Submit Final Baseline PMP to USDOT for review	0%	0 days	11/3/20	11/3/20	53.5 days
48	2440	USDOT Review & Approval of Baseline PMP	0%	5 days	11/3/20	11/10/20	53.5 days
49	2441	Baseline PMP Approved	0%	0 days	11/10/20	11/10/20	53.5 days
50	2908	**Project Management Plan (PMP) - Updates**	85%	950.5 days	10/19/16	8/3/20	122 days
51	3	Maintain PMP and Submit as Needed (LOE)	87%	905.5 days	10/19/16	5/29/20	167 days
52	4	Monthly Project Schedule Updates (LOE)	83%	950.5 days	10/19/16	8/3/20	122 days
53	5	**Monthly Progress Reports**	60%	1062 days	10/10/16	1/5/21	17 days
54	736	Month 1 Report	100%	2 days	10/10/16	10/12/16	0 days
55	735	Month 2 Report	100%	7 days	11/21/16	11/30/16	0 days



NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
56	738	Month 3 Report	100%	8 days	12/19/16	12/29/16	0 days
57	737	Month 4 Report	100%	7 days	1/17/17	1/25/17	0 days
58	1043	Month 5 Report	100%	6 days	2/20/17	2/28/17	0 days
59	1042	Month 6 Report	100%	9 days	3/17/17	3/29/17	0 days
60	1214	Month 7 Report	100%	10 days	4/17/17	4/28/17	0 days
61	1216	Month 8 Report	100%	9 days	5/17/17	5/30/17	0 days
62	1235	Month 9 Report	100%	5 days	6/19/17	6/23/17	0 days
63	1355	Month 10 Report	100%	6 days	7/17/17	7/24/17	0 days
64	1357	Month 11 Report	100%	9 days	8/17/17	8/29/17	0 days
65	1514	Month 12 Report	100%	10 days	9/18/17	9/29/17	0 days
66	1515	Month 13 Report	100%	10 days	10/17/17	10/30/17	0 days
67	1516	Month 14 Report	100%	7 days	11/17/17	11/28/17	0 days
68	1670	Month 15 Report	100%	10 days	12/15/17	12/29/17	0 days
69	1669	Month 16 Report	100%	9 days	1/18/18	1/30/18	0 days
70	1796	Month 17 Report	100%	7 days	2/20/18	2/28/18	0 days
71	1795	Month 18 Report	100%	10 days	3/19/18	3/30/18	0 days
72	1797	Month 19 Report	100%	10 days	4/17/18	4/30/18	0 days
73	2384	Month 20 Report	100%	9 days	5/18/18	5/31/18	0 days
74	2383	Month 21 Report	100%	8 days	6/18/18	6/27/18	0 days
75	2413	Month 22 Report	100%	10 days	7/18/18	7/31/18	0 days
76	2412	Month 23 Report	100%	10 days	8/17/18	8/30/18	0 days
77	2411	Month 24 Report	100%	10 days	9/17/18	9/28/18	0 days
78	2843	Month 25 Report	100%	10 days	10/17/18	10/30/18	0 days
79	2844	Month 26 Report	100%	10 days	11/19/18	12/3/18	0 days
80	2845	Month 27 Report	100%	8 days	12/17/18	12/27/18	0 days
81	2846	Month 28 Report	100%	5 days	1/25/19	1/31/19	0 days
82	2847	Month 29 Report	100%	4 days	2/25/19	2/28/19	0 days
83	2848	Month 30 Report	100%	10 days	3/18/19	3/29/19	0 days



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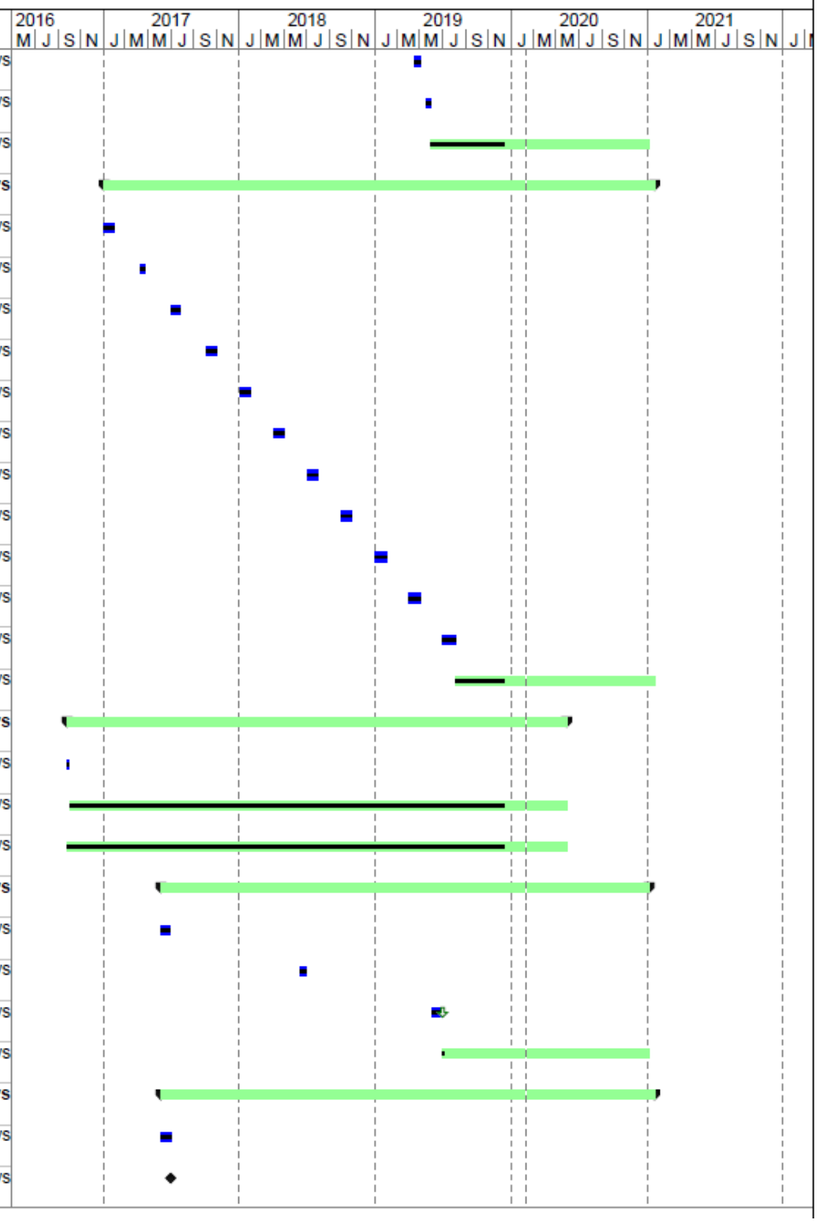
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
84	2849	Month 31 Report	100%	10 days	4/17/19	4/30/19	0 days
85	2850	Month 32 Report	100%	10 days	5/17/19	5/31/19	0 days
86	739	Add additional monthly reports to schedule	33%	400 days	6/1/19	1/5/21	17 days
87	740	**Quarterly Financial Reports (SF-425)**	**52%**	**1016 days**	**1/3/17**	**1/20/21**	**7 days**
88	746	Financial Report Through Dec 2016	100%	19 days	1/3/17	1/30/17	0 days
89	745	Financial Report Through Mar 2017	100%	9 days	4/10/17	4/20/17	0 days
90	744	Financial Report Through Jun 2017	100%	17 days	7/3/17	7/26/17	0 days
91	743	Financial Report Through Sep 2017	100%	19 days	10/3/17	10/30/17	0 days
92	741	Financial Report Through Dec 2017	100%	19 days	1/3/18	1/30/18	0 days
93	749	Financial Report Through Mar 2018	100%	20 days	4/3/18	4/30/18	0 days
94	2385	Financial Report Through Jun 2018	100%	20 days	7/3/18	7/31/18	0 days
95	2416	Financial Report Through Sep 2018	100%	20 days	10/3/18	10/31/18	0 days
96	2415	Financial Report Through Dec 2018	100%	21 days	1/2/19	1/31/19	0 days
97	2851	Financial Report Through Mar 2019	100%	21 days	4/2/19	4/30/19	0 days
98	2852	Financial Report Through Jun 2019	100%	25 days	7/1/19	8/5/19	0 days
99	748	Add additional Financial Reports to Schedule	24%	365 days	8/6/19	1/20/21	7 days
100	2906	**Teleconferences**	**87%**	**922 days**	**9/26/16**	**5/29/20**	**167 days**
101	438	Organize & Schedule Bi-Weekly Coordination Teleconferences	100%	5 days	9/26/16	9/30/16	0 days
102	6	Participate in Bi-Weekly Coordination Teleconferences (LOE)	87%	917 days	10/3/16	5/29/20	167 days
103	7	Participate in Monthly All-Site Coordination teleconferences (LOE)	87%	922 days	9/26/16	5/29/20	167 days
104	750	**Annual Budget Review and Program Plan**	**12%**	**900 days**	**6/5/17**	**1/5/21**	**17 days**
105	751	Year 1 Report	100%	18 days	6/5/17	6/28/17	0 days
106	2323	Year 2 Report	100%	9 days	6/15/18	6/27/18	0 days
107	2417	Year 3 Report	100%	19 days	6/4/19	6/28/19	0 days
108	752	Add future years as needed	1%	380 days	7/1/19	1/5/21	17 days
109	1114	**SF-428(S) Submittal (60 Days Prior to Contract Year End)**	**35%**	**910 days**	**6/5/17**	**1/20/21**	**7 days**
110	1115	Prepare Year 1 Report	100%	20 days	6/5/17	6/30/17	0 days
111	1117	Submit Year 1 Report	100%	0 days	6/30/17	6/30/17	0 days



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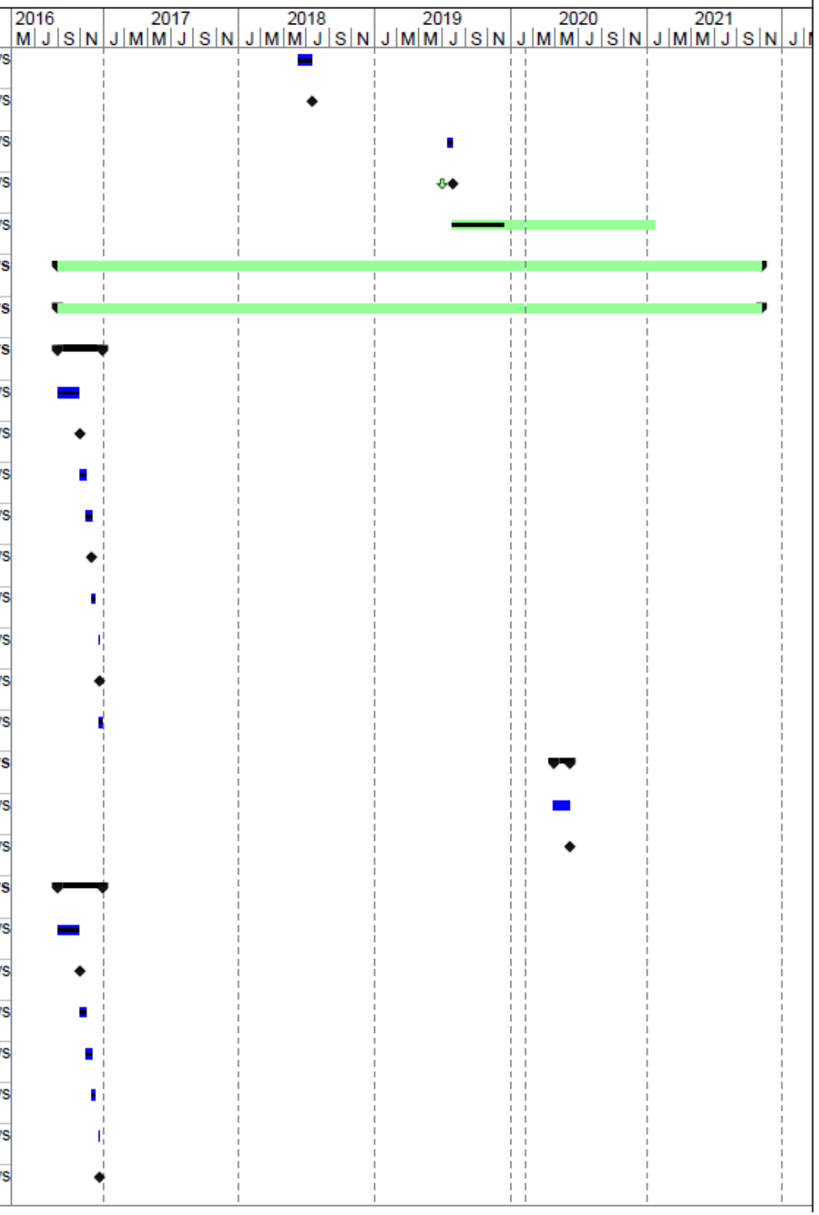
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
112	2325	Prepare Year 2 Report	100%	25 days	6/11/18	7/16/18	0 days
113	2326	Submit Year 2 Report	100%	0 days	7/16/18	7/16/18	0 days
114	2420	Prepare Year 3 Report	100%	9 days	7/17/19	7/29/19	0 days
115	2419	Submit Year 3 Report	100%	0 days	7/29/19	7/29/19	0 days
116	1116	Add future years as needed	25%	370 days	7/30/19	1/20/21	7 days
117	**2475**	**Task 2J/3C: Stakeholder Outreach**	**80%**	**1300 days**	**9/1/16**	**11/5/21**	**15 days**
118	**2476**	**DOP and OIS**	**84%**	**1300 days**	**9/1/16**	**11/5/21**	**15 days**
119	**2477**	**Revised Deployment Outreach Plan (DOP)**	**100%**	**82 days**	**9/1/16**	**12/30/16**	**0 days**
120	2478	Prepare Revised Deployment Outreach Plan (DOP)	100%	40 days	9/1/16	10/28/16	0 days
121	2479	Submit to USDOT - DOP	100%	0 days	10/31/16	10/31/16	0 days
122	2480	USDOT Review of DOP	100%	12 days	10/31/16	11/16/16	0 days
123	2481	Prepare Revised Final Draft Revised DOP	100%	9 days	11/17/16	11/30/16	0 days
124	2482	Submit Revised Final Draft Revised DOP	100%	0 days	11/30/16	11/30/16	0 days
125	2483	USDOT Review/Approval of DOP	100%	6 days	12/1/16	12/8/16	0 days
126	2484	Address USDOT Comments on DOP	100%	2 days	12/21/16	12/22/16	0 days
127	2485	Submit Revised Final Draft Revised DOP	100%	0 days	12/22/16	12/22/16	0 days
128	2486	USDOT Review/Approval of DOP	100%	5 days	12/23/16	12/30/16	0 days
129	**2487**	**As Built Deployment Outreach Plan (DOP)**	**0%**	**30 days**	**4/27/20**	**6/8/20**	**161 days**
130	2488	Prepare As Built Deployment Outreach Plan (DOP)	0%	30 days	4/27/20	6/8/20	161 days
131	2489	Submit to USDOT - DOP	0%	0 days	6/8/20	6/8/20	161 days
132	**2490**	**Initial Outreach Implementation Schedule (OIS)**	**100%**	**82 days**	**9/1/16**	**12/30/16**	**0 days**
133	2491	Prepare Initial Outreach Implementation Schedule (OIS)	100%	40 days	9/1/16	10/28/16	0 days
134	2492	Submit to USDOT (OIS)	100%	0 days	10/31/16	10/31/16	0 days
135	2493	Review Initial Outreach Implementation Schedule (OIS)	100%	12 days	10/31/16	11/16/16	0 days
136	2494	Update Initial Outreach Implementation Schedule (OIS)	100%	9 days	11/17/16	11/30/16	0 days
137	2495	Review/Approve Initial Outreach Implementation Schedule (OIS)	100%	6 days	12/1/16	12/8/16	0 days
138	2496	Address USDOT Comments on OIS	100%	2 days	12/21/16	12/22/16	0 days
139	2497	Submit Revised Final Draft Revised OIS	100%	0 days	12/22/16	12/22/16	0 days



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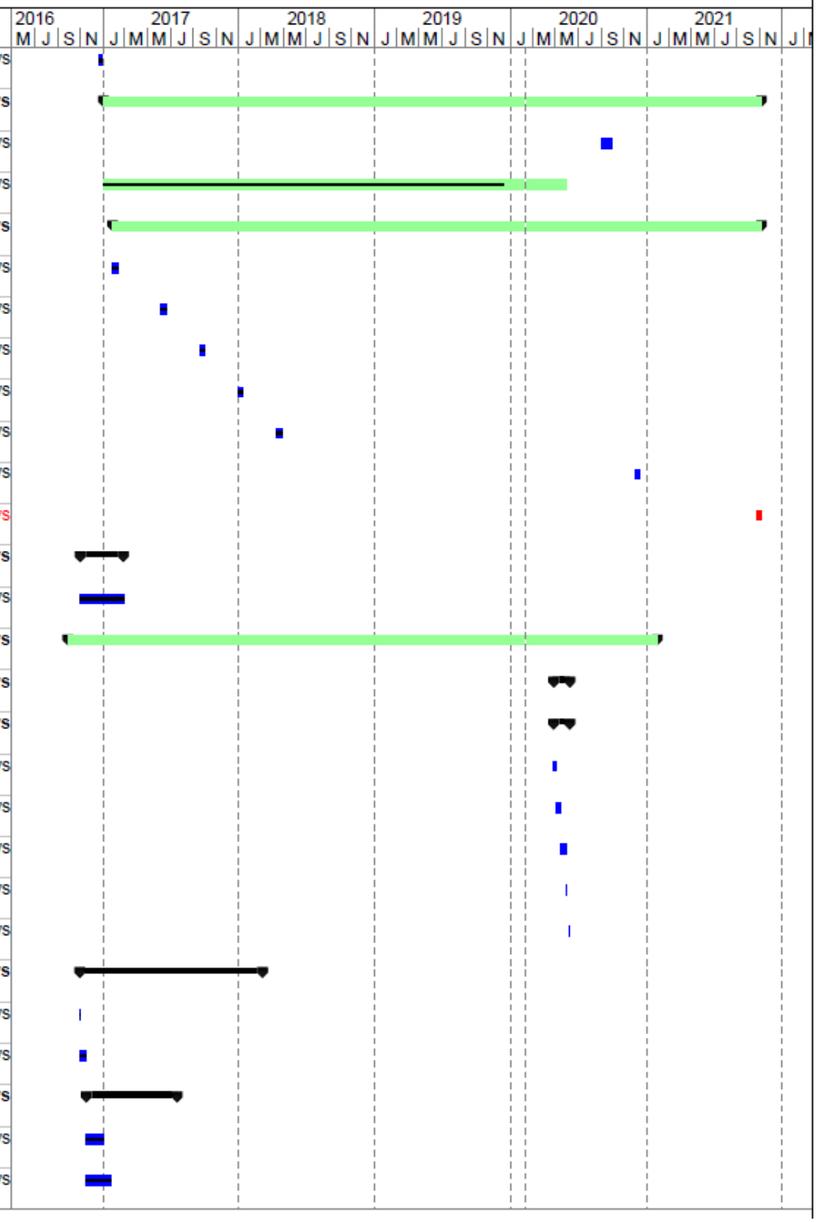
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
140	2498	USDOT Review/Approval of OIS	100%	5 days	12/23/16	12/30/16	0 days
141	**2910**	**Updates - DOP and OIS**	**83%**	**1218 days**	**1/2/17**	**11/5/21**	**15 days**
142	2782	Phase 3 OIS (and possibly DOP) Initial Phase 3 Update	0%	20 days	9/2/20	9/30/20	81 days
143	2499	Updated OIS with Progress/Risk Summary - included in monthly status report and schedule updates (LOE)	86%	856 days	1/2/17	5/29/20	167 days
144	**2500**	**Updated Deployment Outreach Plan (Reviewed Quarterly)**	**71%**	**1201 days**	**1/27/17**	**11/5/21**	**15 days**
145	2501	DOP Quarterly Review 1	100%	10 days	1/27/17	2/9/17	0 days
146	2502	DOP Quarterly Review 2	100%	10 days	6/6/17	6/19/17	0 days
147	2503	DOP Quarterly Review 3	100%	10 days	9/18/17	9/29/17	0 days
148	2504	DOP Quarterly Review 4	100%	10 days	12/29/17	1/12/18	0 days
149	2505	DOP Quarterly Review 5	100%	10 days	4/13/18	4/26/18	0 days
150	2784	DOP Quarterly Review 6 (Changed to End of Phase 2)	0%	10 days	12/1/20	12/14/20	241 days
151	2783	DOP Quarterly Review 7 (Changed to End of Phase 3)	0%	10 days	10/25/21	11/5/21	-195 days
152	**2506**	**Crisis Response Plan**	**100%**	**78 days**	**11/1/16**	**2/24/17**	**0 days**
153	2507	Develop a Plan - Crisis Response	100%	78 days	11/1/16	2/24/17	0 days
154	**2508**	**Outreach Materials**	**79%**	**1086 days**	**9/29/16**	**1/29/21**	**0 days**
155	**2509**	**Press Conference (One per year)**	**0%**	**30 days**	**4/27/20**	**6/8/20**	**161 days**
156	**2510**	**Year 1 (start of installation) - Press Conference**	**0%**	**30 days**	**4/27/20**	**6/8/20**	**161 days**
157	2512	Prepare Press Conference Material	0%	6 days	4/27/20	5/4/20	161 days
158	2513	NYCDOT Approval of Press Conference Material	0%	7 days	5/5/20	5/13/20	161 days
159	2514	USDOT Approval of Press Conference Material	0%	10 days	5/14/20	5/28/20	161 days
160	2515	Press Conference Scheduled	0%	1 day	5/29/20	5/29/20	161 days
161	2516	Press Conference Held (Year 1)	0%	1 day	6/8/20	6/8/20	161 days
162	**2517**	**Video**	**100%**	**335 days**	**10/31/16**	**3/5/18**	**0 days**
163	2518	Schedule Video Preparation Kick Off Meeting	100%	1 day	10/31/16	10/31/16	0 days
164	2519	Prepare workplan for Video Preparation	100%	11 days	11/1/16	11/16/16	0 days
165	**2520**	**Prepare Video**	**100%**	**167 days**	**11/17/16**	**7/18/17**	**0 days**
166	2521	Storyboard/Script - Video	100%	31 days	11/17/16	1/3/17	0 days
167	2522	Finalize Branding - Video	100%	43 days	11/17/16	1/20/17	0 days



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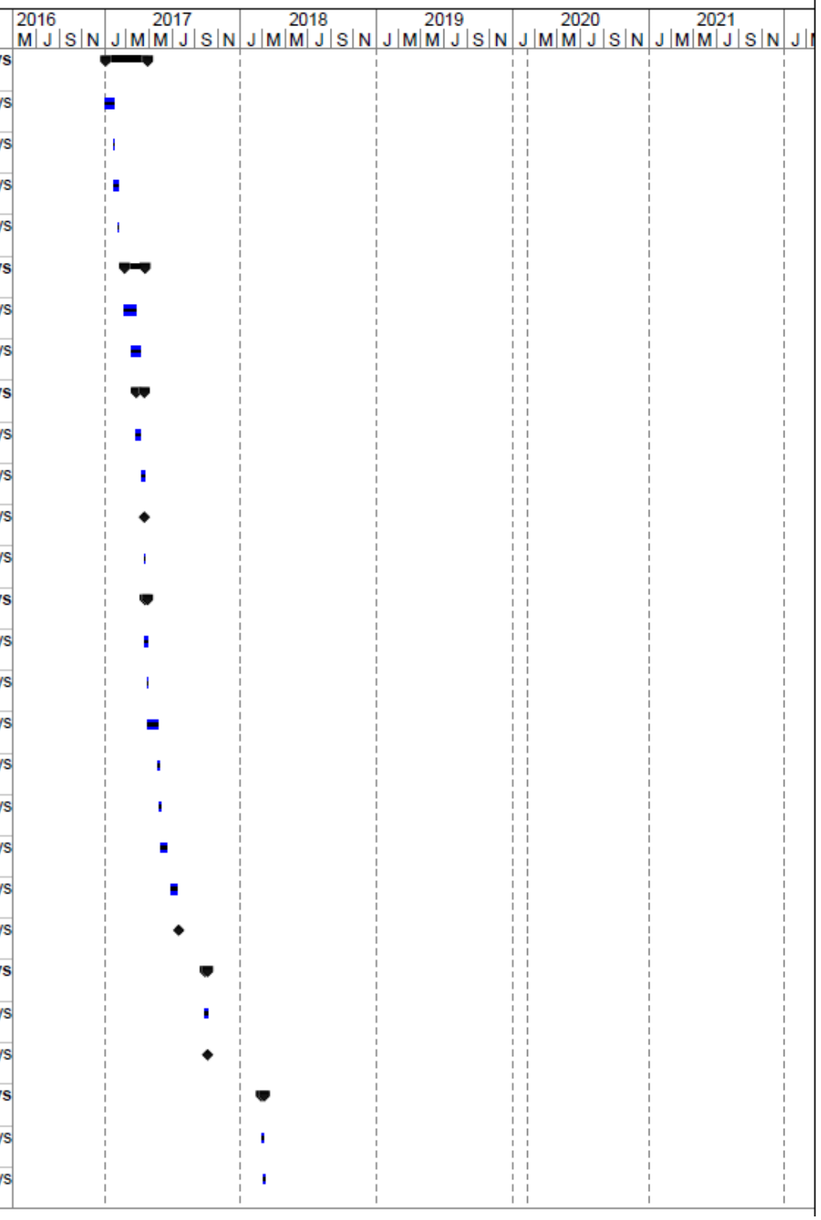
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
168	**2523**	**Video, Audio, Slide Preparation**	**100%**	**79 days**	**1/4/17**	**4/26/17**	**0 days**
169	2524	Prepare Early Draft of Each Section - Video	100%	13 days	1/4/17	1/23/17	0 days
170	2525	Early Draft Review Meeting - Video	100%	1 day	1/24/17	1/24/17	0 days
171	2526	Prepare 2nd Draft - Video	100%	9 days	1/25/17	2/6/17	0 days
172	2527	Review 2nd Draft - Video	100%	1 day	2/7/17	2/7/17	0 days
173	**2528**	**Prepare 3rd Draft - Video**	**100%**	**39 days**	**2/24/17**	**4/19/17**	**0 days**
174	2529	Storyboard/Script - Video	100%	21 days	2/24/17	3/24/17	0 days
175	2530	Filming - Video	100%	18 days	3/13/17	4/5/17	0 days
176	**2531**	**Prepare Video Draft**	**100%**	**16 days**	**3/27/17**	**4/17/17**	**0 days**
177	2532	Part 1 - Video	100%	10 days	3/27/17	4/7/17	0 days
178	2533	Parts 2&3 - Video	100%	6 days	4/10/17	4/17/17	0 days
179	2534	Provide Draft for Internal Review - Video	100%	0 days	4/17/17	4/17/17	0 days
180	2535	Internal Review of Draft 3 - Video	100%	2 days	4/18/17	4/19/17	0 days
181	**2536**	**Draft 4 - Video**	**100%**	**5 days**	**4/20/17**	**4/26/17**	**0 days**
182	2537	Video Prep - Video	100%	3 days	4/20/17	4/24/17	0 days
183	2538	Internal Review - Video	100%	2 days	4/25/17	4/26/17	0 days
184	2539	Final NYC Review - Video	100%	20 days	4/27/17	5/24/17	0 days
185	2540	Final Edits - Video	100%	2 days	5/25/17	5/26/17	0 days
186	2541	Submit to USDOT - Video	100%	2 days	5/29/17	5/31/17	0 days
187	2542	USDOT Review - Video	100%	10 days	6/1/17	6/14/17	0 days
188	2543	Update video to include accessibility features for visually impaired - Video	100%	9 days	6/30/17	7/13/17	0 days
189	2544	Post Video on Website - Video	100%	0 days	7/18/17	7/18/17	0 days
190	**2545**	**Video Update 1 (if needed) - Video**	**100%**	**5 days**	**9/28/17**	**10/4/17**	**0 days**
191	2546	Review Video and Determine Need for Updates - Video	100%	5 days	9/28/17	10/4/17	0 days
192	2547	Make Updates - Video	100%	0 days	10/4/17	10/4/17	0 days
193	**2548**	**Video Update 2 (if needed) - Video**	**100%**	**6 days**	**2/26/18**	**3/5/18**	**0 days**
194	2549	Review Video and Determine Need for Updates - Video	100%	5 days	2/26/18	3/2/18	0 days
195	2550	Make Updates (not needed) - Video	100%	1 day	3/5/18	3/5/18	0 days



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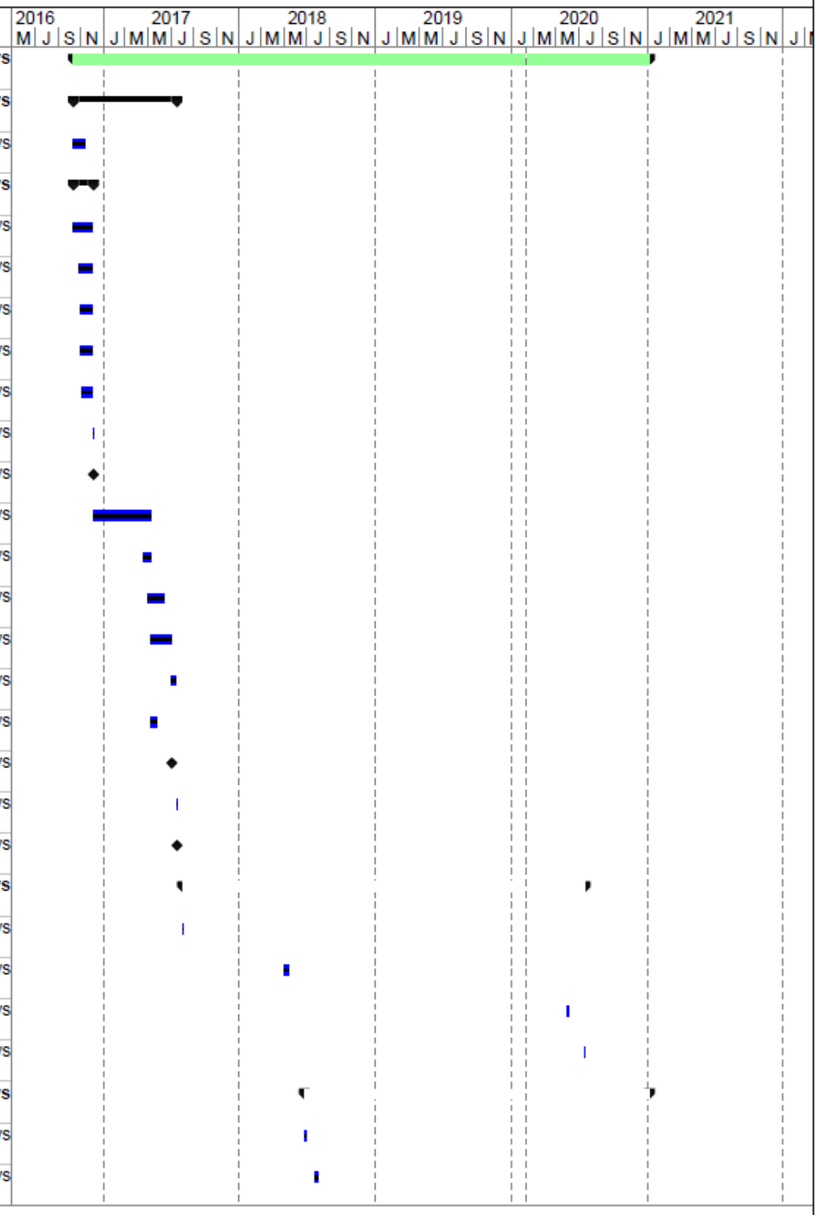
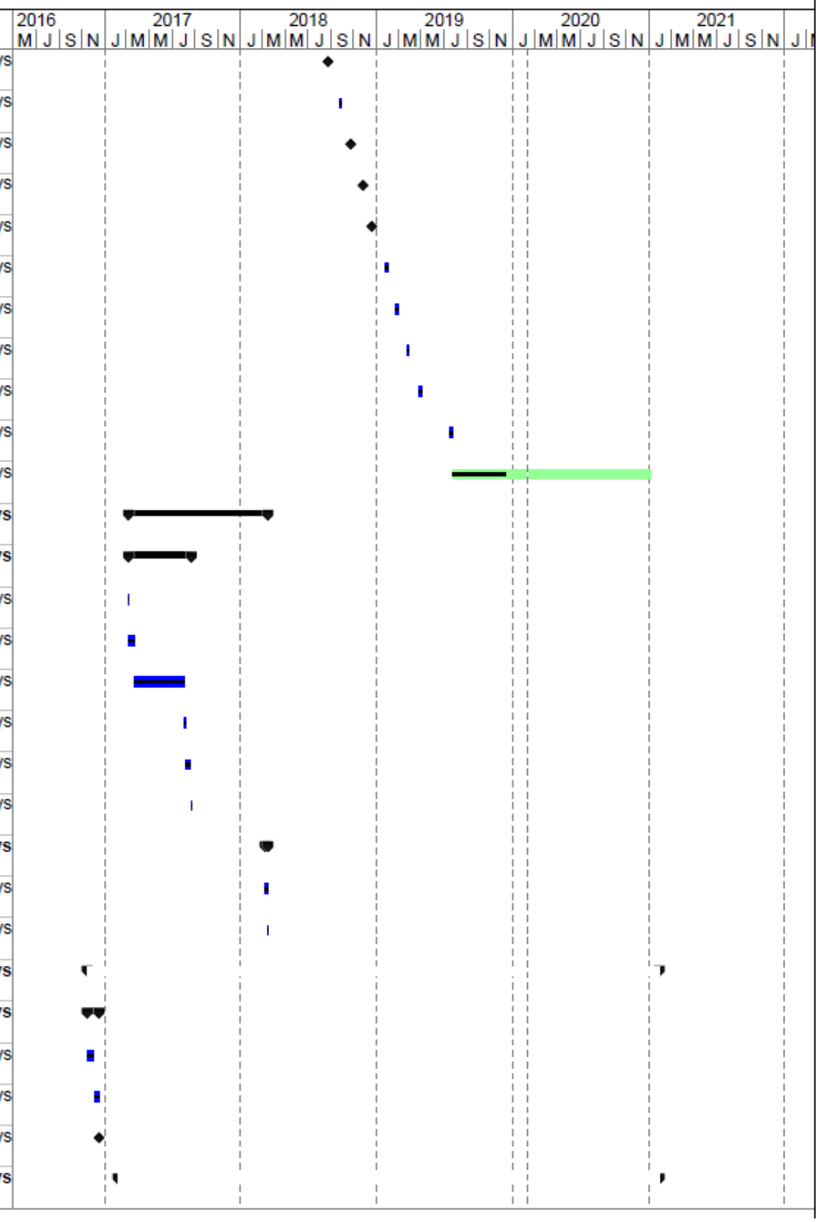
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
196	**2551**	**Website**	**65%**	**1061 days**	**10/13/16**	**1/6/21**	**16 days**
197	**2552**	**Initial Website Development**	**100%**	**190 days**	**10/13/16**	**7/17/17**	**0 days**
198	2553	Requirements Development - Website	100%	21 days	10/13/16	11/10/16	0 days
199	**2554**	**Prototype Build - Website**	**100%**	**36 days**	**10/13/16**	**12/5/16**	**0 days**
200	2555	UI/UX - Website	100%	34 days	10/13/16	12/1/16	0 days
201	2556	Accessibility - Website	100%	26 days	10/26/16	12/2/16	0 days
202	2557	Structure - Website	100%	23 days	10/31/16	12/2/16	0 days
203	2558	Survey - Website	100%	21 days	11/2/16	12/2/16	0 days
204	2559	Acquia Build - Website	100%	18 days	11/4/16	12/1/16	0 days
205	2560	Prototype Demo - Website	100%	1 day	12/5/16	12/5/16	0 days
206	2561	Requirements Validation - Website	100%	0 days	12/5/16	12/5/16	0 days
207	2562	Website Build - Website	100%	106 days	12/6/16	5/8/17	0 days
208	2563	Initial Content Finalization - Website	100%	14 days	4/19/17	5/8/17	0 days
209	2564	Accessibility Assessment - Website	100%	29 days	5/2/17	6/12/17	0 days
210	2565	Final QA/Test - Website	100%	39 days	5/9/17	7/3/17	0 days
211	2566	Security / Vulnerability Assessment - Website	100%	8 days	7/4/17	7/14/17	0 days
212	2567	Training - Website	100%	10 days	5/9/17	5/22/17	0 days
213	2568	CTO Review/ CCB Approval - Website	100%	0 days	7/3/17	7/3/17	0 days
214	2569	Go Live Prep - Website	100%	1 day	7/17/17	7/17/17	0 days
215	2570	Go Live - Website	100%	0 days	7/17/17	7/17/17	0 days
216	**2571**	**Key Website Updates**	**85%**	**743 days**	**8/2/17**	**7/17/20**	**133 days**
217	2572	Post Link to Press Release 2 (Not Held) - Website	100%	1 day	8/2/17	8/2/17	0 days
218	2575	Planned Website Content Review/Update - Milestone 3 - Website	100%	10 days	4/30/18	5/11/18	0 days
219	2574	Post Notice of Press Conference - Website	0%	1 day	6/1/20	6/1/20	165 days
220	2573	Post Link to Press Release 3 - Website	0%	1 day	7/17/20	7/17/20	133 days
221	**2787**	**Monthly Content Review - Website**	**34%**	**636 days**	**6/25/18**	**1/6/21**	**16 days**
222	2786	June 2018 - Website	100%	5 days	6/25/18	6/29/18	0 days
223	2790	July 2018 - Website	100%	5 days	7/24/18	7/30/18	0 days



NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
224	2853	August 2018 (Not submitted due to installation and procurement delays) - Website	100%	0 days	8/24/18	8/24/18	0 days
225	2854	September 2018 - Website	100%	5 days	9/24/18	9/28/18	0 days
226	2855	October 2018 - Website (Not Held; Suspended pending Contract)	100%	0 days	10/24/18	10/24/18	0 days
227	2856	November 2018 - Website (Not Held; Suspended pending Contract)	100%	0 days	11/26/18	11/26/18	0 days
228	2857	December 2018 - Website (Not Held; Suspended pending Contract)	100%	0 days	12/20/18	12/20/18	0 days
229	2858	January 2019 - Website	100%	5 days	1/25/19	1/31/19	0 days
230	2859	February 2019 - Website	100%	5 days	2/22/19	2/28/19	0 days
231	2860	March 2019 - Website	100%	5 days	3/25/19	3/29/19	0 days
232	2861	April 2019 - Website	100%	5 days	4/24/19	4/30/19	0 days
233	2862	May 2019 - Website	100%	5 days	7/17/19	7/23/19	0 days
234	2791	Add more reviews as needed - Website	27%	365 days	7/24/19	1/6/21	16 days
235	**2576**	**Project Brochure**	**100%**	**259 days**	**3/6/17**	**3/15/18**	**0 days**
236	**2577**	**Prepare Brochure**	**100%**	**119 days**	**3/6/17**	**8/21/17**	**0 days**
237	2578	Schedule Brochure & Fact Sheet Preparation Kick Off Meeting	100%	1 day	3/6/17	3/6/17	0 days
238	2579	Prepare workplan for Brochure & Fact Sheet Preparation	100%	10 days	3/7/17	3/20/17	0 days
239	2580	Prepare Brochure	100%	96 days	3/21/17	8/3/17	0 days
240	2581	Send to USDOT - Project Brochure	100%	1 day	8/4/17	8/4/17	0 days
241	2582	USDOT Review - Project Brochure	100%	10 days	8/7/17	8/18/17	0 days
242	2583	Project Brochure Posted on Website	100%	1 day	8/21/17	8/21/17	0 days
243	**2584**	**Brochure Update**	**100%**	**6 days**	**3/8/18**	**3/15/18**	**0 days**
244	2585	Review Brochure and Determine Need for Updates	100%	5 days	3/8/18	3/14/18	0 days
245	2586	Make Updates (not needed) - Project Brochure	100%	1 day	3/15/18	3/15/18	0 days
246	**2587**	**One Page Fact Sheet**	**92%**	**1055 days**	**11/15/16**	**1/29/21**	**0 days**
247	**2588**	**Initial Fact Sheet Development**	**100%**	**23 days**	**11/15/16**	**12/16/16**	**0 days**
248	2589	Prepare Fact Sheet Information	100%	13 days	11/15/16	12/2/16	0 days
249	2590	USDOT Formating and Review - One Page Fact Sheet	100%	10 days	12/5/16	12/16/16	0 days
250	2591	Initial Fact Sheet Complete	100%	0 days	12/16/16	12/16/16	0 days
251	**2911**	**One Page Fact Sheet - Updates**	**90%**	**1000 days**	**2/6/17**	**1/29/21**	**0 days**



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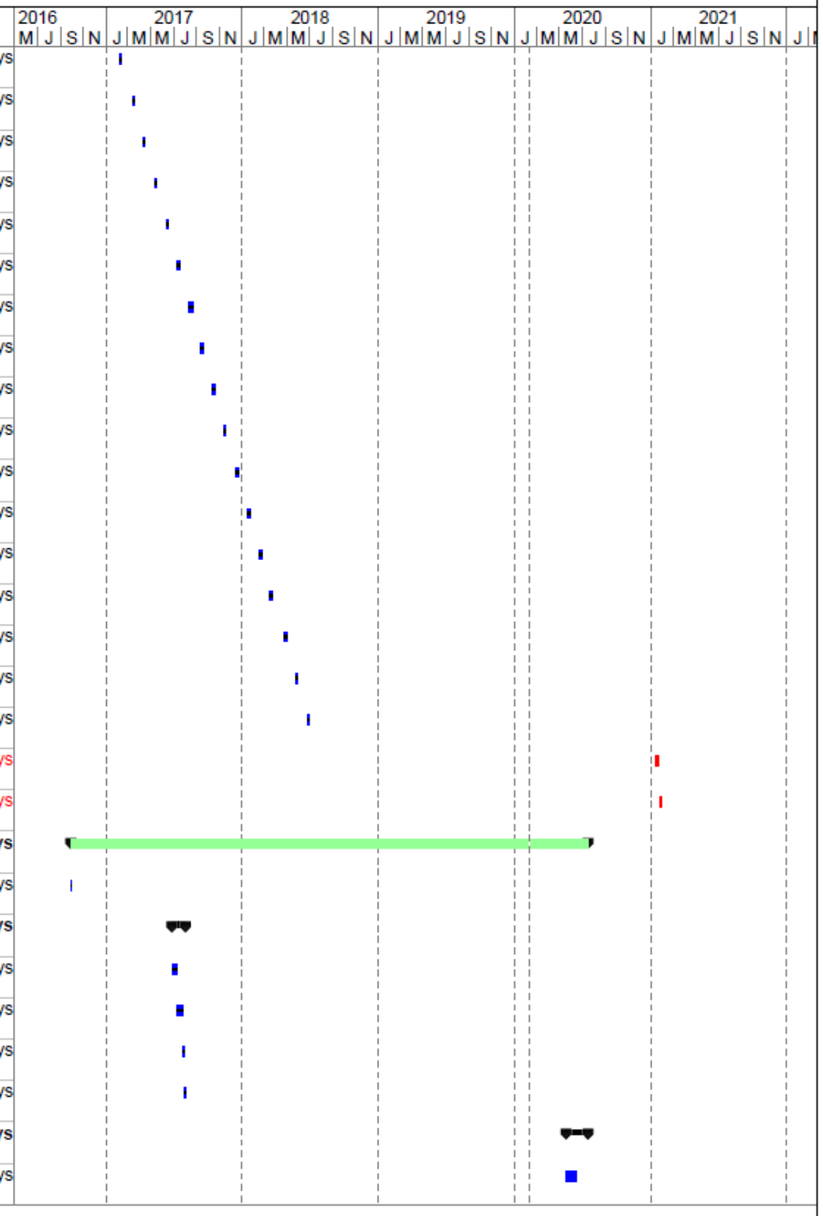
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
252	2592	Review/Update 1 - One Page Fact Sheet	100%	5 days	2/6/17	2/10/17	0 days
253	2593	Review/Update 2 - One Page Fact Sheet	100%	5 days	3/13/17	3/17/17	0 days
254	2594	Review/Update 3 - One Page Fact Sheet	100%	5 days	4/10/17	4/14/17	0 days
255	2595	Review/Update 4 - One Page Fact Sheet	100%	5 days	5/11/17	5/17/17	0 days
256	2596	Review/Update 5 - One Page Fact Sheet	100%	5 days	6/12/17	6/16/17	0 days
257	2597	Review/Update 6 - One Page Fact Sheet	100%	5 days	7/11/17	7/17/17	0 days
258	2598	Review/Update 7 - One Page Fact Sheet	100%	8 days	8/11/17	8/22/17	0 days
259	2599	Review/Update 8 - One Page Fact Sheet	100%	5 days	9/13/17	9/19/17	0 days
260	2600	Review/Update 9 - One Page Fact Sheet	100%	5 days	10/13/17	10/19/17	0 days
261	2601	Review/Update 10 - One Page Fact Sheet	100%	5 days	11/13/17	11/17/17	0 days
262	2602	Review/Update 11 - One Page Fact Sheet	100%	5 days	12/14/17	12/20/17	0 days
263	2603	Review/Update 12 - One Page Fact Sheet	100%	5 days	1/16/18	1/22/18	0 days
264	2604	Review/Update 13 - One Page Fact Sheet	100%	4 days	2/16/18	2/22/18	0 days
265	2605	Review/Update 14 - One Page Fact Sheet	100%	5 days	3/16/18	3/22/18	0 days
266	2819	Review/Update 15 - One Page Fact Sheet	100%	5 days	4/24/18	4/30/18	0 days
267	2818	Review/Update 16 - One Page Fact Sheet	100%	4 days	5/24/18	5/30/18	0 days
268	2821	Review/Update 17 - One Page Fact Sheet	100%	5 days	6/25/18	6/29/18	0 days
269	2820	Review/Update 18 - One Page Fact Sheet	0%	5 days	1/15/21	1/22/21	0 days
270	2788	Add additional updates as needed - One Page Fact Sheet	0%	5 days	1/25/21	1/29/21	0 days
271	**2606**	**Press Releases**	**39%**	**952 days**	**9/29/16**	**7/16/20**	**133 days**
272	2607	Press Release 1 (start of Project)	100%	1 day	9/29/16	9/29/16	0 days
273	**2608**	**CANCELED Press Release 2 (Launch of Website) - Press Office determined that this should not be sent**	**100%**	**25 days**	**6/27/17**	**8/1/17**	**0 days**
274	2609	Prepare Press Release	100%	9 days	6/27/17	7/10/17	0 days
275	2610	NYCDOT Approval of Press Release	100%	10 days	7/11/17	7/24/17	0 days
276	2611	USDOT Approval of Press Release	100%	5 days	7/25/17	7/31/17	0 days
277	2612	Press Release Posted	100%	1 day	8/1/17	8/1/17	0 days
278	**2613**	**Press Release 3 (End of Phase 2)**	**0%**	**41 days**	**5/19/20**	**7/16/20**	**133 days**
279	2614	Prepare Press Release	0%	20 days	5/19/20	6/16/20	133 days



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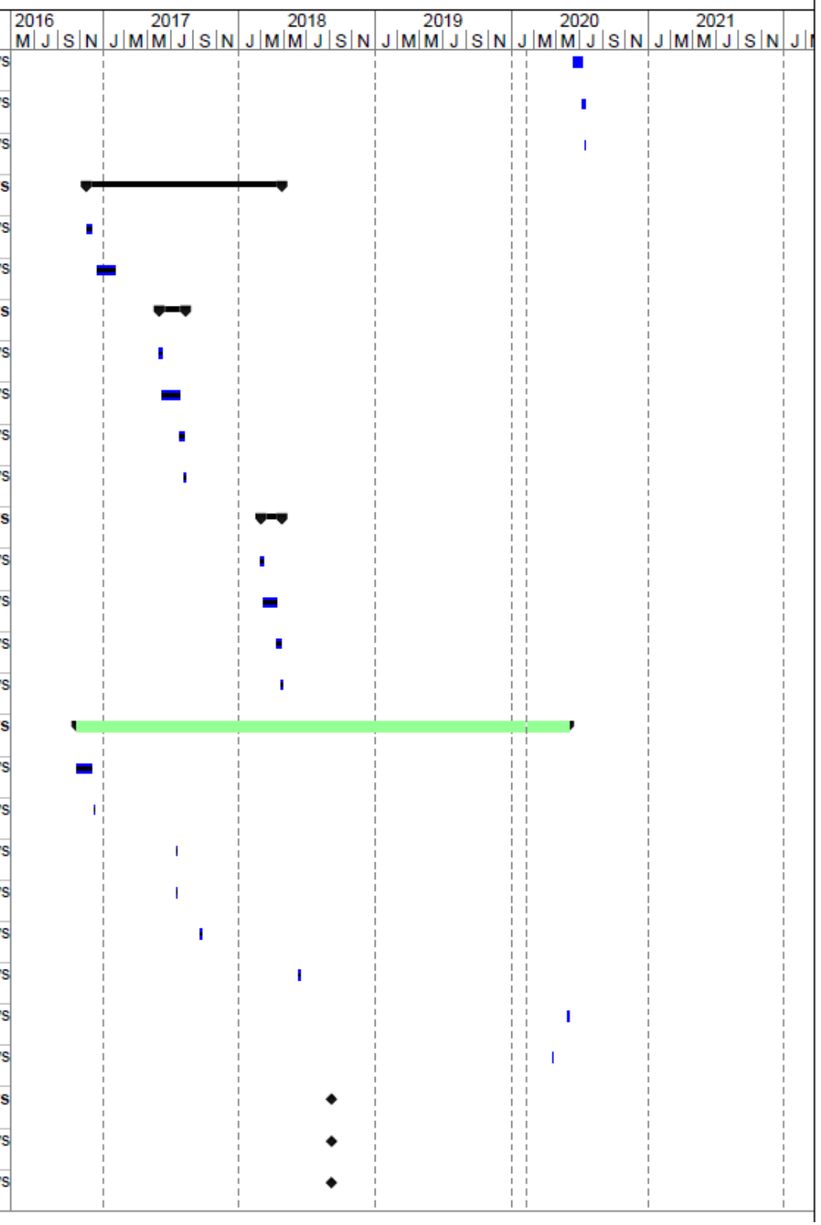
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
280	2615	NYCDOT Approval of Press Release	0%	15 days	6/17/20	7/8/20	133 days
281	2616	USDOT Approval of Press Release	0%	5 days	7/9/20	7/15/20	133 days
282	2617	Press Release Completed	0%	1 day	7/16/20	7/16/20	133 days
283	**2618**	**NYCDOT Newsletter Articles**	**100%**	**359 days**	**11/18/16**	**4/25/18**	**0 days**
284	2619	Develop Newsletter Plan	100%	9 days	11/18/16	12/1/16	0 days
285	2620	Prepare and Publish NYCDOT Newsletter Article 1	100%	32 days	12/16/16	2/2/17	0 days
286	**2621**	**Prepare and Publish NYCDOT Newsletter Article 2**	**100%**	**50 days**	**6/1/17**	**8/10/17**	**0 days**
287	2622	Decide on Topic - NYCDOT Newsletter Article 2	100%	4 days	6/1/17	6/6/17	0 days
288	2623	Prepare Article - NYCDOT Newsletter Article 2	100%	34 days	6/7/17	7/25/17	0 days
289	2624	Internal Review and Finalization - NYCDOT Newsletter Article 2	100%	10 days	7/26/17	8/8/17	0 days
290	2625	Submit to Newsletter Team - NYCDOT Newsletter Article 2	100%	2 days	8/9/17	8/10/17	0 days
291	**2626**	**Prepare and Publish NYCDOT Newsletter Article 3**	**100%**	**40 days**	**3/1/18**	**4/25/18**	**0 days**
292	2627	Decide on Topic - NYCDOT Newsletter Article 3	100%	4 days	3/1/18	3/6/18	0 days
293	2628	Prepare Article - NYCDOT Newsletter Article 3	100%	24 days	3/7/18	4/9/18	0 days
294	2629	Internal Review and Finalization - NYCDOT Newsletter Article 3	100%	10 days	4/10/18	4/23/18	0 days
295	2630	Submit to Newsletter Team - NYCDOT Newsletter Article 3	100%	2 days	4/24/18	4/25/18	0 days
296	**2631**	**Social Media Posts**	**94%**	**904 days**	**10/24/16**	**6/1/20**	**166 days**
297	2632	Establish Social Media Posting Process	100%	28 days	10/24/16	12/2/16	0 days
298	2633	Social Media Post 1	100%	1 day	12/8/16	12/8/16	0 days
299	2634	Social Media Post - Notice of Web Site Launch	100%	1 day	7/18/17	7/18/17	0 days
300	2636	Social Media Post - Release of Video	100%	1 day	7/19/17	7/19/17	0 days
301	2637	Social Media Post - System Architecture/Design Webinar	100%	1 day	9/21/17	9/21/17	0 days
302	2638	Social Media Post - Application Development and Deployment Progress Webinar	100%	1 day	6/12/18	6/12/18	0 days
303	2635	Social Media Post - Notice of Press Conference	0%	1 day	6/1/20	6/1/20	166 days
304	2639	Social Media Post - End of Phase 2	0%	1 day	4/21/20	4/21/20	194 days
305	**2640**	**Public Meetings within Boroughs (On Hold at this time)**	**100%**	**0 days**	**9/6/18**	**9/6/18**	**0 days**
306	2641	Decide if Public Meetings should be removed from the Outreach Plan (Symposium Replaces per Mohamad)	100%	0 days	9/6/18	9/6/18	0 days
307	2642	Map out Schedule - Public Meetings within Boroughs (Not required)	100%	0 days	9/6/18	9/6/18	0 days



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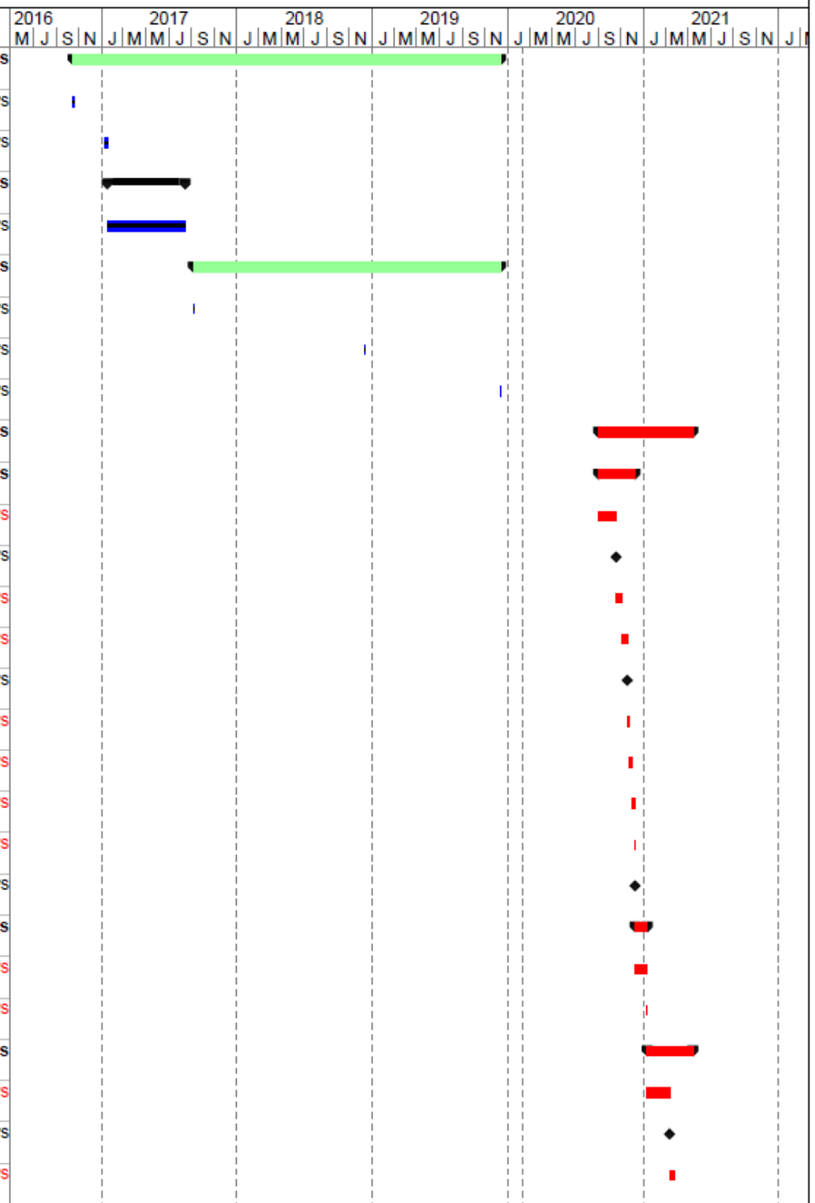
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
308	2643	**Trade Journal Articles**	99%	793 days	10/17/16	12/13/19	282 days
309	2644	Initial Call for AuthorsTrade Journal Articles	100%	1 day	10/17/16	10/17/16	0 days
310	2645	Follow-Up with Targeted Authors and Map Out PlanTrade Journal Articles	100%	2 days	1/12/17	1/16/17	0 days
311	2646	**Year 1 (3 Articles) - Only 1 completed - Trade Journal Articles**	100%	147 days	1/17/17	8/14/17	0 days
312	2647	Article Preparation & Publishing - Trade Journal Articles	100%	147 days	1/17/17	8/14/17	0 days
313	2648	**Year 2 (3 Articles - Overlaps with Phase 3) - Trade Journal Articles**	67%	570 days	9/6/17	12/13/19	282 days
314	2892	Trade Journal Article Preparation & Publishing - Publication 01 - ITE Journal	100%	1 day	9/6/17	9/6/17	0 days
315	2891	Trade Journal Article Preparation & Publishing - Publication 02	100%	1 day	12/12/18	12/12/18	0 days
316	2649	Trade Journal Article Preparation & Publishing - Publication 03	0%	1 day	12/13/19	12/13/19	282 days
317	2756	**Operational Capability Showcase**	0%	175 days	9/2/20	5/14/21	-74 days
318	2757	**Operational Capability Showcase Plan (OCSP)**	0%	67 days	9/2/20	12/9/20	-74 days
319	2758	Prepare Draft OCSP	0%	32 days	9/2/20	10/19/20	-74 days
320	2759	Submit Draft OCSP	0%	0 days	10/19/20	10/19/20	-74 days
321	2760	USDOT Review of Draft OCSP	0%	10 days	10/20/20	11/2/20	-74 days
322	2761	Prepare Revised Draft OCSP	0%	11 days	11/3/20	11/18/20	-74 days
323	2762	Submit Revised Draft OCSP with Comment Resolution Report	0%	0 days	11/18/20	11/18/20	-74 days
324	2763	USDOT Review of Revised Draft OCSP	0%	5 days	11/19/20	11/25/20	-74 days
325	2764	Prepare Final OCSP	0%	3 days	11/26/20	12/1/20	-74 days
326	2765	USDOT Review and Approval of Final OCSP	0%	5 days	12/2/20	12/8/20	-74 days
327	2766	Final Section 508 Edits of OCSP	0%	1 day	12/9/20	12/9/20	-74 days
328	2767	OCSP Complete	0%	0 days	12/9/20	12/9/20	-74 days
329	2768	**Operational Capability Showcase**	0%	21 days	12/10/20	1/11/21	-74 days
330	2769	Prepare for Operational Capability Showcase	0%	20 days	12/10/20	1/8/21	-74 days
331	2770	Hold Operational Capability Showcase	0%	1 day	1/11/21	1/11/21	-74 days
332	2771	**Operational Capability Showcase Summary (OCSS)**	0%	87 days	1/12/21	5/14/21	-74 days
333	2772	Prepare Draft OCSS	0%	42 days	1/12/21	3/12/21	-74 days
334	2773	Submit Draft OCSS	0%	0 days	3/12/21	3/12/21	-74 days
335	2774	USDOT Review of Draft OCSS	0%	10 days	3/15/21	3/26/21	-74 days



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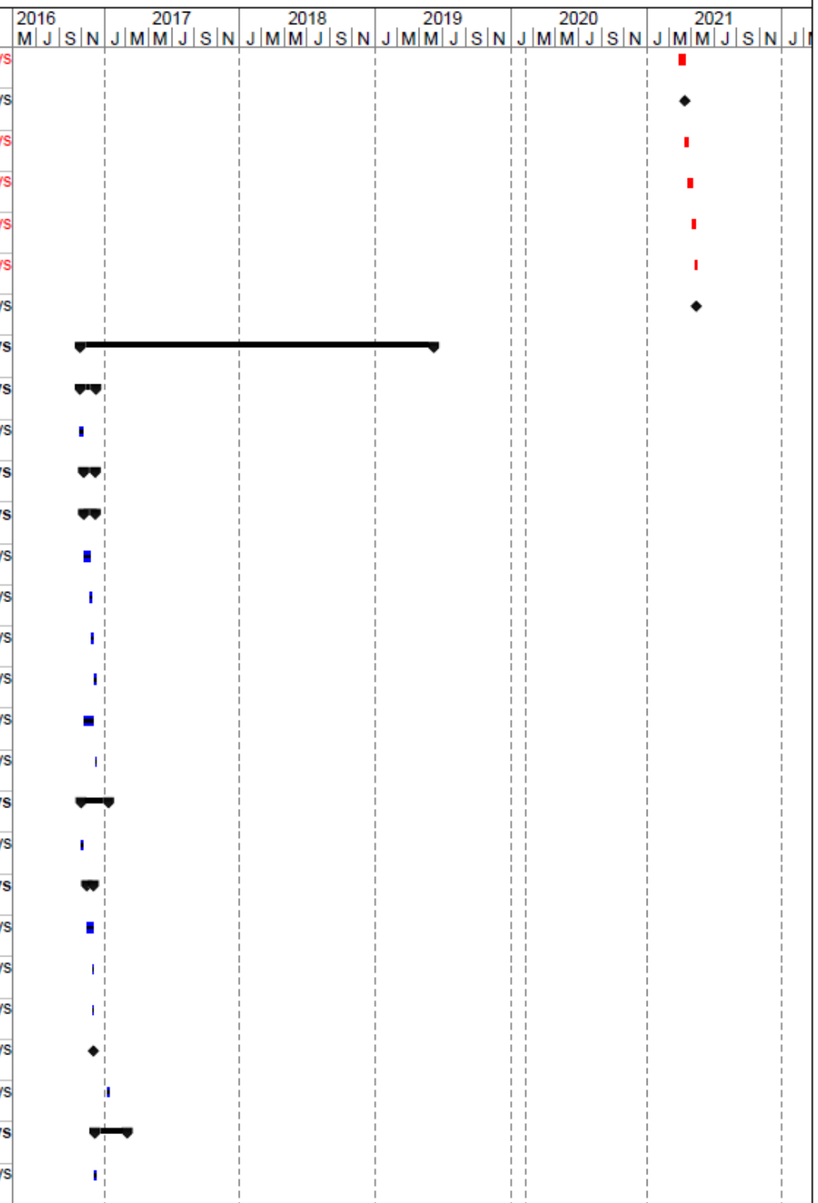
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
336	2775	Prepare Revised Draft OCSS	0%	12 days	3/29/21	4/13/21	-74 days
337	2776	Submit Revised Draft OCSS with Comment Resolution Report	0%	0 days	4/13/21	4/13/21	-74 days
338	2777	USDOT Review of Revised Draft OCSS	0%	5 days	4/14/21	4/20/21	-74 days
339	2778	Prepare Final OCSS	0%	10 days	4/21/21	5/4/21	-74 days
340	2779	USDOT Review and Approval of Final OCSS	0%	5 days	5/5/21	5/11/21	-74 days
341	2780	Final Section 508 Edits of OCSS	0%	3 days	5/12/21	5/14/21	-74 days
342	2781	OCSS Complete	0%	0 days	5/14/21	5/14/21	-74 days
343	2650	**Trade Shows and Conferences**	100%	654 days	10/28/16	6/7/19	0 days
344	2651	**UTRC Symposium**	100%	29 days	10/28/16	12/9/16	0 days
345	2652	Confirm participation - UTRC Symposium	100%	6 days	10/28/16	11/4/16	0 days
346	2653	**Prepare for Symposium**	100%	21 days	11/7/16	12/7/16	0 days
347	2654	**Two Page Flyer**	100%	21 days	11/7/16	12/7/16	0 days
348	2655	Prepare Draft Flyer - UTRC Symposium	100%	12 days	11/7/16	11/23/16	0 days
349	2656	Editor Review - UTRC Symposium	100%	1 day	11/24/16	11/25/16	0 days
350	2657	Final Review & Updates - UTRC Symposium	100%	5 days	11/28/16	12/2/16	0 days
351	2658	Print - UTRC Symposium	100%	3 days	12/5/16	12/7/16	0 days
352	2659	Prepare Materials - UTRC Symposium	100%	18 days	11/7/16	12/2/16	0 days
353	2660	Attend UTRC Symposium	100%	2 days	12/8/16	12/9/16	0 days
354	2661	**TRB 2017 Annual Meeting**	100%	49.9 days	10/31/16	1/12/17	0 days
355	2662	Begin Planning for TRB 2017 Annual Meeting	100%	3 days	10/31/16	11/2/16	0 days
356	2663	**Prepare Fact Sheet Content**	100%	13 days	11/15/16	12/2/16	0 days
357	2664	Prepare Fact Sheet Content - TRB 2017 Annual Meeting	100%	10 days	11/15/16	11/29/16	0 days
358	2665	Internal Review of Fact Sheet Content - TRB 2017 Annual Meeting	100%	2 days	11/30/16	12/1/16	0 days
359	2666	Final Updates for Fact Sheet Content - TRB 2017 Annual Meeting	100%	1 day	12/2/16	12/2/16	0 days
360	2667	Submit Fact Sheet Content to Mike Pina - TRB 2017 Annual Meeting	100%	0 days	12/2/16	12/2/16	0 days
361	2668	Attend TRB 2017 Annual Meeting (TBD)	100%	3.9 days	1/9/17	1/12/17	0 days
362	2669	**2017 SXSW Interactive Festival**	100%	59 days	12/7/16	3/3/17	0 days
363	2670	Begin Planning for 2017 SXSW Interactive Festival	100%	3 days	12/7/16	12/9/16	0 days



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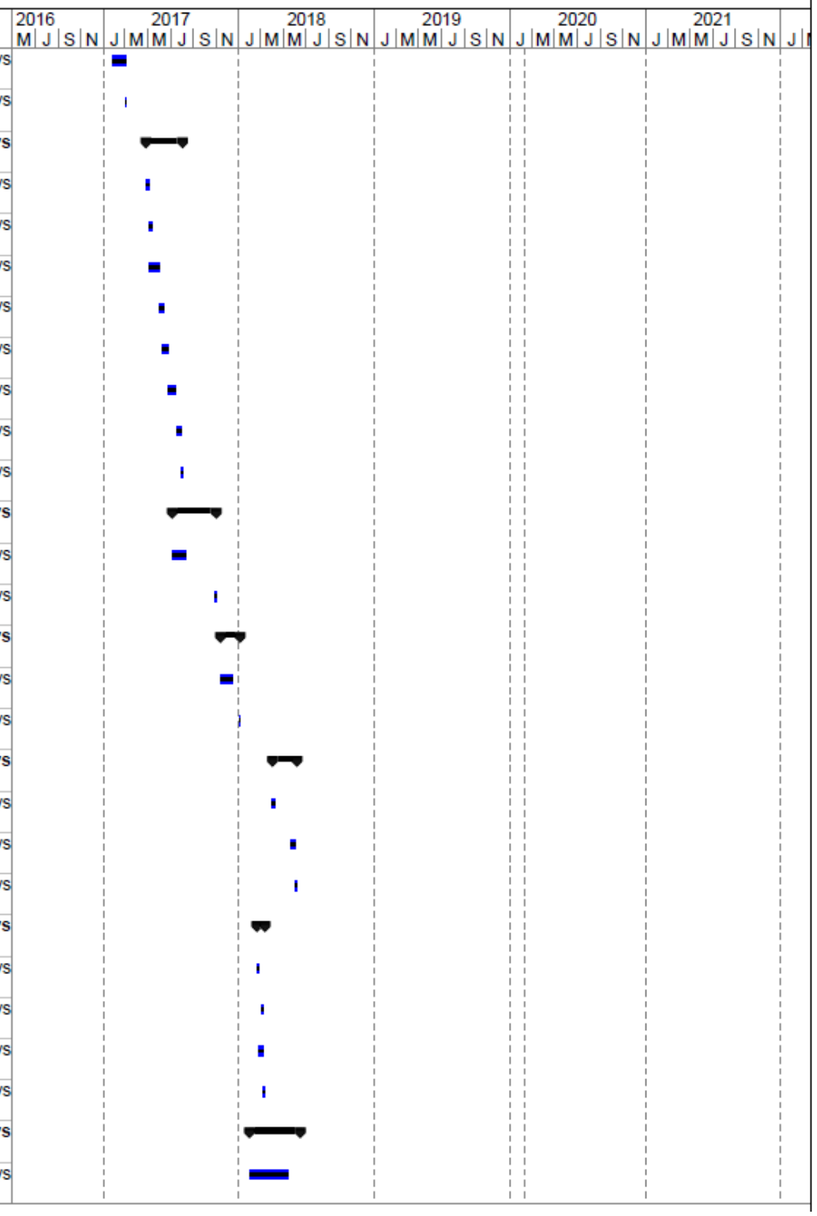
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
364	2671	Prepare Presentation for SXSW	100%	27 days	1/25/17	3/3/17	0 days
365	2672	Attend 2017 SXSW Interactive Festival (TBD)	100%	2.9 days	3/1/17	3/3/17	0 days
366	**2673**	**ITE Annual Meeting 2017**	**100%**	**68.9 days**	**4/26/17**	**8/2/17**	**0 days**
367	2674	Begin Planning for ITE Annual Meeting 2017	100%	7 days	4/26/17	5/4/17	0 days
368	2675	Finalize speaker list for ITE	100%	7 days	5/4/17	5/12/17	0 days
369	2676	Decide on Format for ITE Booth Pop-Up Banner - ITE Annual Meeting 2017	100%	20 days	5/4/17	6/1/17	0 days
370	2677	Develop Banner for ITE Booth - ITE Annual Meeting 2017	100%	8 days	6/2/17	6/13/17	0 days
371	2678	Decide on Handouts for ITE Booth - ITE Annual Meeting 2017	100%	12 days	6/8/17	6/23/17	0 days
372	2679	Develop Handouts for ITE Booth - ITE Annual Meeting 2017	100%	14 days	6/26/17	7/14/17	0 days
373	2680	Ship Materials to Ontario - ITE Annual Meeting 2017	100%	10 days	7/17/17	7/28/17	0 days
374	2681	Attend ITE Annual Meeting 2017	100%	2.9 days	7/31/17	8/2/17	0 days
375	**2682**	**24th World Congress on ITS**	**100%**	**83 days**	**7/5/17**	**11/1/17**	**0 days**
376	2683	Begin Planning for 24th World Congress on ITS	100%	25 days	7/5/17	8/9/17	0 days
377	2684	Attend 24th World Congress on ITS (TBD)	100%	2.9 days	10/30/17	11/1/17	0 days
378	**2685**	**TRB 2018 Annual Meeting**	**100%**	**35.9 days**	**11/13/17**	**1/4/18**	**0 days**
379	2686	Begin Planning for TRB 2018 Annual Meeting	100%	24 days	11/13/17	12/15/17	0 days
380	2687	Attend TRB 2018 Annual Meeting (TBD)	100%	2.9 days	1/2/18	1/4/18	0 days
381	**2688**	**ITS America Annual Meeting & Expo**	**100%**	**47 days**	**4/2/18**	**6/6/18**	**0 days**
382	2689	Request Approval - ITS America Annual Meeting & Expo	100%	5 days	4/2/18	4/6/18	0 days
383	2690	Prepare Presentation - ITS America Annual Meeting & Expo	100%	9 days	5/21/18	6/1/18	0 days
384	2691	Attend Meeting - ITS America Annual Meeting & Expo	100%	3 days	6/4/18	6/6/18	0 days
385	**2692**	**SXSW 2018**	**100%**	**15 days**	**2/19/18**	**3/12/18**	**0 days**
386	2693	Prepare Booth Materials - SXSW 2018	100%	4 days	2/19/18	2/23/18	0 days
387	2694	Ship Booth Materials - SXSW 2018	100%	5 days	3/2/18	3/8/18	0 days
388	2695	Prepare Presentation - SXSW 2018	100%	10 days	2/23/18	3/8/18	0 days
389	2696	Attend Meeting - SXSW 2018	100%	2 days	3/9/18	3/12/18	0 days
390	**2697**	**ITS NY - 2018**	**100%**	**97 days**	**1/30/18**	**6/15/18**	**0 days**
391	2698	Determine Attendees - ITS NY 2018	100%	74 days	1/30/18	5/14/18	0 days



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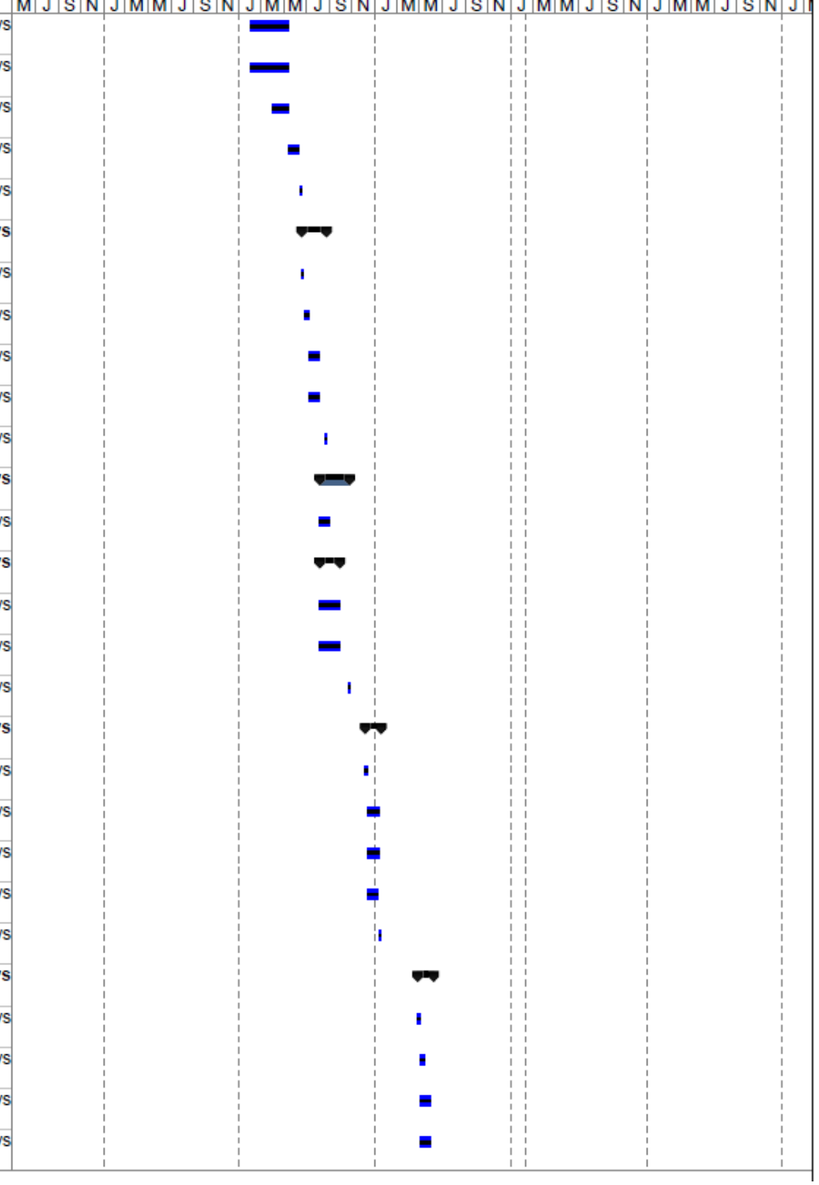
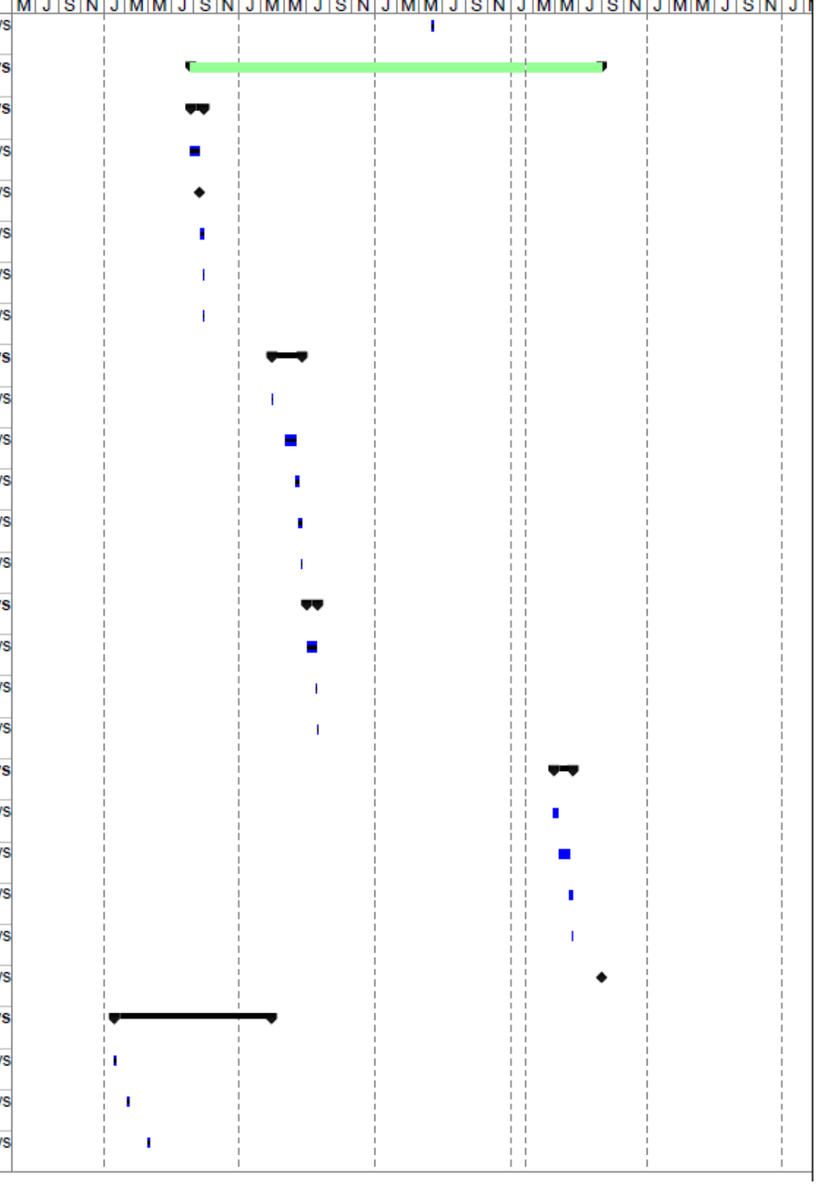
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
392	2699	Coordinate NYC Speakers and Attendees - ITS NY 2018	100%	74 days	1/30/18	5/14/18	0 days
393	2700	Coordinate CV Vehicle Demonstration - ITS NY 2018	100%	74 days	1/30/18	5/14/18	0 days
394	2701	Coordinate PID Demonstration - ITS NY 2018	100%	31 days	4/2/18	5/14/18	0 days
395	2702	Finalize Presentations Etc. - ITS NY 2018	100%	19 days	5/15/18	6/11/18	0 days
396	2703	Attend Conference - ITS NY 2018	100%	2 days	6/14/18	6/15/18	0 days
397	2793	**ITE Annual Meeting 2018**	100%	48 days	6/18/18	8/23/18	0 days
398	2794	Choose Speaker(s) - ITE Annual Meeting 2018	100%	5 days	6/18/18	6/22/18	0 days
399	2795	Determine booth support - ITE Annual Meeting 2018	100%	9 days	6/25/18	7/6/18	0 days
400	2796	Prepare presentation - ITE Annual Meeting 2018	100%	20 days	7/9/18	8/3/18	0 days
401	2803	Update Outreach Material (if needed) - ITE Annual Meeting 2018	100%	20 days	7/9/18	8/3/18	0 days
402	2797	Attend conference - ITE Annual Meeting 2018	100%	4 days	8/20/18	8/23/18	0 days
403	2863	**NYU CAV Symposium 2018**	100%	58 days	8/6/18	10/24/18	0 days
404	2868	Confirm and Reserve Auditorium Space - NYU CAV Symposium	100%	20 days	8/6/18	8/31/18	0 days
405	2865	**Prepare for NYU CAV Symposium**	100%	39 days	8/6/18	9/28/18	0 days
406	2867	Prepare Flyer - NYU CAV Symposium	100%	39 days	8/6/18	9/28/18	0 days
407	2869	Materials - NYU CAV Symposium	100%	39 days	8/6/18	9/28/18	0 days
408	2866	Attend NYU CAV Symposium	100%	2 days	10/23/18	10/24/18	0 days
409	2798	**TRB 2019 Annual Meeting**	100%	29 days	12/6/18	1/17/19	0 days
410	2799	Choose Speaker(s) - TRB 2019 Annual Meeting	100%	5 days	12/6/18	12/12/18	0 days
411	2800	Determine booth support - TRB 2019 Annual Meeting (no support required)	100%	20 days	12/13/18	1/11/19	0 days
412	2801	Prepare presentation - TRB 2019 Annual Meeting	100%	20 days	12/13/18	1/11/19	0 days
413	2804	Update Outreach Material (if needed) - TRB 2019 Annual Meeting	100%	17 days	12/13/18	1/8/19	0 days
414	2802	Attend conference - TRB 2019 Annual Meeting	100%	4 days	1/13/19	1/17/19	0 days
415	2806	**ITS America Annual Meeting & Expo 2019 (Actual date of conference is estimated)**	100%	30 days	4/26/19	6/7/19	0 days
416	2807	Choose Speaker(s) - ITS America Annual Meeting & Expo 2019	100%	3 days	4/26/19	4/30/19	0 days
417	2808	Determine booth support - ITS America Annual Meeting & Expo 2019	100%	10 days	5/1/19	5/14/19	0 days
418	2809	Prepare presentation - ITS America Annual Meeting & Expo 2019	100%	20 days	5/1/19	5/29/19	0 days
419	2810	Update Outreach Material (if needed) - ITS America Annual Meeting & Expo 2019	100%	20 days	5/1/19	5/29/19	0 days



NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
420	2811	Attend conference - ITS America Annual Meeting & Expo 2019	100%	4 days	6/4/19	6/7/19	0 days
421	**2704**	**Webinars**	**68%**	**759 days**	**8/24/17**	**9/1/20**	**101 days**
422	**2705**	**System Architecture/Design Webinar**	**100%**	**24 days**	**8/24/17**	**9/27/17**	**0 days**
423	2706	Prepare System Architecture/Design Webinar Presentation	100%	16 days	8/24/17	9/15/17	0 days
424	2707	Send Slides to USDOT - System Architecture/Design Webinar	100%	0 days	9/15/17	9/15/17	0 days
425	2708	USDOT Review of System Architecture/Design Webinar Presentation	100%	6 days	9/18/17	9/25/17	0 days
426	2709	System Architecture/Design Webinar Dry Run	100%	1 day	9/26/17	9/26/17	0 days
427	2710	Deliver System Architecture/Design Webinar	100%	1 day	9/27/17	9/27/17	0 days
428	**2711**	**Application Development and Deployment Progress Webinar**	**100%**	**56 days**	**3/30/18**	**6/18/18**	**0 days**
429	2712	Select Date and Schedule with ITS America - Application Development and Deployment Progress Webinar	100%	1 day	3/30/18	3/30/18	0 days
430	2713	Prepare Application Development and Deployment Progress Webinar Presentation	100%	19 days	5/7/18	6/1/18	0 days
431	2714	USDOT Review of Application Development and Deployment Progress Webinar Presentation	100%	5 days	6/4/18	6/8/18	0 days
432	2715	Application Development and Deployment Progress Webinar Dry Run	100%	5 days	6/11/18	6/15/18	0 days
433	2716	Deliver Application Development and Deployment Progress	100%	1 day	6/18/18	6/18/18	0 days
434	**2717**	**CVP NYC Acquisition and Installation Public Webinar**	**100%**	**20 days**	**7/2/18**	**7/30/18**	**0 days**
435	2718	Prepare slides for CVP NYC Acquisition and Installation Public Webinar	100%	19 days	7/2/18	7/27/18	0 days
436	2719	CVP NYC Acquisition and Installation Public Webinar Dry Run	100%	1 day	7/27/18	7/27/18	0 days
437	2720	Deliver CVP NYC Acquisition and Installation Public Webinar	100%	1 day	7/30/18	7/30/18	0 days
438	**2721**	**Operational Readiness/ Baseline Data Collection Plan Webinar**	**0%**	**36 days**	**4/27/20**	**6/16/20**	**155 days**
439	2816	Determine date/time frame - Operational Readiness/ Baseline Data Collection Plan Webinar	0%	10 days	4/27/20	5/8/20	155 days
440	2722	Prepare Presentation Slides - Operational Readiness/ Baseline Data Collection Plan Webinar	0%	20 days	5/11/20	6/8/20	155 days
441	2814	Dry Run - Operational Readiness/ Baseline Data Collection Plan Webinar	0%	5 days	6/9/20	6/15/20	155 days
442	2815	Deliver to Public - Operational Readiness/ Baseline Data Collection Plan Webinar	0%	1 day	6/16/20	6/16/20	155 days
443	2817	Add Phase 3 Webinars into Schedule	0%	0 days	9/1/20	9/1/20	101 days
444	**2723**	**USDOT Visits to NYC**	**100%**	**292 days**	**1/30/17**	**3/28/18**	**0 days**
445	2724	Final Systems Architecture Document Review	100%	5 days	1/30/17	2/3/17	0 days
446	2726	Final Data Management Plan & Draft Comprehensive Acquisition Plan (CAP) - CANCELED	100%	5 days	3/6/17	3/10/17	0 days
447	2727	Final Comprehensive Acquisition Plan	100%	5 days	5/1/17	5/5/17	0 days



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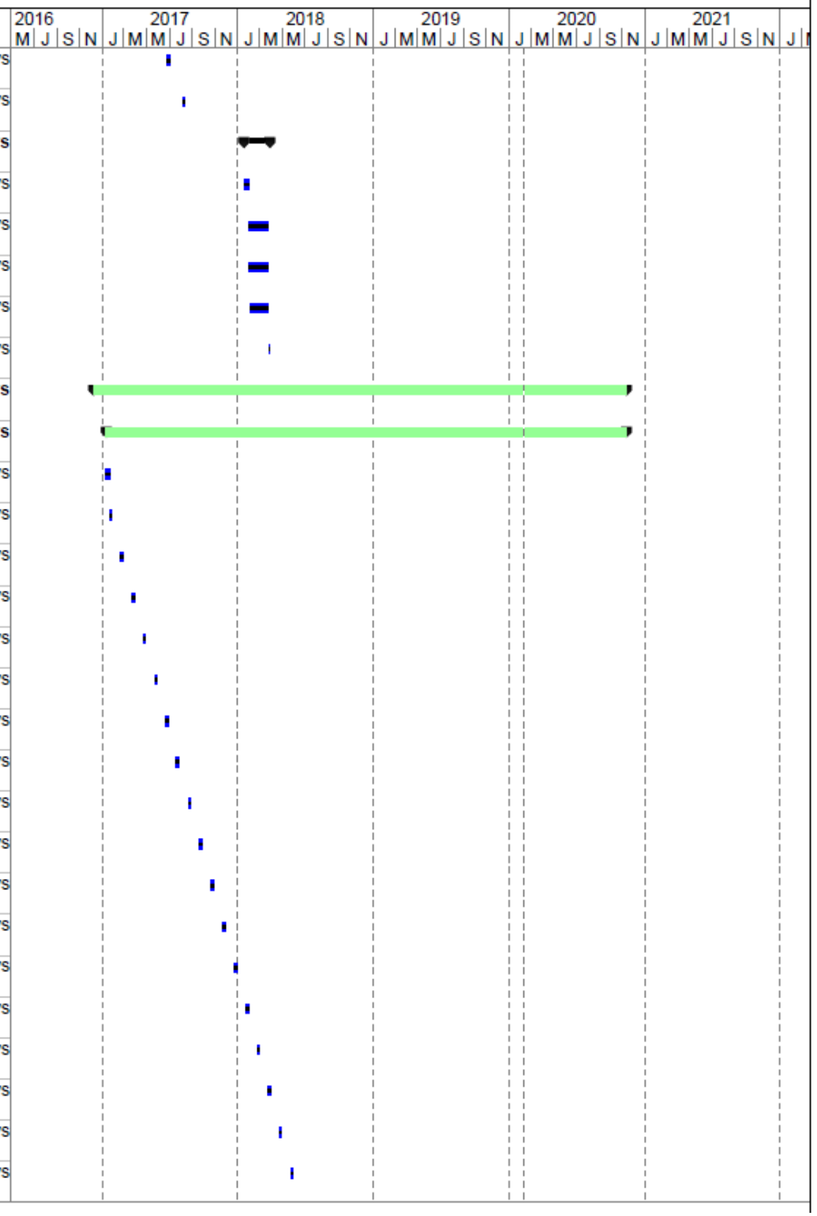
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
448	2728	Draft Comprehensive Installation Plan (CIP)	100%	5 days	6/26/17	6/30/17	0 days
449	2725	Final Systems Design Document - CANCELED	100%	5 days	8/7/17	8/11/17	0 days
450	2729	**USDOT Visit to Witness Installation**	100%	49 days	1/18/18	3/28/18	0 days
451	2730	Prepare Agenda - USDOT Visit to Witness Installation	100%	9 days	1/18/18	1/30/18	0 days
452	2731	Finalize Logistics - USDOT Visit to Witness Installation	100%	36 days	1/31/18	3/22/18	0 days
453	2732	Prepare Sample Installation Video - USDOT Visit to Witness Installation	100%	36 days	1/31/18	3/22/18	0 days
454	2733	Prepare draft installation drawings and instructions - USDOT Visit to Witness Installation	100%	34 days	2/5/18	3/23/18	0 days
455	2734	USDOT Visit to Witness Installation	100%	2 days	3/27/18	3/28/18	0 days
456	2735	**Other Deployment Activity Coordination**	72%	986 days	12/9/16	11/12/20	52 days
457	2736	**Maintain Lessons Learned Log**	55%	964 days	1/12/17	11/12/20	52 days
458	2737	Prepare Lessons Learned Collection/Report Tool	100%	6 days	1/12/17	1/20/17	0 days
459	2738	Monthly Review of Lessons Learned Log	100%	4 days	1/23/17	1/26/17	0 days
460	2739	Monthly Review of Lessons Learned Log	100%	4 days	2/20/17	2/24/17	0 days
461	2740	Monthly Review of Lessons Learned Log	100%	5 days	3/21/17	3/27/17	0 days
462	2741	Monthly Review of Lessons Learned Log	100%	5 days	4/21/17	4/27/17	0 days
463	2742	Monthly Review of Lessons Learned Log	100%	5 days	5/22/17	5/26/17	0 days
464	2743	Monthly Review of Lessons Learned Log	100%	5 days	6/20/17	6/26/17	0 days
465	2744	Monthly Review of Lessons Learned Log	100%	5 days	7/19/17	7/25/17	0 days
466	2745	Monthly Review of Lessons Learned Log	100%	5 days	8/21/17	8/25/17	0 days
467	2746	Monthly Review of Lessons Learned Log	100%	5 days	9/19/17	9/25/17	0 days
468	2747	Monthly Review of Lessons Learned Log	100%	5 days	10/20/17	10/26/17	0 days
469	2748	Monthly Review of Lessons Learned Log	100%	4 days	11/22/17	11/28/17	0 days
470	2749	Monthly Review of Lessons Learned Log	100%	5 days	12/21/17	12/28/17	0 days
471	2750	Monthly Review of Lessons Learned Log	100%	5 days	1/24/18	1/30/18	0 days
472	2751	Monthly Review of Lessons Learned Log	100%	5 days	2/22/18	2/28/18	0 days
473	2752	Monthly Review of Lessons Learned Log	100%	5 days	3/23/18	3/29/18	0 days
474	2753	Monthly Review of Lessons Learned Log	100%	5 days	4/23/18	4/27/18	0 days
475	2823	Monthly Review of Lessons Learned Log	100%	4 days	5/24/18	5/30/18	0 days



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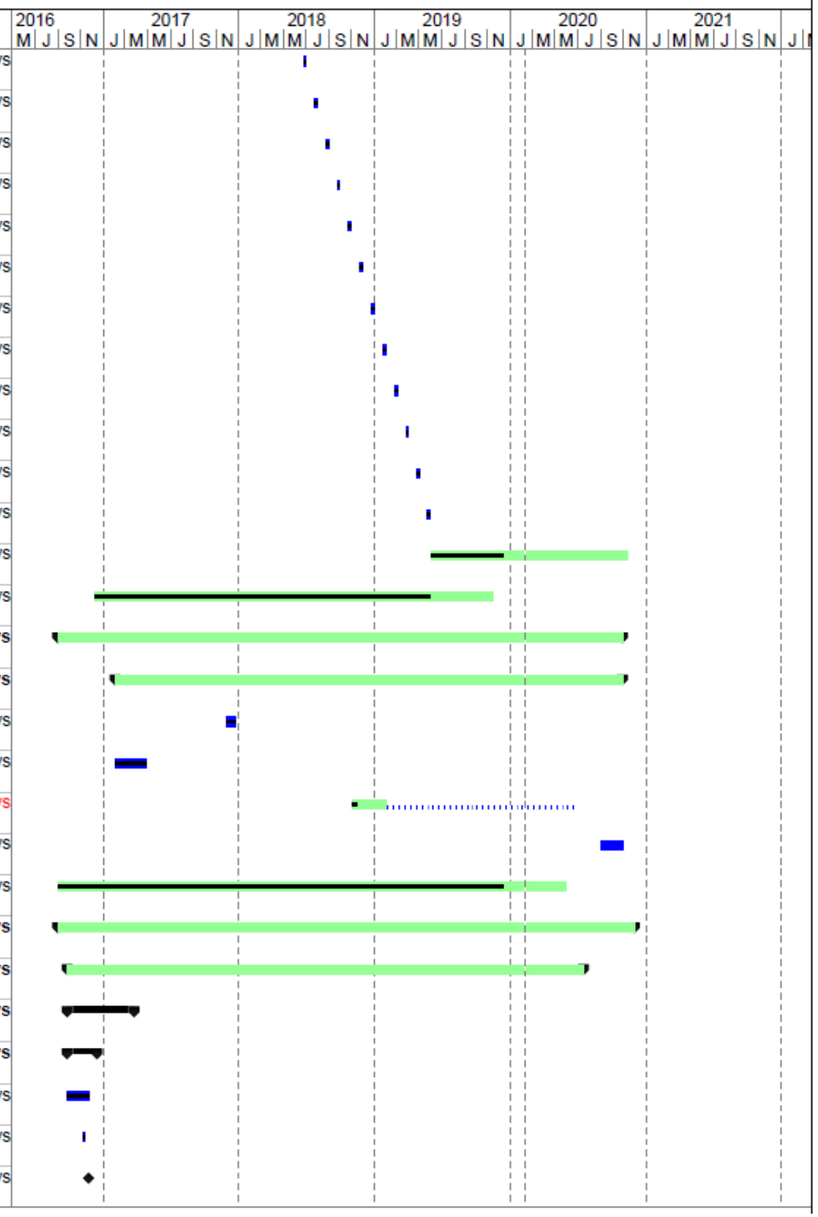
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
476	2822	Monthly Review of Lessons Learned Log	100%	5 days	6/25/18	6/29/18	0 days
477	2825	Monthly Review of Lessons Learned Log	100%	5 days	7/24/18	7/30/18	0 days
478	2824	Monthly Review of Lessons Learned Log	100%	5 days	8/24/18	8/30/18	0 days
479	2870	Monthly Review of Lessons Learned Log	100%	5 days	9/24/18	9/28/18	0 days
480	2871	Monthly Review of Lessons Learned Log	100%	5 days	10/23/18	10/29/18	0 days
481	2872	Monthly Review of Lessons Learned Log	100%	5 days	11/23/18	11/29/18	0 days
482	2873	Monthly Review of Lessons Learned Log	100%	5 days	12/24/18	12/31/18	0 days
483	2874	Monthly Review of Lessons Learned Log	100%	5 days	1/25/19	1/31/19	0 days
484	2875	Monthly Review of Lessons Learned Log	100%	5 days	2/26/19	3/4/19	0 days
485	2876	Monthly Review of Lessons Learned Log	100%	5 days	3/27/19	4/2/19	0 days
486	2877	Monthly Review of Lessons Learned Log	100%	5 days	4/25/19	5/1/19	0 days
487	2878	Monthly Review of Lessons Learned Log	100%	5 days	5/24/19	5/31/19	0 days
488	2792	Add additional updates as needed	36%	365 days	6/3/19	11/12/20	52 days
489	2754	Site Visit Accomodation (LOE)	84%	737 days	12/9/16	11/15/19	301 days
490	2455	**Task 2L/3F: Participation in Standards Development**	65%	1044 days	9/1/16	10/29/20	61 days
491	2456	**SDO-specific Technical Memoranda**	25%	941 days	2/2/17	10/29/20	61 days
492	2457	Determine schedule for Technical Memoranda per SAD - SDO-specific Technical Memoranda	100%	15 days	12/1/17	12/21/17	0 days
493	2459	Outline Approach for Standards Development Support - SDO-specific Technical Memoranda	100%	59 days	2/2/17	4/26/17	0 days
494	2458	Prepare Technical Memoranda (Phase 2) - SDO-specific Technical Memoranda	14%	417 days	11/1/18	6/30/20	0 days
495	2461	Prepare Technical Memoranda (Phase 3) - SDO-specific Technical Memoranda	0%	40 days	9/2/20	10/29/20	61 days
496	2460	Participation in SDO meetings/activities (Phases 1 thorugh 3) (LOE)	88%	938 days	9/1/16	5/29/20	167 days
497	2410	**Phase 2**	84%	1064 days	9/1/16	11/30/20	251 days
498	94	**Task 2B: System Architecture and Design**	78%	955 days	9/26/16	7/16/20	134 days
499	140	**System Architecture Document (SAD) with Standards Plan**	100%	123 days	9/26/16	3/24/17	0 days
500	8	**Draft System Architecture Document (SAD) with Standards Plan**	100%	55.5 days	9/26/16	12/15/16	0 days
501	128	Prepare Draft SAD	100%	39.5 days	9/26/16	11/22/16	0 days
502	711	Obtain SAD Outline Guidance from USDOT	100%	1 day	11/10/16	11/10/16	0 days
503	882	Submit Draft for Internal Review - SAD	100%	0 days	11/22/16	11/22/16	0 days



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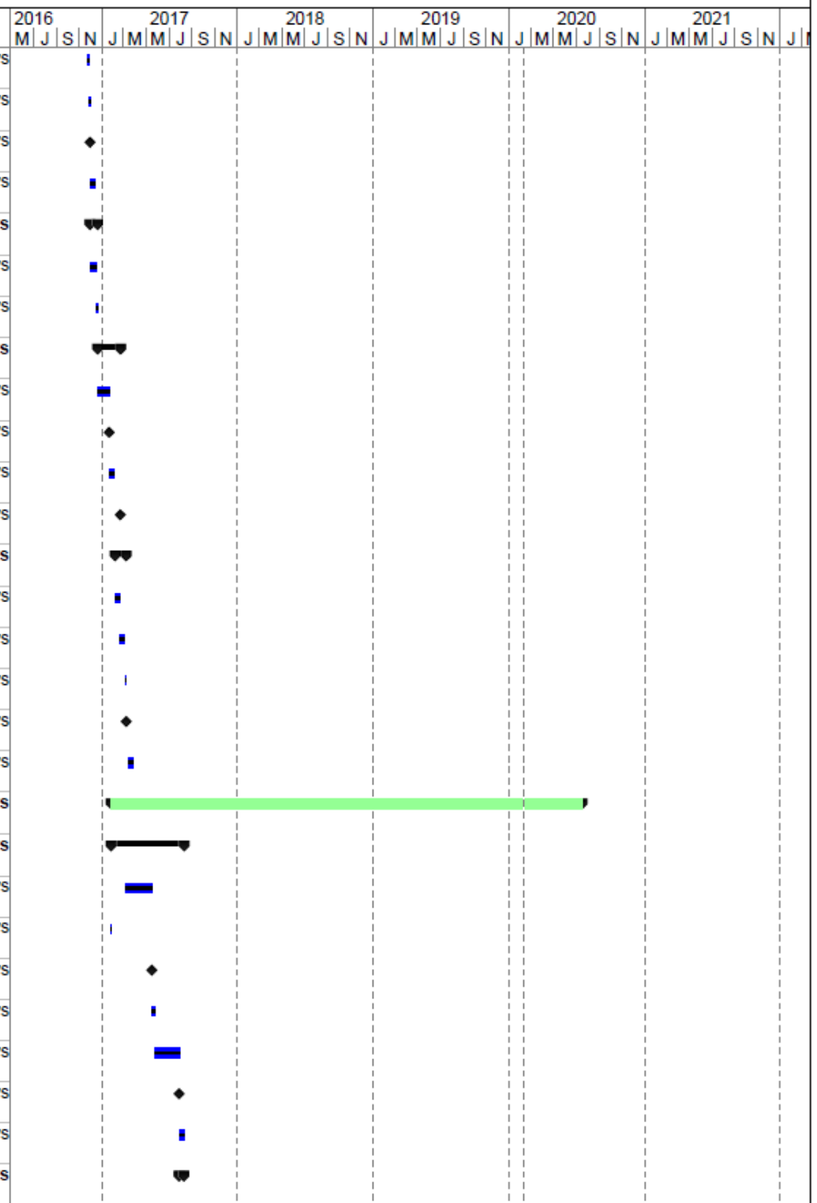
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
504	881	Internal Review - SAD	100%	4 days	11/22/16	11/29/16	0 days
505	883	Final Updates to Draft - SAD	100%	1 day	11/29/16	11/30/16	0 days
506	129	Submit Draft SAD	100%	0 days	11/30/16	11/30/16	0 days
507	133	USDOT Review of Draft SAD	100%	11 days	11/30/16	12/15/16	0 days
508	**9**	**Systems Architecture (SAD) Walkthrough and Workbook**	**100%**	**14.5 days**	**11/30/16**	**12/20/16**	**0 days**
509	130	Prepare SAD Walkthrough Workbook	100%	12.5 days	11/30/16	12/16/16	0 days
510	131	Hold SAD Walkthrough	100%	2 days	12/19/16	12/20/16	0 days
511	**10**	**Revised SAD with Comment Resolution Report**	**100%**	**40 days**	**12/21/16**	**2/20/17**	**0 days**
512	134	Prepare Revised Draft SAD	100%	20 days	12/21/16	1/20/17	0 days
513	135	Submit Revised Draft SAD with Comment Resolution Report	100%	0 days	1/20/17	1/20/17	0 days
514	137	USDOT Review of Revised Draft SAD	100%	10 days	1/23/17	2/3/17	0 days
515	1171	SAD Appendix A Standards Plan table (NO LONGER REQUIRED)	100%	0 days	2/20/17	2/20/17	0 days
516	**11**	**Final SAD with Standards Plan**	**100%**	**21 days**	**2/6/17**	**3/7/17**	**0 days**
517	136	Prepare Final SAD	100%	10 days	2/6/17	2/17/17	0 days
518	138	USDOT Review and Approval of Final SAD	100%	9 days	2/20/17	3/3/17	0 days
519	139	Final Section 508 Edits of SAD	100%	2 days	3/6/17	3/7/17	0 days
520	162	SAD Complete	100%	0 days	3/7/17	3/7/17	0 days
521	1221	Post-Approval SAD Updates	100%	9 days	3/14/17	3/24/17	0 days
522	**156**	**System Design Document (SDD)**	**74%**	**873 days**	**1/26/17**	**7/16/20**	**134 days**
523	**141**	**Draft Systems Design Document (SDD)**	**100%**	**138 days**	**1/26/17**	**8/10/17**	**0 days**
524	142	Prepare Draft SDD	100%	49 days	3/8/17	5/15/17	0 days
525	792	Finalize RACI Chart for SDD	100%	1 day	1/26/17	1/26/17	0 days
526	886	Submit Draft for Internal Review	100%	0 days	5/15/17	5/15/17	0 days
527	885	Internal Review - Draft SDD	100%	5 days	5/16/17	5/22/17	0 days
528	884	Final Updates to Draft SDD	100%	46 days	5/23/17	7/27/17	0 days
529	143	Submit Draft SDD	100%	0 days	7/27/17	7/27/17	0 days
530	144	USDOT Review of Draft SDD	100%	10 days	7/28/17	8/10/17	0 days
531	**145**	**Systems Design Walkthrough and Workbook**	**100%**	**9 days**	**7/28/17**	**8/9/17**	**0 days**



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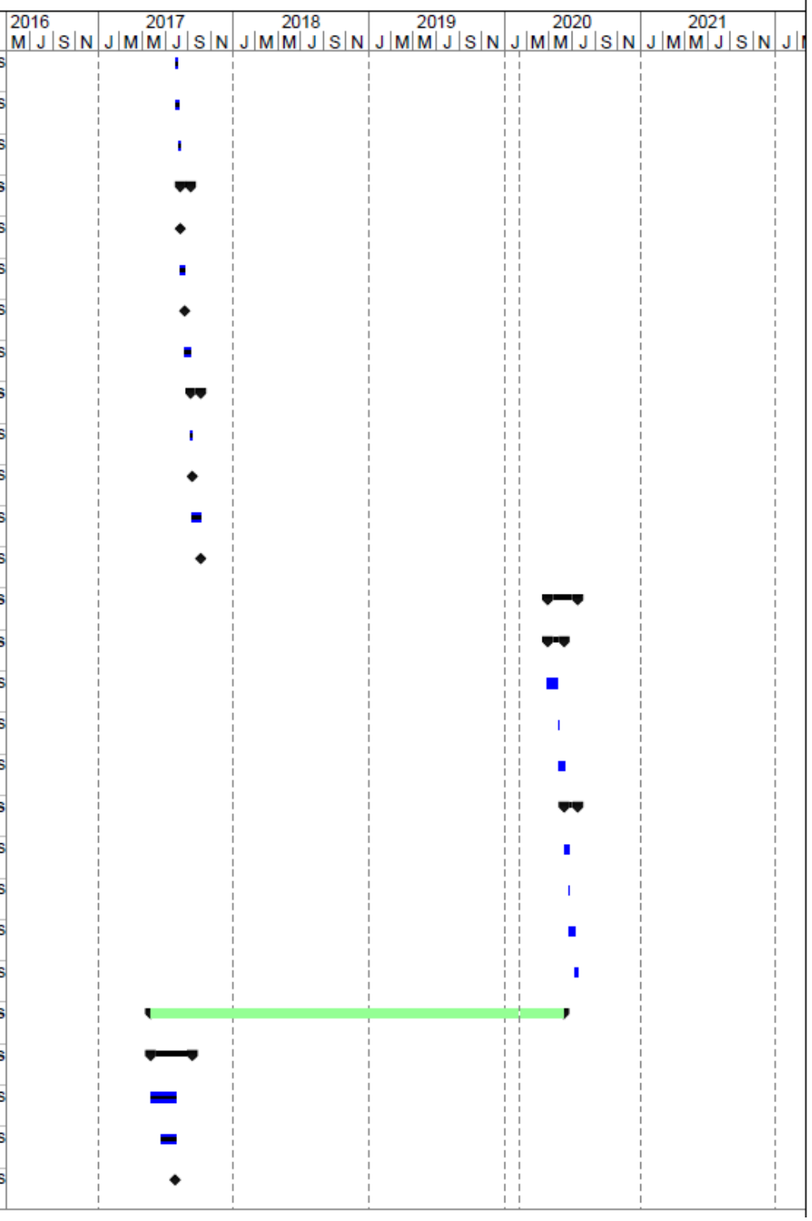
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
532	1386	Prepare Systems Design Walkthrough Agenda	100%	3 days	7/28/17	8/1/17	0 days
533	146	Prepare Systems Design Walkthrough Workbook	100%	7 days	7/28/17	8/7/17	0 days
534	147	Hold Systems Design Walkthrough	100%	2 days	8/8/17	8/9/17	0 days
535	148	**Revised SDD with Comment Resolution Report**	100%	19 days	8/10/17	9/7/17	0 days
536	1511	Receive Comment Resolution Report - Revised Draft SDD	100%	0 days	8/10/17	8/10/17	0 days
537	149	Prepare Revised Draft SDD	100%	8 days	8/11/17	8/22/17	0 days
538	150	Submit Revised Draft SDD with Comment Resolution Report	100%	0 days	8/22/17	8/22/17	0 days
539	151	USDOT Review of Revised Draft SDD	100%	11 days	8/23/17	9/7/17	0 days
540	152	**Final SDD**	100%	19 days	9/8/17	10/4/17	0 days
541	153	Prepare Final SDD	100%	2 days	9/8/17	9/11/17	0 days
542	1518	Submit Final SDD	100%	0 days	9/11/17	9/11/17	0 days
543	154	USDOT Review and Approval of Final SDD	100%	17 days	9/12/17	10/4/17	0 days
544	161	SDD Complete	100%	0 days	10/4/17	10/4/17	0 days
545	1610	**SDD - As-Built**	0%	57 days	4/27/20	7/16/20	134 days
546	1619	**Draft SDD - As-Built**	0%	31 days	4/27/20	6/9/20	134 days
547	1618	Prepare Draft SDD - As-Built	0%	20 days	4/27/20	5/22/20	134 days
548	1613	Submit - Draft SDD - As-Built	0%	1 day	5/26/20	5/26/20	134 days
549	1612	USDOT Review - Draft SDD - As-Built	0%	10 days	5/27/20	6/9/20	134 days
550	1620	**Final SDD - As-Built**	0%	26 days	6/10/20	7/16/20	134 days
551	1621	Prepare Final SDD - As-Built	0%	10 days	6/10/20	6/23/20	134 days
552	1625	Submit - Final SDD - As-Built	0%	1 day	6/24/20	6/24/20	134 days
553	1626	USDOT Review - Final SDD - As-Built	0%	10 days	6/25/20	7/9/20	134 days
554	1627	Final Section 508 Edits of Final SDD - As-Built	0%	5 days	7/10/20	7/16/20	134 days
555	16	**Updated Phase 1 Deliverables**	49%	764 days	5/23/17	6/8/20	161 days
556	165	**Update Phase 1 Deliverables**	100%	77 days	5/23/17	9/11/17	0 days
557	167	Concept of Operations Update - Update Phase 1 Deliverables	100%	46 days	5/23/17	7/27/17	0 days
558	168	System Requirements Specification - Update Phase 1 Deliverables	100%	26 days	6/21/17	7/27/17	0 days
559	166	Submit Updated Phase 1 Deliverable - Concept of Operations and System Requirements Specification	100%	0 days	7/27/17	7/27/17	0 days



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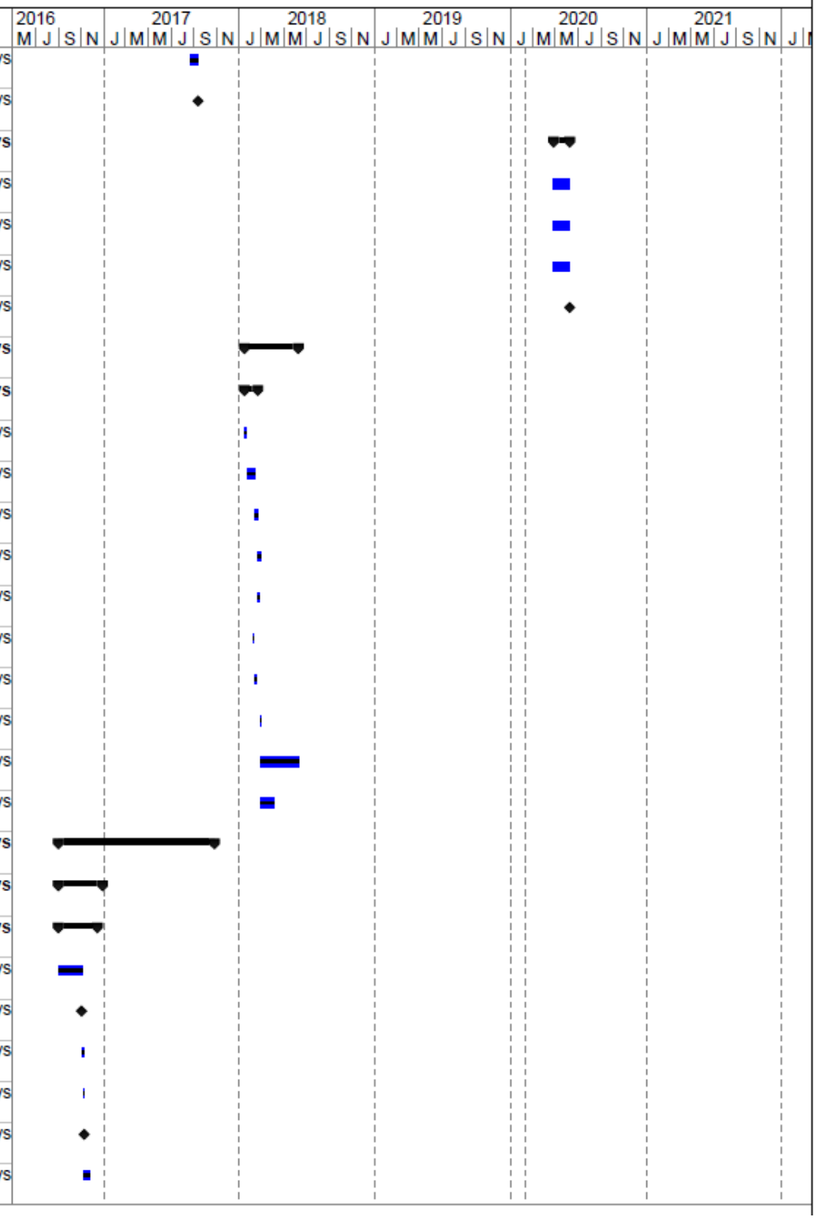
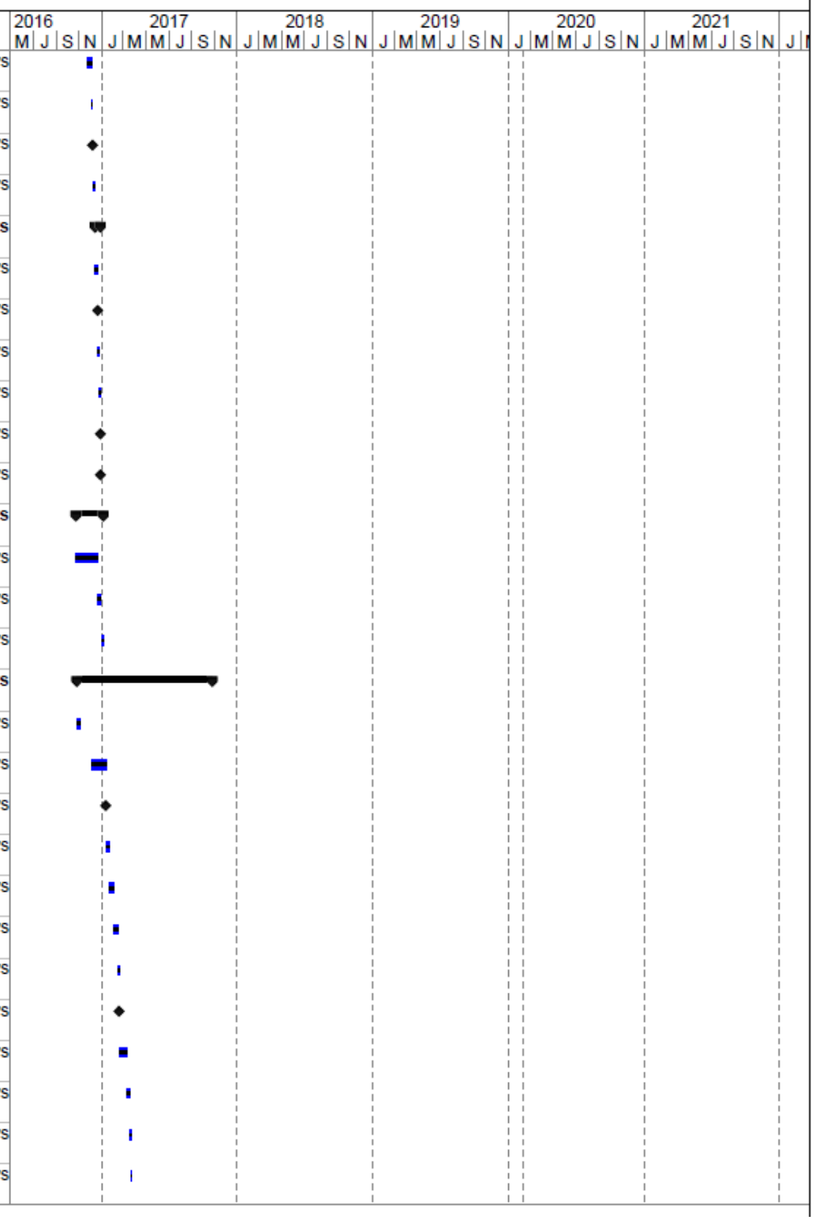
560	169	Comprehensive Pilot Deployment - Update Phase 1 Deliverables	100%	13 days	8/23/17	9/11/17	0 days
561	1443	Submit Updated Phase 1 Deliverables - Comprehensive Pilot Development	100%	0 days	9/11/17	9/11/17	0 days
562	2391	**Update Phase 1 Deliverables - As Builts**	0%	30 days	4/27/20	6/8/20	161 days
563	2392	Concept of Operations Update - Prepare As-Builts	0%	30 days	4/27/20	6/8/20	161 days
564	2393	System Requirements Specification Update - Prepare As-Builts	0%	30 days	4/27/20	6/8/20	161 days
565	2394	Comprehensive Pilot Deployment Plan Updates - Prepare As-Builts	0%	30 days	4/27/20	6/8/20	161 days
566	2395	Submit Updated Phase 1 Deliverable - As Builts	0%	0 days	6/8/20	6/8/20	161 days
567	1786	**Design Finalization Meeting**	100%	102 days	1/15/18	6/8/18	0 days
568	1787	**Prepare Agenda - Design Finalization Meeting**	100%	24 days	1/15/18	2/19/18	0 days
569	1791	Initial Draft - Design Finalization Meeting	100%	4 days	1/15/18	1/19/18	0 days
570	1792	Review - Design Finalization Meeting	100%	16 days	1/22/18	2/12/18	0 days
571	1793	Finalize - Design Finalization Meeting	100%	4 days	2/13/18	2/19/18	0 days
572	1818	Complete Slides - Design Finalization Meeting	100%	5 days	2/20/18	2/26/18	0 days
573	1819	Order Food - Design Finalization Meeting	100%	4 days	2/20/18	2/23/18	0 days
574	1794	Permission from City to Contact Vendor - Design Finalization Meeting	100%	1 day	2/9/18	2/9/18	0 days
575	1788	Schedule Meeting - Design Finalization Meeting	100%	2 days	2/12/18	2/13/18	0 days
576	1789	Hold Design Finalization Meeting with Vendors - Design Finalization Meeting	100%	2 days	2/27/18	2/28/18	0 days
577	2004	Finalize OTA Design - Design Finalization Meeting	100%	71 days	3/1/18	6/8/18	0 days
578	1790	Prepare & Send Action Item List - Design Finalization Meeting	100%	24 days	3/1/18	4/3/18	0 days
579	96	**Task 2C: Data Management Planning**	100%	288 days	9/1/16	10/25/17	0 days
580	17	**Data Privacy Plan (DPP)**	100%	80 days	9/1/16	12/28/16	0 days
581	2912	**Data Privacy Plan (DPP) - Draft**	100%	71 days	9/1/16	12/14/16	0 days
582	173	Prepare Draft - Data Privacy Plan (DPP)	100%	42.5 days	9/1/16	11/2/16	0 days
583	889	Install and Test Sample Devices - Data Privacy Plan (DPP)	100%	0 days	11/2/16	11/2/16	0 days
584	888	Internal Review - Data Privacy Plan (DPP)	100%	4 days	11/2/16	11/8/16	0 days
585	887	Final Updates to Draft - Data Privacy Plan (DPP)	100%	1 day	11/8/16	11/9/16	0 days
586	172	Submit Draft - Data Privacy Plan (DPP)	100%	0 days	11/9/16	11/9/16	0 days
587	171	USDOT Review of - Data Privacy Plan (DPP)	100%	9 days	11/9/16	11/23/16	0 days



NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
588	176	Prepare Revised - Data Privacy Plan (DPP)	100%	7 days	11/23/16	12/5/16	0 days
589	786	Editor Review of Revised Draft DPP	100%	2 days	12/5/16	12/7/16	0 days
590	175	Submit Revised Draft DPP with Comment Resolution Report	100%	0 days	12/8/16	12/8/16	0 days
591	174	USDOT Review of Revised Draft DPP	100%	5 days	12/8/16	12/14/16	0 days
592	**2913**	**Data Privacy Plan (DPP) - Final**	**100%**	**9 days**	**12/15/16**	**12/28/16**	**0 days**
593	179	Prepare Final DPP	100%	5 days	12/15/16	12/21/16	0 days
594	939	Submit Final DPP	100%	0 days	12/21/16	12/21/16	0 days
595	178	USDOT Review and Approval of Final DPP	100%	2 days	12/22/16	12/23/16	0 days
596	177	Final Section 508 Edits of Final DPP	100%	2 days	12/26/16	12/28/16	0 days
597	940	Submit 508 Compliant Version of Approved DPP	100%	0 days	12/28/16	12/28/16	0 days
598	19	Final Data Privacy Plan (DPP) Complete	100%	0 days	12/28/16	12/28/16	0 days
599	**196**	**Privacy Management Plan**	**100%**	**50 days**	**10/24/16**	**1/5/17**	**0 days**
600	914	Determine whether or not a plan exists - Privacy Management Plan	100%	41 days	10/24/16	12/21/16	0 days
601	197	Prepare a Privacy Management Plan (or confirm prior existence) - Review Existing	100%	6 days	12/22/16	12/30/16	0 days
602	20	Prepare and Submit Notice of Privacy Management Consistency	100%	3 days	1/2/17	1/5/17	0 days
603	**21**	**Data Management Plan (DMP)**	**100%**	**250.5 days**	**10/26/16**	**10/25/17**	**0 days**
604	893	Prepare RACI Chart for DMP	100%	5 days	10/26/16	11/2/16	0 days
605	195	Prepare Draft DMP	100%	26.5 days	12/5/16	1/12/17	0 days
606	892	Submit Draft for Internal Review - Data Management Plan (DMP)	100%	0 days	1/12/17	1/12/17	0 days
607	891	Internal Review - Part 1 - Data Management Plan (DMP)	100%	5.5 days	1/12/17	1/20/17	0 days
608	1152	Make updates from initial comments and USDOT Guidance - Data Management Plan (DMP)	100%	9 days	1/23/17	2/2/17	0 days
609	1153	Internal Review - Part 2 (Bob&David) - Data Management Plan (DMP)	100%	7 days	2/3/17	2/13/17	0 days
610	890	Final Updates to Draft Data Management Plan (DMP)	100%	3 days	2/14/17	2/16/17	0 days
611	194	Submit Draft Data Management Plan (DMP)	100%	0 days	2/16/17	2/16/17	0 days
612	193	USDOT Review of Draft Data Management Plan (DMP)	100%	13 days	2/17/17	3/8/17	0 days
613	192	Prepare Revised Draft Data Management Plan (DMP)	100%	6 days	3/9/17	3/16/17	0 days
614	1044	Internal Review of Revised Draft Data Management Plan (DMP)	100%	3 days	3/17/17	3/21/17	0 days
615	1209	Address Internal Review Comments - Draft Data Management Plan (DMP)	100%	1 day	3/22/17	3/22/17	0 days



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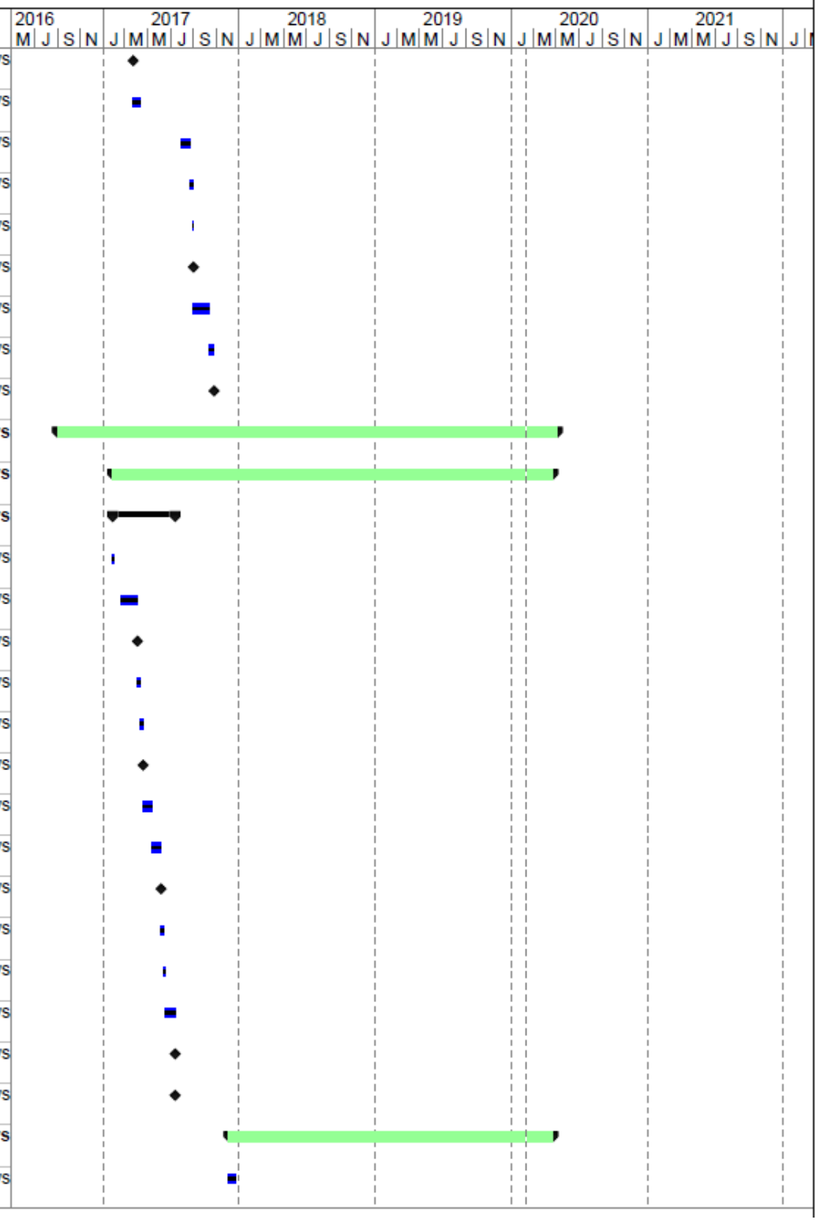
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
616	191	Submit Revised Draft DMP with Comment Resolution Report	100%	0 days	3/22/17	3/22/17	0 days
617	190	USDOT Review of Revised Draft DMP	100%	14 days	3/23/17	4/11/17	0 days
618	189	Prepare Final DMP Internal Draft (Including ICD-Related Information)	100%	19 days	7/28/17	8/23/17	0 days
619	1208	Internal Review of Revised Draft Data Management Plan (DMP)	100%	4 days	8/24/17	8/29/17	0 days
620	1210	Address Internal Review Comments - Data Management Plan (DMP)	100%	2 days	8/30/17	8/31/17	0 days
621	1211	Submit Final Draft Data Management Plan (DMP)	100%	0 days	8/31/17	8/31/17	0 days
622	188	USDOT Review and Approval of Final Data Management Plan (DMP)	100%	28 days	9/1/17	10/12/17	0 days
623	187	Final Section 508 Edits of Data Management Plan (DMP)	100%	9 days	10/13/17	10/25/17	0 days
624	186	Data Management Plan (DMP) Complete	100%	0 days	10/25/17	10/25/17	0 days
625	**97**	**Task 2D: Acquisition and Installation Planning**	**99%**	**920 days**	**9/1/16**	**5/4/20**	**185 days**
626	**2915**	**Comprehensive Acquisition Plan (CAP)**	**87%**	**813 days**	**1/27/17**	**4/22/20**	**193 days**
627	**24**	**Comprehensive Acquisition Plan (CAP) - Initial Version**	**100%**	**117 days**	**1/27/17**	**7/13/17**	**0 days**
628	897	Prepare RACI Chart	100%	1 day	1/27/17	1/27/17	0 days
629	213	Prepare Draft CAP	100%	31 days	2/17/17	4/3/17	0 days
630	896	Submit Draft for Internal Review - Comprehensive Acquisition Plan (CAP)	100%	0 days	4/3/17	4/3/17	0 days
631	895	Internal Review - Comprehensive Acquisition Plan (CAP)	100%	6 days	4/4/17	4/11/17	0 days
632	894	Final Updates to Draft - Comprehensive Acquisition Plan (CAP)	100%	5 days	4/12/17	4/18/17	0 days
633	214	Submit Draft CAP	100%	0 days	4/19/17	4/19/17	0 days
634	215	USDOT Review of Draft CAP	100%	17 days	4/19/17	5/11/17	0 days
635	216	Prepare Revised Draft CAP	100%	16 days	5/12/17	6/5/17	0 days
636	217	Submit Revised Draft CAP with Comment Resolution Report	100%	0 days	6/5/17	6/5/17	0 days
637	218	USDOT Review of Revised Draft CAP	100%	5 days	6/6/17	6/12/17	0 days
638	219	Prepare Final CAP	100%	2 days	6/13/17	6/14/17	0 days
639	220	USDOT Review and Approval of Final CAP	100%	20 days	6/15/17	7/13/17	0 days
640	221	Final Section 508 Edits of CAP (Not Needed)	100%	0 days	7/13/17	7/13/17	0 days
641	222	Initial Version of CAP Complete	100%	0 days	7/13/17	7/13/17	0 days
642	**1573**	**CAP with HSM Included**	**82%**	**598 days**	**12/5/17**	**4/22/20**	**193 days**
643	1475	Prepare Updated CAP with HSM Included	100%	13 days	12/5/17	12/21/17	0 days



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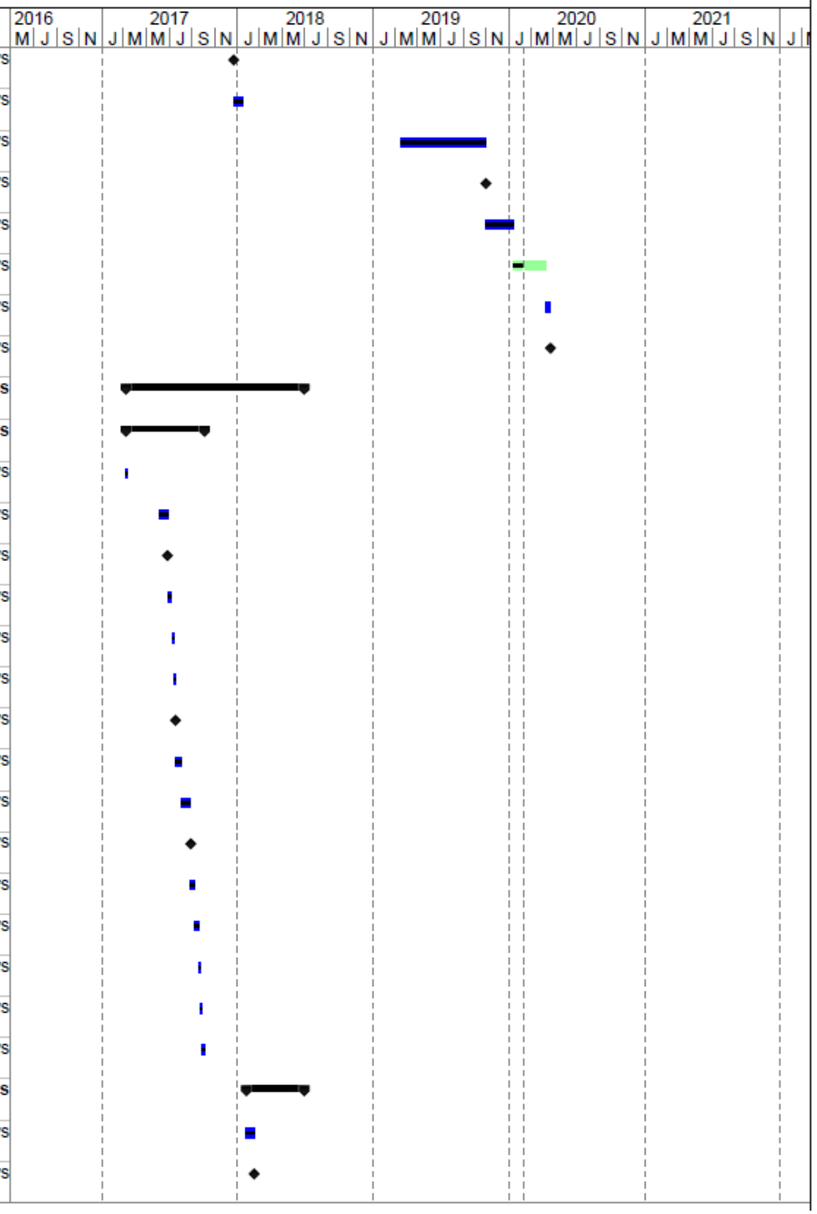
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
644	1478	Submit Updated CAP	100%	0 days	12/21/17	12/21/17	0 days
645	1476	USDOT Review of Updated CAP with HSM Included	100%	15 days	12/22/17	1/16/18	0 days
646	1572	Prepare Revised Draft Updated CAP with HSM Included (w/end of Phase 2)	100%	160 days	3/18/19	10/31/19	0 days
647	1571	Submit Revised Updated CAP with HSM Included with Comment Resolution Report	100%	0 days	10/31/19	10/31/19	0 days
648	1570	USDOT Review of Revised Draft Updated CAP with HSM Included	100%	48 days	11/1/19	1/13/20	0 days
649	1569	Prepare Final Updated CAP with HSM Included	27%	60 days	1/14/20	4/8/20	193 days
650	1568	USDOT Review and Approval of Final Updated CAP with HSM Included	0%	10 days	4/9/20	4/22/20	193 days
651	1574	Updated CAP with HSM Included Complete	0%	0 days	4/22/20	4/22/20	193 days
652	**2916**	**Comprehensive Installation Plan (CIP)**	**100%**	**333 days**	**3/7/17**	**6/29/18**	**0 days**
653	**27**	**Comprehensive Installation Plan (CIP) - Initial Version**	**100%**	**148.5 days**	**3/7/17**	**10/4/17**	**0 days**
654	904	Prepare RACI Chart	100%	3 days	3/7/17	3/9/17	0 days
655	233	Prepare Draft CIP	100%	16 days	6/5/17	6/26/17	0 days
656	903	Submit Draft for Internal Review - Comprehensive Installation Plan (CIP)	100%	0 days	6/26/17	6/26/17	0 days
657	902	Internal Review - Comprehensive Installation Plan (CIP)	100%	8 days	6/27/17	7/7/17	0 days
658	901	Final Updates to Draft - Comprehensive Installation Plan (CIP)	100%	4.5 days	7/10/17	7/14/17	0 days
659	1263	Prepare for Submission - Comprehensive Installation Plan (CIP)	100%	2 days	7/14/17	7/18/17	0 days
660	232	Submit Draft CIP	100%	0 days	7/18/17	7/18/17	0 days
661	231	USDOT Review of Draft CIP	100%	10 days	7/18/17	8/1/17	0 days
662	230	Prepare Revised Draft CIP	100%	19 days	8/1/17	8/28/17	0 days
663	229	Submit Revised Draft CIP with Comment Resolution Report	100%	0 days	8/28/17	8/28/17	0 days
664	228	USDOT Review of Revised Draft CIP	100%	7 days	8/28/17	9/7/17	0 days
665	227	Prepare Revised CIP	100%	8 days	9/7/17	9/19/17	0 days
666	226	USDOT Review and Approval of Revised CIP	100%	2 days	9/19/17	9/21/17	0 days
667	1628	Address minor comments - Comprehensive Installation Plan (CIP)	100%	4 days	9/21/17	9/27/17	0 days
668	1629	USDOT Review and Approval of Revised Comprehensive Installation Plan (CIP)	100%	5 days	9/27/17	10/4/17	0 days
669	**1578**	**CIP with HSM Included**	**100%**	**110 days**	**1/25/18**	**6/29/18**	**0 days**
670	1580	Prepare Updated CIP with HSM Included	100%	15 days	1/25/18	2/14/18	0 days
671	1579	Submit Updated CIP with HSM Included	100%	0 days	2/14/18	2/14/18	0 days



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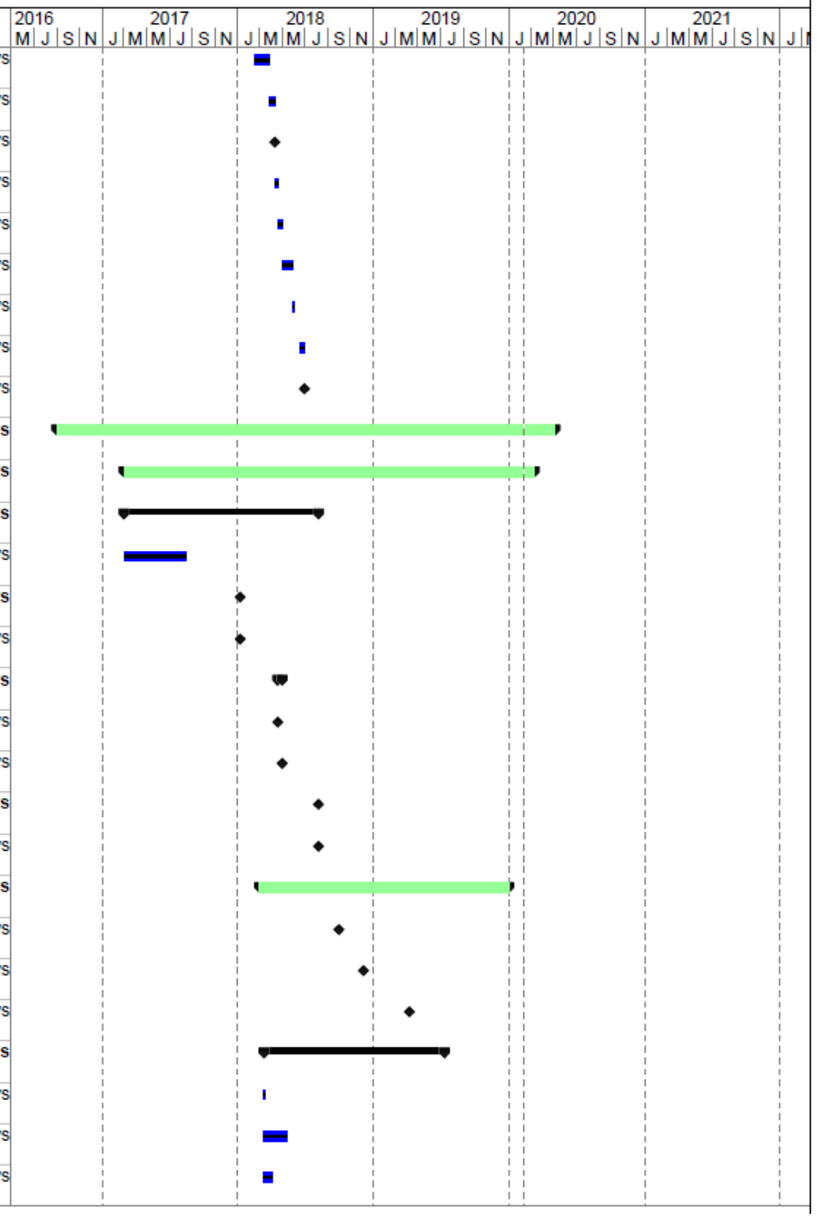
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
672	1566	USDOT Review of Updated CIP with HSM Included	100%	28 days	2/15/18	3/27/18	0 days
673	1581	Prepare Revised Draft Updated CIP with HSM Included	100%	10 days	3/28/18	4/10/18	0 days
674	1565	Submit Revised Draft Updated CIP with HSM Included with Comment Resolution Report	100%	0 days	4/10/18	4/10/18	0 days
675	1567	USDOT Review of Revised Draft Updated CIP with HSM Included	100%	6 days	4/11/18	4/18/18	0 days
676	1564	Prepare Final Updated CIP with HSM Included	100%	10 days	4/19/18	5/2/18	0 days
677	2401	Distribution delay - Updated CIP with HSM Included	100%	19 days	5/3/18	5/30/18	0 days
678	1563	USDOT Review and Approval of Final Updated CIP with HSM Included	100%	1 day	5/31/18	5/31/18	0 days
679	225	Final Section 508 Edits of Updated CIP with HSM Included	100%	10 days	6/18/18	6/29/18	0 days
680	224	Updated CIP with HSM Included Complete	100%	0 days	6/29/18	6/29/18	0 days
681	**2045**	**Procurement**	**99%**	**920 days**	**9/1/16**	**5/4/20**	**-55 days**
682	**2046**	**ASD and RSU Procurement**	**99%**	**759 days**	**3/1/17**	**3/9/20**	**-15 days**
683	**2123**	**Procure & Receive Sample Devices - ASD and RSU**	**100%**	**362 days**	**3/1/17**	**8/6/18**	**0 days**
684	2124	Procure Sample Devices - ASD and RSU	100%	118 days	3/1/17	8/15/17	0 days
685	**2296**	**Receive Sample Devices - ASD**	**100%**	**0 days**	**1/8/18**	**1/8/18**	**0 days**
686	2297	Receive Sample Devices - ASD - Savari	100%	0 days	1/8/18	1/8/18	0 days
687	**2298**	**Receive Sample Devices - ASD - Danlaw**	**100%**	**8 days**	**4/19/18**	**4/30/18**	**0 days**
688	2336	Receive 1st Batch Sample Devices - ASD - Danlaw	100%	0 days	4/19/18	4/19/18	0 days
689	2337	Receive 2nd Batch Sample Devices - ASD - Danlaw	100%	0 days	4/30/18	4/30/18	0 days
690	**2983**	**Receive Sample Devices - RSU - Siemens**	**100%**	**0 days**	**8/6/18**	**8/6/18**	**0 days**
691	2341	Receive Sample Devices - RSU - Siemens	100%	0 days	8/6/18	8/6/18	0 days
692	**2047**	**Danlaw Schedule - ASD**	**99%**	**462 days**	**3/1/18**	**12/31/19**	**0 days**
693	2968	Milestone: Pre-Contract Execution Mobilization - Danlaw - ASD	100%	0 days	10/1/18	10/1/18	0 days
694	2982	Milestone: NYC Issues and Executes Vendor Contract - Danlaw - ASD	100%	0 days	12/6/18	12/6/18	0 days
695	3014	Milestone: NYC Issues and Executes Vendor Purchase Order - Danlaw - ASD	100%	0 days	4/9/19	4/9/19	0 days
696	**2056**	**Software Development - ASD - Danlaw**	**100%**	**336 days**	**3/13/18**	**7/11/19**	**0 days**
697	2057	HW Rev 1.8 - Danlaw - ASD	100%	1 day	3/13/18	3/13/18	0 days
698	2058	Prototype Cables - Danlaw - ASD	100%	44 days	3/13/18	5/11/18	0 days
699	2059	SW Release 1.0 - Danlaw - ASD	100%	18 days	3/13/18	4/5/18	0 days



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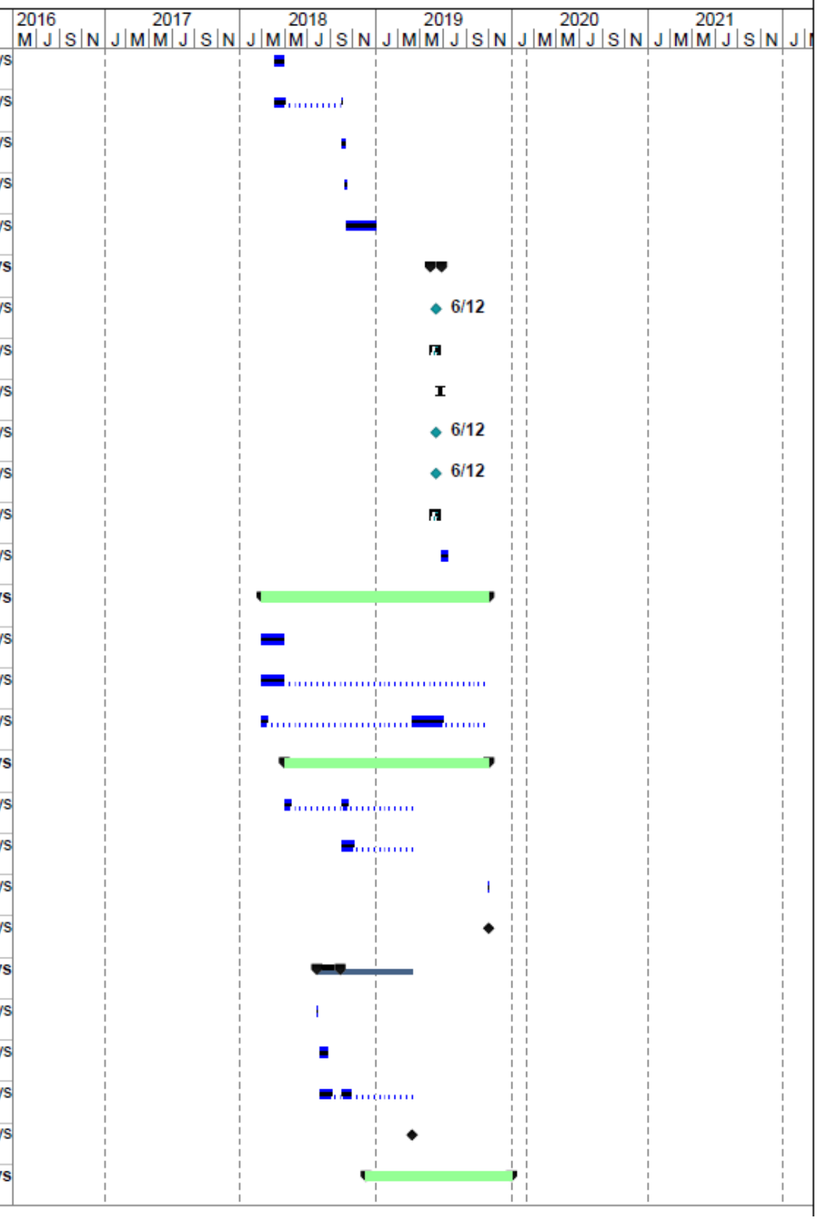
700	2060	SW flashing and ASD Shipment - Danlaw - ASD	100%	15 days	4/6/18	4/26/18	0 days
701	2061	SW Release 2 (Event Logging, App Updates) - Danlaw - ASD	100%	124 days	4/6/18	10/1/18	0 days
702	2062	Vehicle SW Update - SW Release 2 - Danlaw - ASD	100%	4 days	10/2/18	10/8/18	0 days
703	2063	SW Release 3.0 (OTA, Log Transfer, QA Cert Refresh, App Update) - Danlaw - ASD	100%	5 days	10/9/18	10/15/18	0 days
704	2064	Vehicle SW Update - SW Release 3.0.6 - Danlaw - ASD	100%	52 days	10/16/18	12/31/18	0 days
705	**3097**	**SW Release 4.1**	**100%**	**22 days**	**5/28/19**	**6/26/19**	**0 days**
706	3098	Updated SCMS Available (External Milestone)	100%	0 days	6/12/19	6/12/19	0 days
707	3099	Proxy Implementation Cohda	100%	10 days	5/28/19	6/21/19	0 days
708	3100	Test Certification Top Up in NYC	100%	5 days	6/20/19	6/26/19	0 days
709	3101	On demand firmware download	100%	0 days	6/12/19	6/12/19	0 days
710	3102	Urgent Firmware Download	100%	0 days	6/12/19	6/12/19	0 days
711	3103	Data Upload	100%	10 days	5/28/19	6/21/19	0 days
712	3104	Vehicle SW Update 4.1	100%	10 days	6/27/19	7/11/19	0 days
713	**2048**	**Design Documentation - ASD - Danlaw**	**99%**	**422 days**	**3/1/18**	**10/31/19**	**0 days**
714	2049	V2V Design Document - Danlaw - ASD	100%	42 days	3/1/18	4/27/18	0 days
715	2050	V2I Design Documents - Danlaw - ASD	100%	422 days	3/1/18	10/31/19	0 days
716	2051	Non-Safety App Design Documents - Danlaw - ASD	100%	422 days	3/1/18	10/31/19	0 days
717	**2052**	**Test Documentation - ASD - Danlaw**	**99%**	**380 days**	**4/30/18**	**10/31/19**	**0 days**
718	2053	V2V Test Document - Danlaw - ASD	100%	246 days	4/30/18	4/22/19	0 days
719	2054	V2I Test Documents - Danlaw - ASD	100%	139 days	10/1/18	4/22/19	0 days
720	2055	Non-Safety App Test Documents - Danlaw - ASD	100%	1 day	10/31/19	10/31/19	0 days
721	2329	Milestone: All Test Documentation Complete - Danlaw - ASD	100%	0 days	10/31/19	10/31/19	0 days
722	**2879**	**Cohda RSU Triangulation for Location Accuracy Testing - Danlaw - ASD**	**100%**	**44 days**	**7/26/18**	**9/26/18**	**0 days**
723	2882	TFHRC Visit - Danlaw - ASD	100%	1 day	7/26/18	7/26/18	0 days
724	2881	Install Survey - Danlaw - ASD	100%	15 days	8/6/18	8/24/18	0 days
725	2880	Installation and Testing of 10 RSUs for Cohda RSU Triangulation Testing - Danlaw - ASD	100%	168 days	8/6/18	4/8/19	0 days
726	2883	Milestone: Cohda RSU Triangulation Testing Complete - Danlaw - ASD	100%	0 days	4/8/19	4/8/19	0 days
727	**2909**	**Procurement - ASD - Danlaw**	**99%**	**268 days**	**12/6/18**	**12/31/19**	**0 days**



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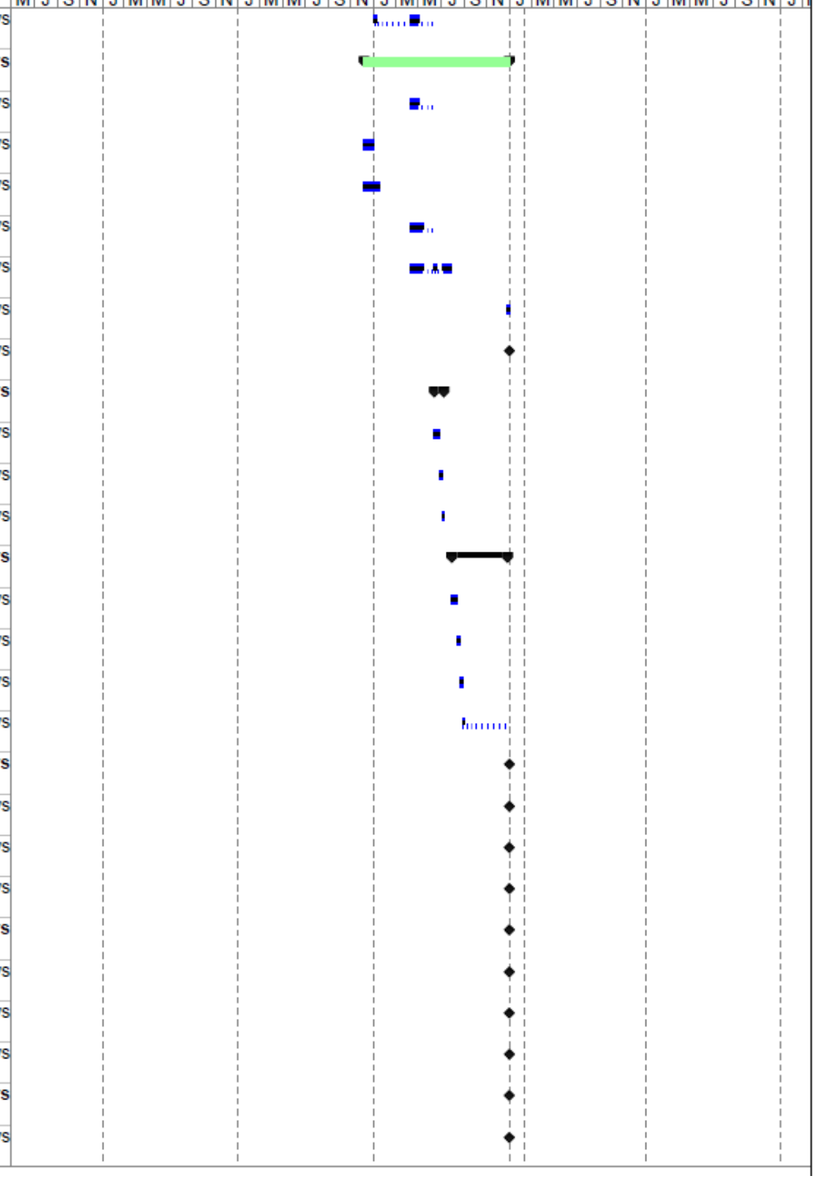
728	2065	Device Certification - ASD - Danlaw	100%	119 days	12/31/18	6/19/19	0 days
729	**2066**	**Production Device Finalization and Production - ASD - Danlaw**	**99%**	**268 days**	**12/6/18**	**12/31/19**	**0 days**
730	2067	Initial Production SW Release - Danlaw - ASD	100%	51 days	4/9/19	6/19/19	0 days
731	3062	Production Component Order/Production/Burn In/Ship - Danlaw - ASD (50 for Prototype)	100%	17 days	12/6/18	12/31/18	0 days
732	2981	Production Component Order/Production/Burn In/Ship - Danlaw - ASD (50 for Prototype)	100%	26 days	12/6/18	1/14/19	0 days
733	3003	Production Component Order (1000 Pcs) - Danlaw - ASD	100%	64.38 edays	4/9/19	6/12/19	0 edays
734	3070	Production Component Order (3000 Pcs) - Danlaw - ASD (16 weeks) - (Final 100% per Amendment 6)	100%	112 edays	4/9/19	7/30/19	0 edays
735	3139	Production Component Order Hold for NYC/USDOT Negotiations - (Final 100% per Amendment 6)**Removed per Amendment 6**	100%	3 days	12/27/19	12/31/19	0 days
736	2068	Production Component Order (4000 Pcs) - Danlaw - ASD (16 Weeks)**Removed per Amendment 6**	100%	0 edays	12/31/19	12/31/19	0 edays
737	**3063**	**Equipment Delivered for 20% Installation - Danlaw - ASD (20% of original 8000)**	**100%**	**17 days**	**6/13/19**	**7/8/19**	**0 days**
738	2069	Production - Equipment for 20% Installation - Danlaw - ASD (% of original 8000)	100%	10 days	6/13/19	6/26/19	0 days
739	2070	Burn In - Equipment for 20% Installation - Danlaw - ASD (% of original 8000)	100%	5 days	6/27/19	7/3/19	0 days
740	2071	Equipment Delivered for 20% Installation - Danlaw - ASD (20%) (% of original 8000)	100%	2 days	7/4/19	7/8/19	0 days
741	**3064**	**Equipment Delivered for 50% Installation - Danlaw - ASD (% of original 8000)**	**100%**	**103 days**	**7/30/19**	**12/26/19**	**0 days**
742	2072	Production - Equipment for 50% Installation - Danlaw - ASD (% of original 8000)	100%	10 days	7/30/19	8/12/19	0 days
743	2073	Burn In Test - Equipment for 50% Installation - Danlaw - ASD (% of original 8000)	100%	5 days	8/13/19	8/19/19	0 days
744	3136	Equipment Delivered for 50% Installation - Danlaw - ASD (50%) - Partial (% of original 8000)	100%	5 days	8/20/19	8/26/19	0 days
745	2074	Equipment Delivered for 50% Installation - Danlaw - ASD (50%) - Remaining (% of original 8000)	100%	83 days	8/27/19	12/26/19	0 days
746	**3065**	**Equipment Delivered for 80% Installation - Partial Batch 1 - Danlaw - ASD (80%)**Removed per Amendment 6****	**100%**	**0 days**	**12/31/19**	**12/31/19**	**0 days**
747	2075	Production - Equipment for 80% Installation - Partial Batch 1 - Danlaw - ASD**Removed per Amendment 6**	100%	0 days	12/31/19	12/31/19	0 days
748	2076	Burn In Test - Equipment for 80% Installation - Partial Batch 1 - Danlaw - ASD**Removed per Amendment 6**	100%	0 days	12/31/19	12/31/19	0 days
749	2077	Equipment Delivered for 80% Installation - Partial Batch 1 - Danlaw - ASD (80%)**Removed per Amendment 6**	100%	0 days	12/31/19	12/31/19	0 days
750	**3066**	**Equipment Delivered for 80% Installation - Partial Batch 2 - Danlaw - ASD**Removed per Amendment 6****	**100%**	**0 days**	**12/31/19**	**12/31/19**	**0 days**
751	3015	Production - Equipment for 80% Installation - Partial Batch 2 - Danlaw - ASD**Removed per Amendment 6**	100%	0 days	12/31/19	12/31/19	0 days
752	3016	Burn In Test - Equipment for 80% Installation - Partial Batch 2 - Danlaw - ASD**Removed per Amendment 6**	100%	0 days	12/31/19	12/31/19	0 days
753	3017	Equipment Delivered for 80% Installation - Partial Batch 2 - Danlaw - ASD (80%)**Removed per Amendment 6**	100%	0 days	12/31/19	12/31/19	0 days
754	**3067**	**Equipment Delivered for 100% Installation - Danlaw - ASD**Removed per Amendment 6****	**100%**	**0 days**	**12/31/19**	**12/31/19**	**0 days**
755	2934	Production - Equipment for 100% Installation - Danlaw - ASD**Removed per Amendment 6**	100%	0 days	12/31/19	12/31/19	0 days



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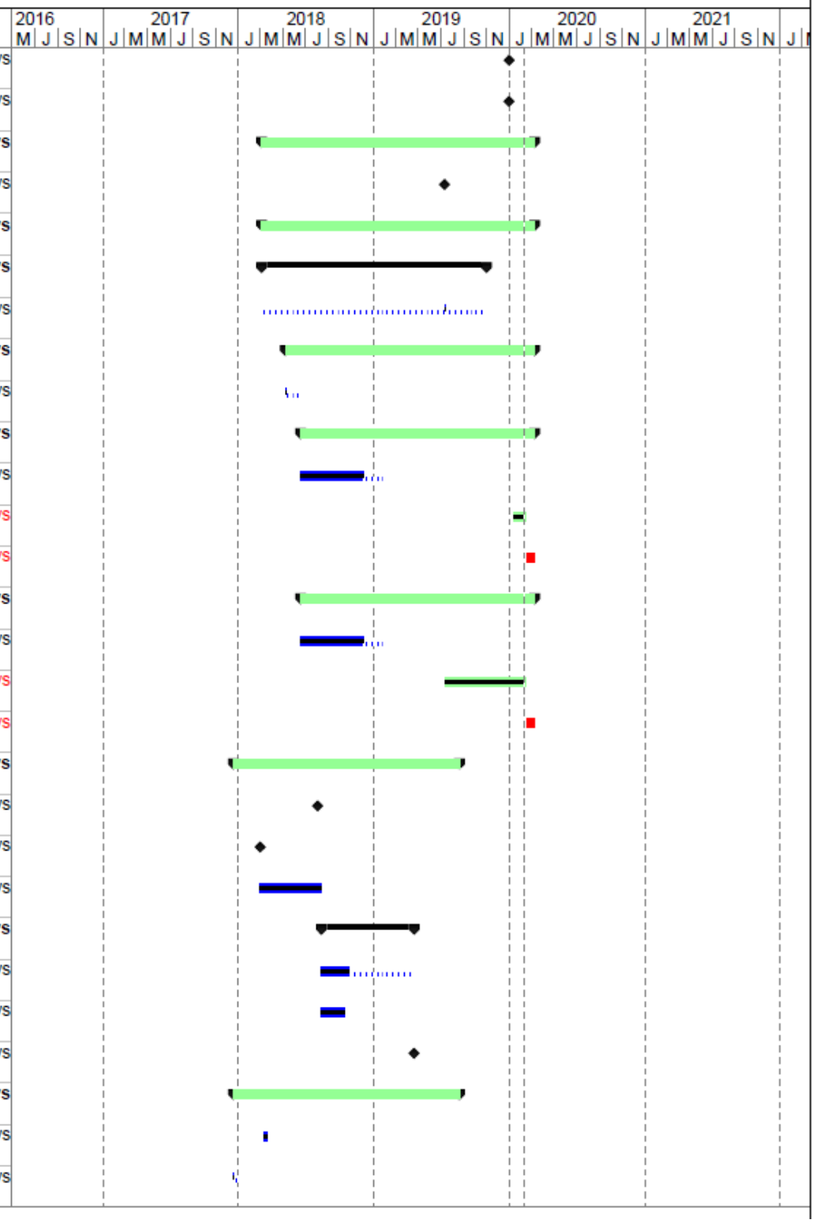
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
756	2935	Burn In Test - Equipment for 100% Installation - Danlaw - ASD**Removed per Amendment 6**	100%	0 days	12/31/19	12/31/19	0 days
757	2936	Equipment Delivered for 100% Installation - Danlaw - ASD (100%)**Removed per Amendment 6**	100%	0 days	12/31/19	12/31/19	0 days
758	**2078**	**Savari Schedule - PID**	95%	**506 days**	**3/5/18**	**3/9/20**	**-15 days**
759	2886	Milestone: NYC Issues and Executes Vendor Subcontract - Savari (PID Only)	100%	0 days	7/11/19	7/11/19	0 days
760	**2402**	**PID - Savari**	95%	**506 days**	**3/5/18**	**3/9/20**	**-15 days**
761	**2969**	**Savari Design Documentation - PID**	100%	**420 days**	**3/5/18**	**10/31/19**	**0 days**
762	2970	PID Design Documentation - Savari	100%	420 days	3/5/18	10/31/19	0 days
763	**2971**	**Savari Design and Development - PID**	92%	**460 days**	**5/8/18**	**3/9/20**	**-15 days**
764	2403	Design - PID - Savari	100%	29 days	5/8/18	6/18/18	0 days
765	**2998**	**Android Application - PID - Savari**	89%	**432 days**	**6/18/18**	**3/9/20**	**-15 days**
766	2405	Development - Android Application - PID - Savari	100%	156 days	6/18/18	1/31/19	0 days
767	2406	Testing - UI Logic and Feedback - Android Application - PID - Savari	71%	24 days	1/13/20	2/14/20	-296 days
768	2404	Deployment for Experiments and Trials (Prototype Delivery) - Android Application - PID - Savari	0%	15 days	2/18/20	3/9/20	-198 days
769	**2407**	**iOS Application - PID - Savari**	93%	**432 days**	**6/18/18**	**3/9/20**	**-15 days**
770	3000	Development - iOS Application - PID - Savari	100%	156 days	6/18/18	1/31/19	0 days
771	3001	Testing - UI Logic and Feedback - iOS Application - PID - Savari	95%	150 days	7/11/19	2/14/20	-296 days
772	3002	Deployment for Experiments and Trials (Prototype Delivery) - iOS Application - PID - Savari	0%	15 days	2/18/20	3/9/20	-198 days
773	**2088**	**Siemens Schedule - RSU**	99%	**419 days**	**12/19/17**	**8/19/19**	**0 days**
774	2884	Milestone: NYC Issues and Executes Vendor Subcontract - Siemens	100%	0 days	8/3/18	8/3/18	0 days
775	2089	Design Approval - Siemens - RSU	100%	0 days	2/28/18	2/28/18	0 days
776	2090	Finalize Specification with NYCDOT - Siemens - RSU	100%	115 days	3/1/18	8/10/18	0 days
777	**2112**	**Documentation and Drawing Submital - Siemens - RSU**	100%	**172 days**	**8/13/18**	**4/19/19**	**0 days**
778	2113	Applications documentation - Siemens - RSU	100%	172 days	8/13/18	4/19/19	0 days
779	2114	Non-safety feature documentation - Siemens - RSU (not required)	100%	43 days	8/13/18	10/12/18	0 days
780	2330	Milestone: Siemens Documentation complete - Siemens - RSU	100%	0 days	4/19/19	4/19/19	0 days
781	**2091**	**SW Functionality Releases - Siemens - RSU**	99%	**419 days**	**12/19/17**	**8/19/19**	**0 days**
782	2092	Receive OTA specification - Siemens - RSU	100%	4 days	3/13/18	3/17/18	0 days
783	2093	Receive Steinwurf library - Siemens - RSU	100%	9 days	12/19/17	1/2/18	0 days



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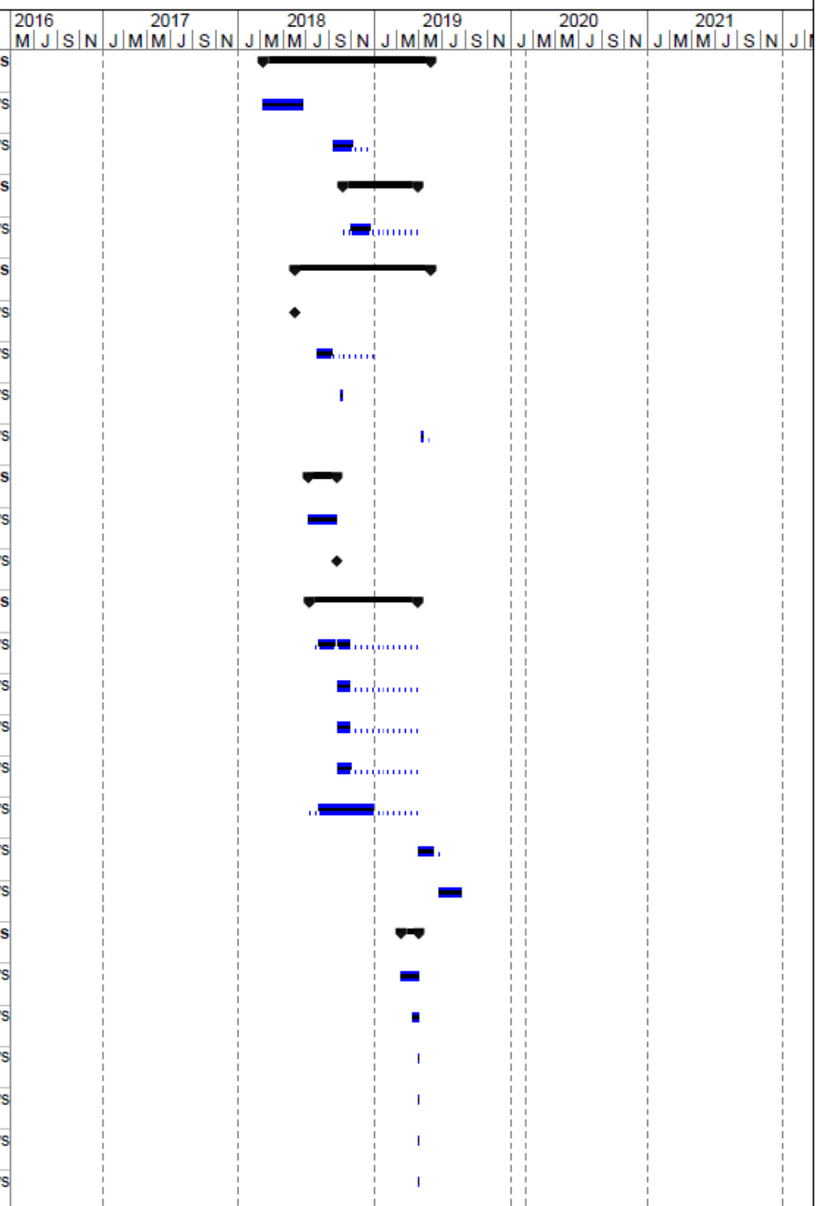
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
784	**2380**	**OTA - Siemens - Siemens - RSU**	**100%**	**311 days**	**3/8/18**	**5/31/19**	**0 days**
785	2094	Over the Air Update for ASD (OBU) -on Siemens - RSU	100%	74 days	3/8/18	6/20/18	0 days
786	2894	OTA on Demand - Siemens - RSU	100%	68 days	9/13/18	12/20/18	0 days
787	**2381**	**OTA - Back Office - Siemens - RSU**	**100%**	**138 days**	**10/8/18**	**4/26/19**	**0 days**
788	2097	Communication with Back office (Data Upload)	100%	138 days	10/8/18	4/26/19	0 days
789	**2895**	**OTA Testing - Siemens - RSU**	**100%**	**251 days**	**5/31/18**	**5/31/19**	**0 days**
790	2887	Receive OBUs for OTA testing - Siemens - RSU	100%	0 days	5/31/18	5/31/18	0 days
791	2890	In-house OTA testing - @ Danlaw Facility	100%	102 days	8/1/18	12/27/18	0 days
792	2889	In-house OTA testing - @ TCore Atlanta Facility	100%	2 days	10/3/18	10/4/18	0 days
793	2096	In-house OTA testing - @ New York Facility	100%	19 days	5/6/19	5/31/19	0 days
794	**2897**	**NYC CVP TMC RSU Interface Design Document - Siemens - RSU**	**100%**	**54 days**	**7/7/18**	**9/21/18**	**0 days**
795	2898	Develop/Review NYC CVP TMC - Siemens - RSU Interface Document - Siemens - RSU	100%	54 days	7/7/18	9/21/18	0 days
796	2896	Acceptance of NYC CVP TMC - Siemens - RSU Interface Design Document - Siemens - RSU	100%	0 days	9/21/18	9/21/18	0 days
797	**3008**	**Develop NYC CVP TMC RSU Interface - Siemens - RSU**	**100%**	**201 days**	**7/10/18**	**4/26/19**	**0 days**
798	2101	Communication ATC to RSU (OID and SPAT)	100%	196 days	7/17/18	4/26/19	0 days
799	2900	ATC MIB Object Test - Siemens - RSU	100%	148 days	9/24/18	4/26/19	0 days
800	2100	DTLS Implementation - Siemens - RSU	100%	148 days	9/24/18	4/26/19	0 days
801	2103	ASD Data Log Transfer - Siemens - RSU	100%	148 days	9/24/18	4/26/19	0 days
802	2104	Security, performance - Siemens - RSU	100%	201 days	7/10/18	4/26/19	0 days
803	2105	System Test - Siemens - RSU	100%	39 days	4/29/19	6/21/19	0 days
804	2901	System Support and Troubleshooting - Siemens - RSU	100%	40 days	6/24/19	8/19/19	0 days
805	**2106**	**Applications - Siemens - RSU**	**100%**	**34 days**	**3/13/19**	**4/29/19**	**0 days**
806	2102	RSU Computational data collection (first and last, detection zone) - Siemens - RSU	100%	33 days	3/13/19	4/26/19	0 days
807	2107	Red Light Violation Warning - Siemens - RSU	100%	10 days	4/15/19	4/26/19	0 days
808	2108	Speed Compliance - Siemens - RSU	100%	1 day	4/29/19	4/29/19	0 days
809	2109	Speed Compliance/Work Zone - Siemens - RSU	100%	1 day	4/29/19	4/29/19	0 days
810	2110	Oversize Vehicle Compliance - Siemens - RSU	100%	1 day	4/29/19	4/29/19	0 days
811	2111	Emergency Communications and Evacuations Information - Siemens - RSU	100%	1 day	4/29/19	4/29/19	0 days



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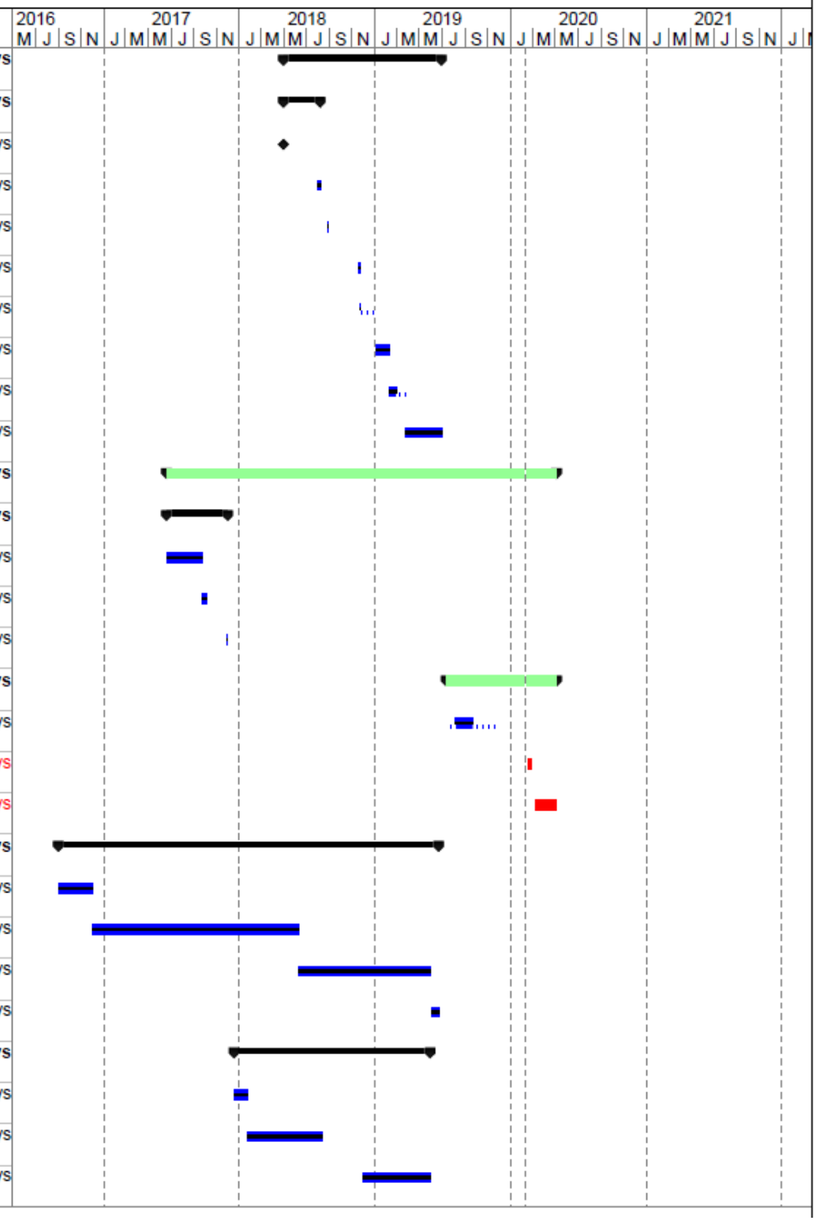
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
812	2115	**RSU Shipments - Siemens - RSU**	100%	294 days	4/30/18	6/28/19	0 days
813	2116	**Prototype Delivery - 10 - Siemens - RSU**	100%	69 days	4/30/18	8/6/18	0 days
814	2387	1st 2 - Siemens - RSU Prototype (Atlanta Lab)	100%	0 days	4/30/18	4/30/18	0 days
815	2386	Remaining 10 - Siemens - RSU Prototype	100%	3 days	8/2/18	8/6/18	0 days
816	2118	1st shipment - 10 - Siemens - RSU (for Installation Facilities) Prior to Prototype Testing	100%	1 day	8/27/18	8/27/18	0 days
817	2117	Place Production - Siemens - RSU Order	100%	1 day	11/20/18	11/20/18	0 days
818	2119	Equipment Delivered for 20% Installation - Siemens - RSU (20%)	100%	28 days	11/21/18	1/2/19	0 days
819	2120	Equipment Delivered for 50% Installation - Siemens - RSU (50%) - 200 RSUs	100%	26 days	1/3/19	2/8/19	0 days
820	2121	Equipment Delivered for 80% Installation - Siemens - RSU (80%) - 320 RSUs	100%	29 days	2/11/19	3/22/19	0 days
821	2122	Equipment Delivered for 100% Installation - Siemens - RSU (100%) - 400 RSUs	100%	69 days	3/25/19	6/28/19	0 days
822	2180	**Ped App Procurement (PID) - NYU and Savari**	79%	722 days	6/19/17	5/4/20	-101 days
823	2181	**Procure Sample PID App - NYU**	100%	114 days	6/19/17	11/30/17	0 days
824	2182	Decide on Procurement Method - PID App - NYU	100%	68 days	6/19/17	9/22/17	0 days
825	2183	Finalize PID Procurement Schedule - PID App - NYU	100%	6 days	9/25/17	10/2/17	0 days
826	2185	Sample Demonstration - PID App - NYU	100%	1 day	11/30/17	11/30/17	0 days
827	2973	**Procure PID Location Equipment - Savari**	67%	204 days	7/12/19	5/4/20	-101 days
828	2974	Production and Delivery of Sample PID Location Equipment - Savari (2 Pcs for Sample)	100%	93 days	7/12/19	11/22/19	0 days
829	2976	Sample Demonstration - PID Location Equipment - Savari	0%	5 days	2/18/20	2/24/20	-296 days
830	2187	Procure & Receive Production - PID App and Location Equipment - Savari (98 Pcs for Production) (may be reduced to 10)	0%	40 days	3/10/20	5/4/20	-101 days
831	2214	**PED Detection Systems**	100%	703 days	9/1/16	6/21/19	0 days
832	2215	Determine device specifications and procurement method - PED	100%	61 days	9/1/16	11/30/16	0 days
833	2216	Procure PED Detection Systems	100%	382 days	12/1/16	6/8/18	0 days
834	2409	Work with vendor to finalize locations and delivery schedule, etc - PED	100%	245 days	6/11/18	5/31/19	0 days
835	2430	Plan for Installation - PED	100%	15 days	6/3/19	6/21/19	0 days
836	2190	**Installation Services Procurement**	100%	363 days	12/18/17	5/29/19	0 days
837	2191	Prepare Specification from Installation Procedures - Drafts - Taxi & MTA	100%	24 days	12/18/17	1/23/18	0 days
838	2192	Finalize Installation Contracts	100%	140 days	1/24/18	8/10/18	0 days
839	3079	Procurement Period - Taxi	100%	181.38 edays	11/29/18	5/29/19	0 edays



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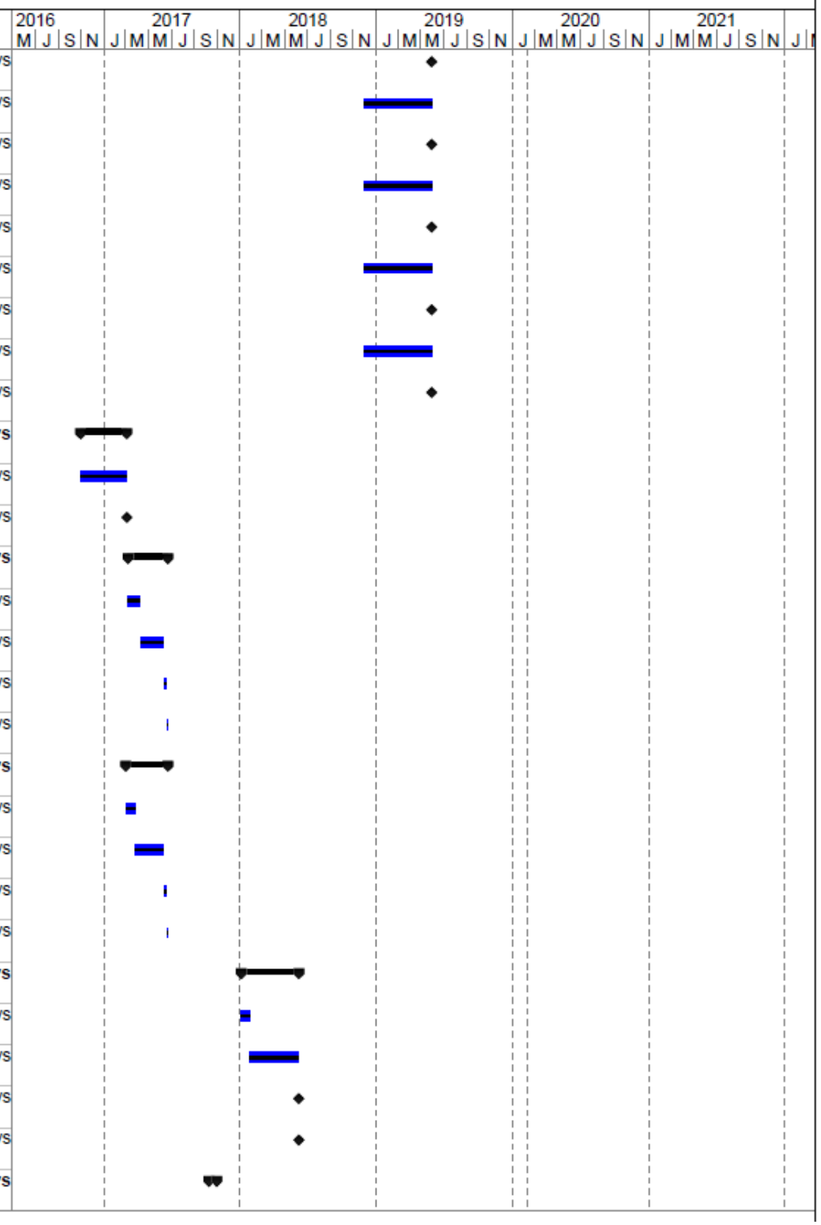
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
840	3080	Installation Services Contract Complete - Taxi	100%	0 days	5/29/19	5/29/19	0 days
841	3083	Procurement Period - NYC Fleet Vehicles	100%	181.38 edays	11/29/18	5/29/19	0 edays
842	3084	Installation Services Contract Complete - NYC Fleet Vehicles	100%	0 days	5/29/19	5/29/19	0 days
843	3081	Procurement Period - MTA	100%	181.38 edays	11/29/18	5/29/19	0 edays
844	3082	Installation Services Contract Complete - MTA	100%	0 days	5/29/19	5/29/19	0 days
845	3085	Procurement Period - DCAS	100%	181.38 edays	11/29/18	5/29/19	0 edays
846	3086	Installation Services Contract Complete - DCAS	100%	0 days	5/29/19	5/29/19	0 days
847	2193	Procurement Period - Sanitation	100%	181.38 edays	11/29/18	5/29/19	0 edays
848	2194	Installation Services Contract Complete - Sanitation	100%	0 days	5/29/19	5/29/19	0 days
849	**2195**	**Volume Monitoring Stations (Procument Canceled - Another Solution Selected)**	**100%**	**84 days**	**10/31/16**	**3/3/17**	**0 days**
850	2196	Determine device specifications and procurement method - Volume Monitoring Stations	100%	84 days	10/31/16	3/3/17	0 days
851	2197	Procure Volume Monitoring Stations - Volume Monitoring Stations	100%	0 days	3/3/17	3/3/17	0 days
852	**2198**	**Network Equipment**	**100%**	**76 days**	**3/7/17**	**6/21/17**	**0 days**
853	2199	Develop Specification and Procurement Method - Network Equipment	100%	24 days	3/7/17	4/7/17	0 days
854	2200	Purchase and Receive - Network Equipment	100%	44 days	4/10/17	6/9/17	0 days
855	2201	Add to Inventory - Network Equipment	100%	4 days	6/12/17	6/15/17	0 days
856	2202	Add into Budget Tracking - Network Equipment	100%	3 days	6/19/17	6/21/17	0 days
857	**2203**	**TMC Hardware & Licenses**	**100%**	**80 days**	**3/1/17**	**6/21/17**	**0 days**
858	2204	Develop Specification and Procurement Method - TMC Hardware & Licenses	100%	18 days	3/1/17	3/24/17	0 days
859	2205	Purchase and Receive - TMC Hardware & Licenses	100%	54 days	3/27/17	6/9/17	0 days
860	2206	Add to Inventory - TMC Hardware & Licenses	100%	4 days	6/12/17	6/15/17	0 days
861	2207	Add into Budget Tracking - TMC Hardware & Licenses	100%	3 days	6/19/17	6/21/17	0 days
862	**2208**	**Online Training Module SW License**	**100%**	**107 days**	**1/5/18**	**6/8/18**	**0 days**
863	2209	Clarify Need - Online Training Module SW License	100%	14 days	1/5/18	1/25/18	0 days
864	2210	Research Tools - Online Training Module SW License	100%	93 days	1/26/18	6/7/18	0 days
865	2211	Identified as Not Needed for Install Training - Online Training Module SW License	100%	0 days	6/7/18	6/7/18	0 days
866	2408	Identified as Not Needed for Driver Training - Online Training Module SW License	100%	0 days	6/8/18	6/8/18	0 days
867	**2212**	**Captivate SW License - Not needed**	**100%**	**15 days**	**10/10/17**	**10/30/17**	**0 days**



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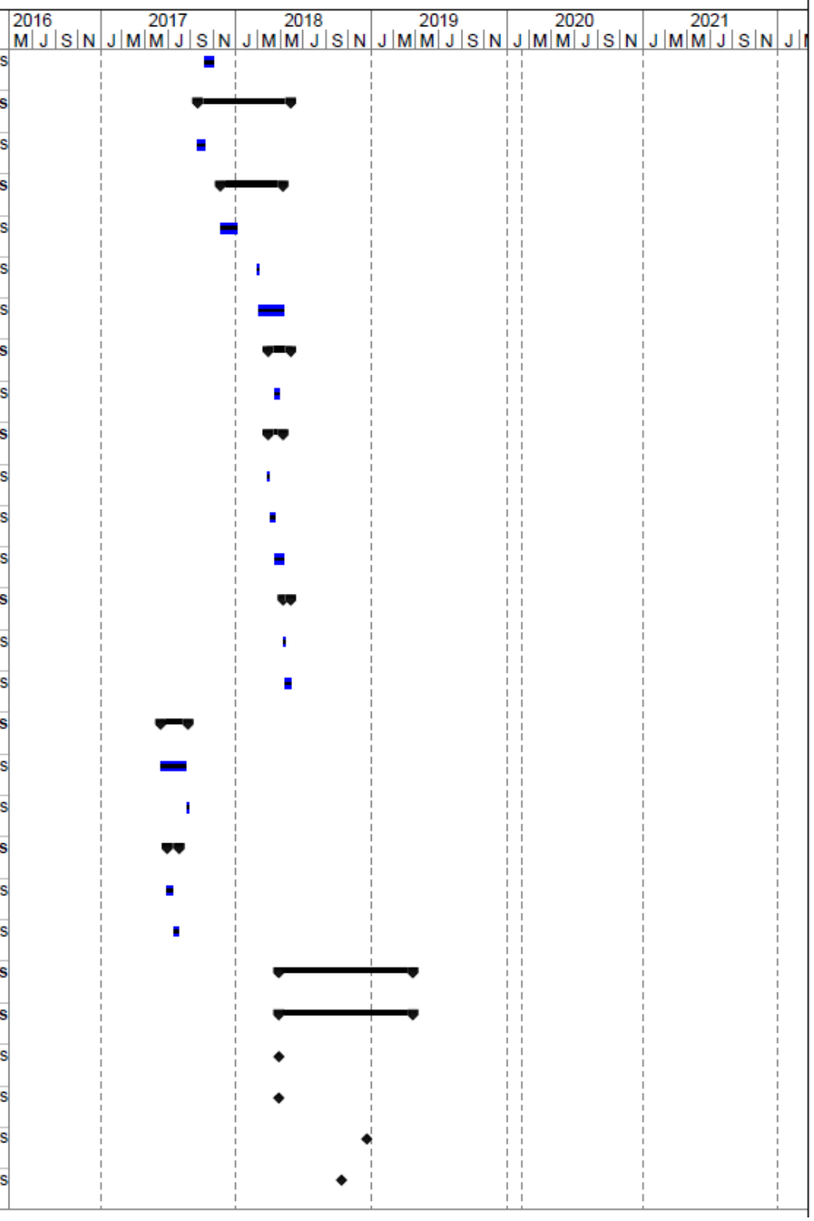
868	2213	Clarify Need - Captivate SW License	100%	15 days	10/10/17	10/30/17	0 days
869	**2219**	**ISS TMC Authority System (ITAS) Schedule (Change Order #3)**	**100%**	**171 days**	**9/20/17**	**5/28/18**	**0 days**
870	2220	Finalize SOW - ISS	100%	13 days	9/20/17	10/6/17	0 days
871	**2221**	**Test/QA - ISS**	**100%**	**116 days**	**11/20/17**	**5/7/18**	**0 days**
872	2222	Establish Connection - ISS	100%	29 days	11/20/17	1/2/18	0 days
873	2223	Establish Testing Plan and Contacts - ISS	100%	1 day	3/1/18	3/1/18	0 days
874	2224	Test within Host Environment (HSM) - ISS	100%	47 days	3/2/18	5/7/18	0 days
875	**2225**	**Deliver and Install HSM - ISS**	**100%**	**42 days**	**3/29/18**	**5/28/18**	**0 days**
876	2226	Ship and Deliver HSM Device - ISS	100%	8 days	4/17/18	4/26/18	0 days
877	**2227**	**Configure Network for HSM - ISS**	**100%**	**28 days**	**3/29/18**	**5/7/18**	**0 days**
878	2228	Hold Kickoff Meeting - ISS	100%	1 day	3/29/18	3/29/18	0 days
879	2229	Complete Plant Worksheet - ISS	100%	9 days	4/4/18	4/16/18	0 days
880	2230	Establish & Test VPN Access for ISS	100%	15 days	4/17/18	5/7/18	0 days
881	**2231**	**HSM SetUp - ISS**	**100%**	**14 days**	**5/8/18**	**5/28/18**	**0 days**
882	2232	Rack and Prep Device - ISS	100%	5 days	5/8/18	5/14/18	0 days
883	2233	Test and Finalize Set Up - ISS	100%	9 days	5/15/18	5/28/18	0 days
884	**2234**	**ASTC Interface Updates**	**100%**	**53 days**	**6/12/17**	**8/24/17**	**0 days**
885	2235	Finalize SOW - ASTC Interface Updates	100%	49 days	6/12/17	8/18/17	0 days
886	2236	Execute SOW/PO - ASTC Interface Updates	100%	4 days	8/21/17	8/24/17	0 days
887	**2237**	**RTCM Facilities**	**100%**	**21 days**	**6/30/17**	**7/31/17**	**0 days**
888	2238	Finalize SOW - RTCM Facilities	100%	10 days	6/30/17	7/14/17	0 days
889	2239	Execute SOW/PO - RTCM Facilities	100%	11 days	7/17/17	7/31/17	0 days
890	**2299**	**Vendor Design and Test Documentation**	**100%**	**247 days**	**4/27/18**	**4/22/19**	**0 days**
891	**2300**	**ASD and RSU Vendor Design Completion Milestones**	**100%**	**247 days**	**4/27/18**	**4/22/19**	**0 days**
892	2301	Milestone: V2V Design Document Complete - Danlaw	100%	0 days	4/27/18	4/27/18	0 days
893	2302	Milestone: V2I Design Documents Complete - Danlaw	100%	0 days	4/27/18	4/27/18	0 days
894	2917	Milestone: Non-Safety App Design Documents Complete - ASDs - Danlaw	100%	0 days	12/20/18	12/20/18	0 days
895	2303	Milestone: Non-Safety App Design Documents Complete - RSUs - Siemens	100%	0 days	10/12/18	10/12/18	0 days



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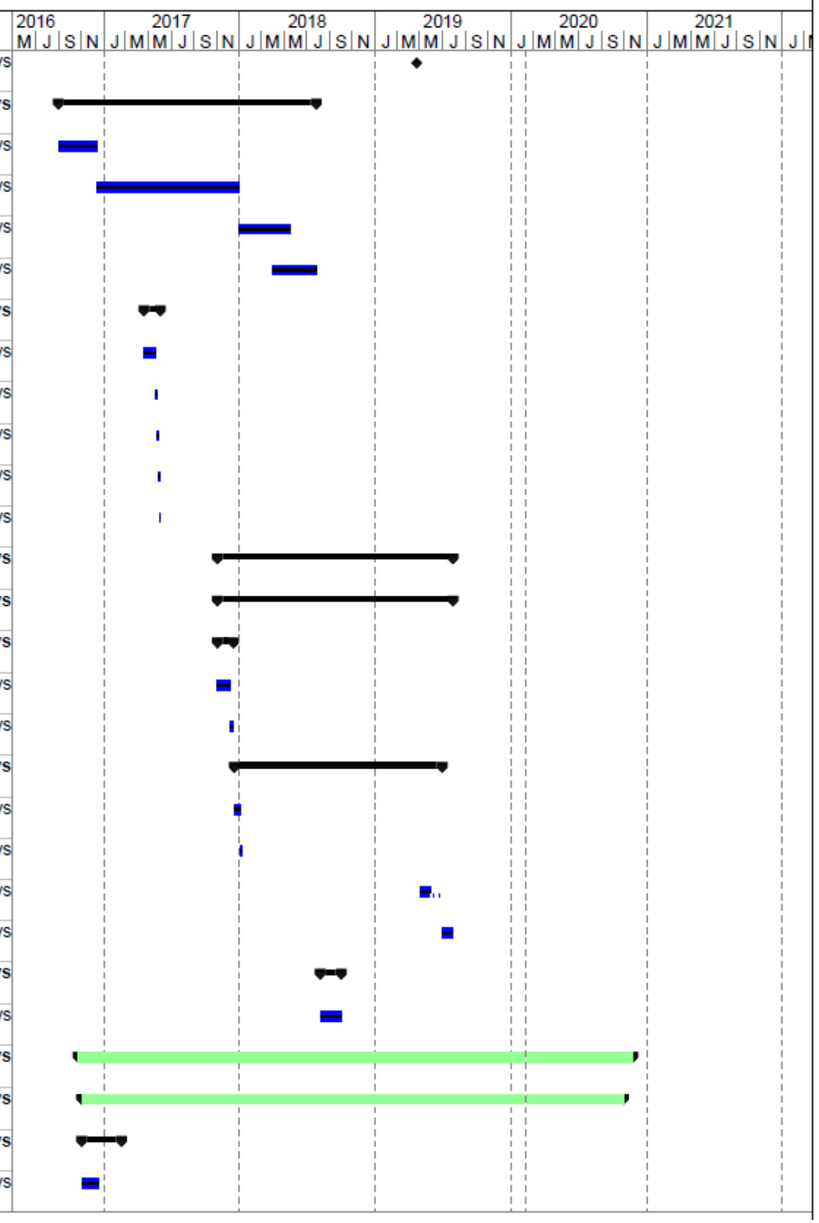
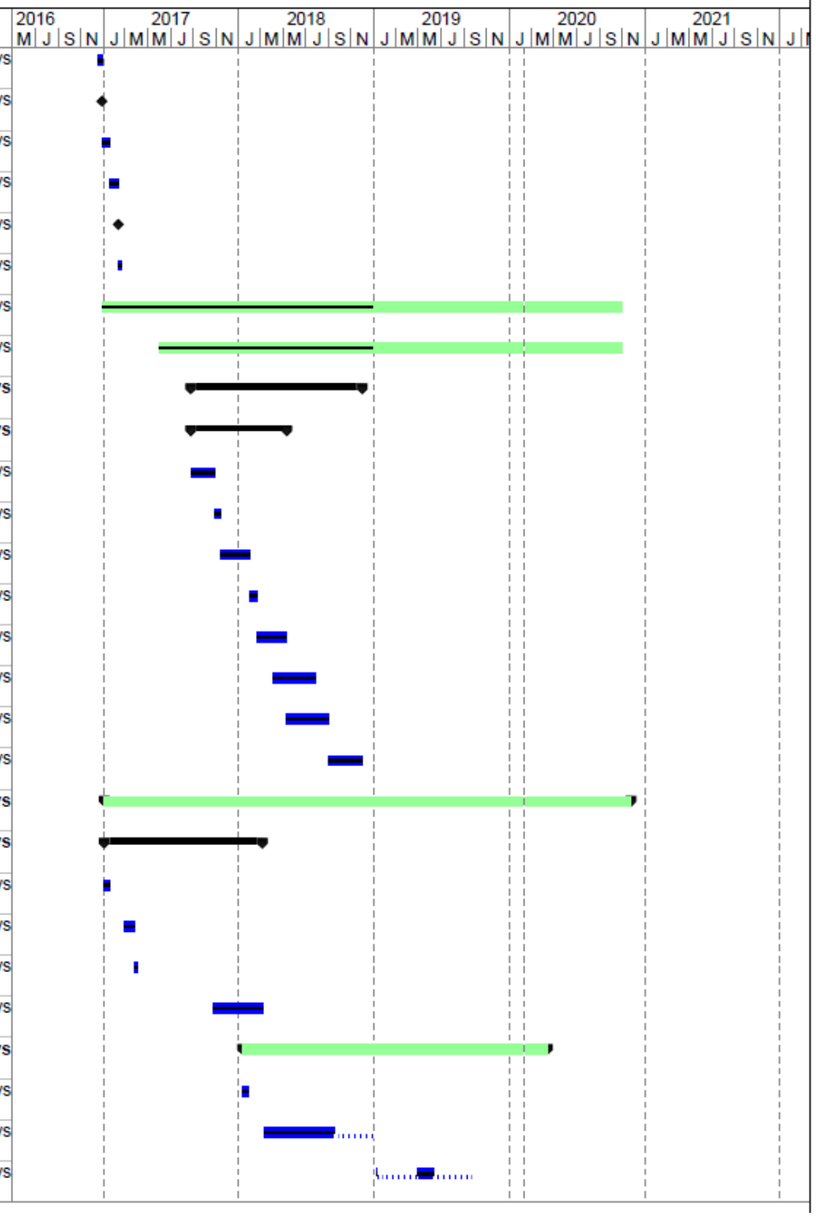
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
896	2304	Milestone: All Other Vendor Test Documentation Complete	100%	0 days	4/22/19	4/22/19	0 days
897	**2041**	**DSRC License Registration**	**100%**	**476 days**	**9/1/16**	**7/26/18**	**0 days**
898	2042	Register 10 prototype sites - DSRC License Registration	100%	71 days	9/1/16	12/14/16	0 days
899	2043	Register all project sites (initial sites) - DSRC License Registration	100%	260 days	12/15/16	12/28/17	0 days
900	2044	Register additional sites - DSRC License Registration	100%	98 days	12/29/17	5/18/18	0 days
901	2319	Research need for paperwork to extend licenses - DSRC License Registration	100%	82 days	4/2/18	7/26/18	0 days
902	**1253**	**Inventory Tracking Planning**	**100%**	**31 days**	**4/19/17**	**6/1/17**	**0 days**
903	1254	Prepare Draft Inventory Tracking Tool	100%	22 days	4/19/17	5/18/17	0 days
904	1255	Review Inventory Tracking Tool	100%	3 days	5/19/17	5/23/17	0 days
905	1256	Update Inventory Tracking Tool	100%	3 days	5/24/17	5/26/17	0 days
906	1258	Review Inventory Tracking Tool	100%	1 day	5/29/17	5/30/17	0 days
907	1257	Finalize Inventory Tracking Tool	100%	2 days	5/31/17	6/1/17	0 days
908	**1545**	**Installation Procedures**	**100%**	**434 days**	**11/3/17**	**7/29/19**	**0 days**
909	**1553**	**ASD Installation Procedures**	**100%**	**434 days**	**11/3/17**	**7/29/19**	**0 days**
910	**1546**	**ASD Installation Procedures - Draft 1**	**100%**	**29 days**	**11/3/17**	**12/15/17**	**0 days**
911	1547	ASD: Draft 1 of ASD Installation Procedures	100%	21 days	11/3/17	12/5/17	0 days
912	1548	Internal Review of Installation Procedures - Draft 1	100%	8 days	12/6/17	12/15/17	0 days
913	**1550**	**ASD Installation Procedures - Draft 2**	**100%**	**385 days**	**12/18/17**	**6/30/19**	**0 days**
914	1551	ASD: Draft 2 of ASD Installation Procedures	100%	10 days	12/18/17	1/2/18	0 days
915	1552	Internal Review of Installation Procedures - Draft 2	100%	3 days	1/3/18	1/5/18	0 days
916	3007	Verify Install Procedures - Prototype Installation (for 20% Install)	100%	42 days	5/1/19	6/30/19	0 days
917	1560	ASD Installation Procedure Finalization and Validation	100%	20 days	6/30/19	7/29/19	0 days
918	**1549**	**RSU Installation Procedures**	**100%**	**39 days**	**8/7/18**	**10/1/18**	**0 days**
919	1562	RSU Installation Procedure Development	100%	39 days	8/7/18	10/1/18	0 days
920	**98**	**Task 2E: Application Development**	**80%**	**1026 days**	**10/24/16**	**11/24/20**	**44 days**
921	**30**	**Application Development Schedule (ADS)**	**55%**	**1002 days**	**11/2/16**	**10/30/20**	**60.5 days**
922	**927**	**Initial ADS**	**100%**	**72 days**	**11/2/16**	**2/17/17**	**0 days**
923	238	Prepare the Initial ADS	100%	30 days	11/2/16	12/16/16	0 days



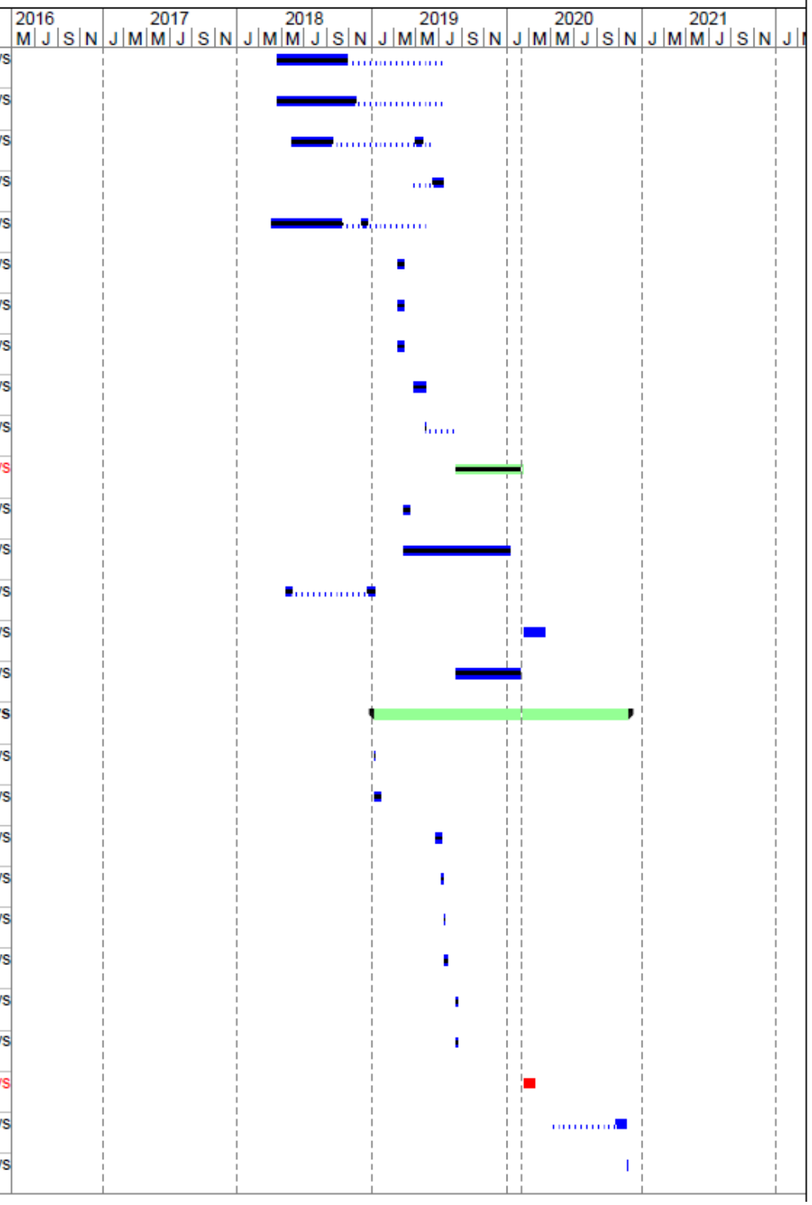
NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
924	928	Integrate ADS into overall schedule	100%	7 days	12/16/16	12/28/16	0 days
925	239	Submit the ADS to USDOT	100%	0 days	12/28/16	12/28/16	0 days
926	1154	USDOT Review ADS	100%	12 days	12/28/16	1/17/17	0 days
927	1155	Address USDOT Comments - ADS	100%	18 days	1/17/17	2/10/17	0 days
928	1156	Submit Updated ADS	100%	0 days	2/10/17	2/10/17	0 days
929	1173	USDOT Review & Approval of ADS	100%	5 days	2/10/17	2/17/17	0 days
930	31	ADS Updates with Progress/Risk Summary (LOE)	52%	965 days	12/28/16	10/30/20	60.5 days
931	32	Open Source Software and Supporting Documentation (LOE)	46%	859 days	6/1/17	10/30/20	60 days
932	**1492**	**ASTC Vendor (PEEK) Updates the ASTC Interface**	**100%**	**317 days**	**8/24/17**	**11/30/18**	**0 days**
933	**1659**	**Protocol Design Document - ASTC (PEEK) Interface**	**100%**	**177 days**	**8/24/17**	**5/10/18**	**0 days**
934	1522	Protocol Design Document - ASTC (PEEK) Interface	100%	43 days	8/24/17	10/26/17	0 days
935	1660	Review and Finalization - ASTC (PEEK) Interface	100%	12 days	10/27/17	11/14/17	0 days
936	1783	Review & Discuss - ASTC (PEEK) Interface	100%	50 days	11/15/17	1/29/18	0 days
937	1782	Revise per Comments - ASTC (PEEK) Interface	100%	14 days	1/30/18	2/19/18	0 days
938	1662	Approval - ASTC (PEEK) Interface	100%	58 days	2/20/18	5/10/18	0 days
939	1520	Provide Test Procedures - ASTC (PEEK) Interface	100%	80 days	4/5/18	7/27/18	0 days
940	1784	Complete Release 1 - ASTC (PEEK) Interface	100%	81 days	5/9/18	8/31/18	0 days
941	2388	Test and Fix - ASTC (PEEK) Interface	100%	61 days	9/1/18	11/30/18	0 days
942	**236**	**Develop Back Office/TMC Application Software (TransCore)**	**92%**	**979 days**	**1/3/17**	**11/24/20**	**44 days**
943	**1947**	**Initial Design Planning - Back Office/TMC Application Software**	**100%**	**293 days**	**1/3/17**	**3/5/18**	**0 days**
944	1948	Data base Schema Layout	100%	9 days	1/3/17	1/16/17	0 days
945	1949	Define Filestructure for Event Data	100%	20 days	2/27/17	3/24/17	0 days
946	1950	Obfuscation Design Review	100%	5 days	3/27/17	3/31/17	0 days
947	1951	Generate a document that outlines the format of event and RF data and share with vendor	100%	90 days	10/23/17	3/5/18	0 days
948	**1953**	**Back Office Software Development (TransCore ATC)**	**98%**	**565 days**	**1/12/18**	**4/13/20**	**198 days**
949	1952	Weather data – receive and store	100%	9 days	1/12/18	1/25/18	0 days
950	3069	Manage X.509 - Release 1	100%	207 days	3/13/18	1/7/19	0 days
951	1932	Manage X.509 - Release 2	100%	185 days	1/8/19	9/30/19	0 days



NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
952	1933	Manage TIM	100%	305 days	4/20/18	7/8/19	0 days
953	1934	Manage MAP	100%	305 days	4/20/18	7/8/19	0 days
954	1936	RSU Comm Mgr	100%	263 days	5/28/18	6/13/19	0 days
955	1935	Modify UCM (for RSU)	100%	55 days	4/25/19	7/12/19	0 days
956	1937	ASTC Support	100%	289 days	4/3/18	5/24/19	0 days
957	1938	RF Upload	100%	13 days	3/12/19	3/28/19	0 days
958	1939	TT Upload	100%	13 days	3/12/19	3/28/19	0 days
959	1940	ASD Event Upload	100%	13 days	3/12/19	3/28/19	0 days
960	1941	ASD Event Decode	100%	22 days	4/25/19	5/24/19	0 days
961	1942	ASD Event Treatment (without obfuscation)	100%	58 days	5/24/19	8/16/19	0 days
962	1946	ASD Event Treatment (including obfuscation)	94%	123 days	8/19/19	2/14/20	-332 days
963	1943	RF Heat Map	100%	11 days	3/29/19	4/12/19	0 days
964	1944	TT Calculation	100%	198 days	3/29/19	1/10/20	0 days
965	1945	PID Support	100%	163 days	5/15/18	1/8/19	0 days
966	3116	Performance Evaluation (TransCore & Cambridge Systems)	0%	40 days	2/17/20	4/13/20	198 days
967	1930	Management Reports	100%	116 days	8/19/19	2/5/20	0 days
968	1050	**Code Release and Bug Fixes**	17%	474 days	1/8/19	11/24/20	44 days
969	1954	Code Release for Dry Run 1 - TransCore BOS	100%	2 days	1/8/19	1/9/19	0 days
970	3058	Fix Critical Bug Fixes from Code Release for Dry Run 1 - Prototype Test Phase 1	100%	10 days	1/10/19	1/24/19	0 days
971	3057	Code Release prior to Install - TransCore BOS - Prototype Test Phase 2	100%	10 days	6/22/19	7/8/19	0 days
972	1599	Fix Critical Bug Fixes from Code Release prior to Installation	100%	3 days	7/9/19	7/11/19	0 days
973	1955	Code Release for Dry Run 2 - TransCore BOS	100%	2 days	7/15/19	7/16/19	0 days
974	1958	Fix Critical Bug Fixes from Code Release for Dry Run 2	100%	5 days	7/17/19	7/23/19	0 days
975	1957	Code Release prior to Operational Readiness Demonstration - TransCore BOS	100%	1 day	8/19/19	8/19/19	0 days
976	3106	Fix Critical Bug Fixes from Code Release Prior to Operational Readiness Demonstration - Part 1	100%	1 day	8/19/19	8/19/19	0 days
977	3122	Fix Critical Bug Fixes from ASD Punchlist and ORD Part 1 - Prior to Operational Readiness Demonstration - Part 2	0%	20 days	2/17/20	3/16/20	-332 days
978	1960	Fix Critical Bug Fixes from Code Release Prior to Final Production Code Release	0%	145 days	4/27/20	11/20/20	44 days
979	1956	Code Release - Final Production - TranScore BOS	0%	2 days	11/23/20	11/24/20	44 days



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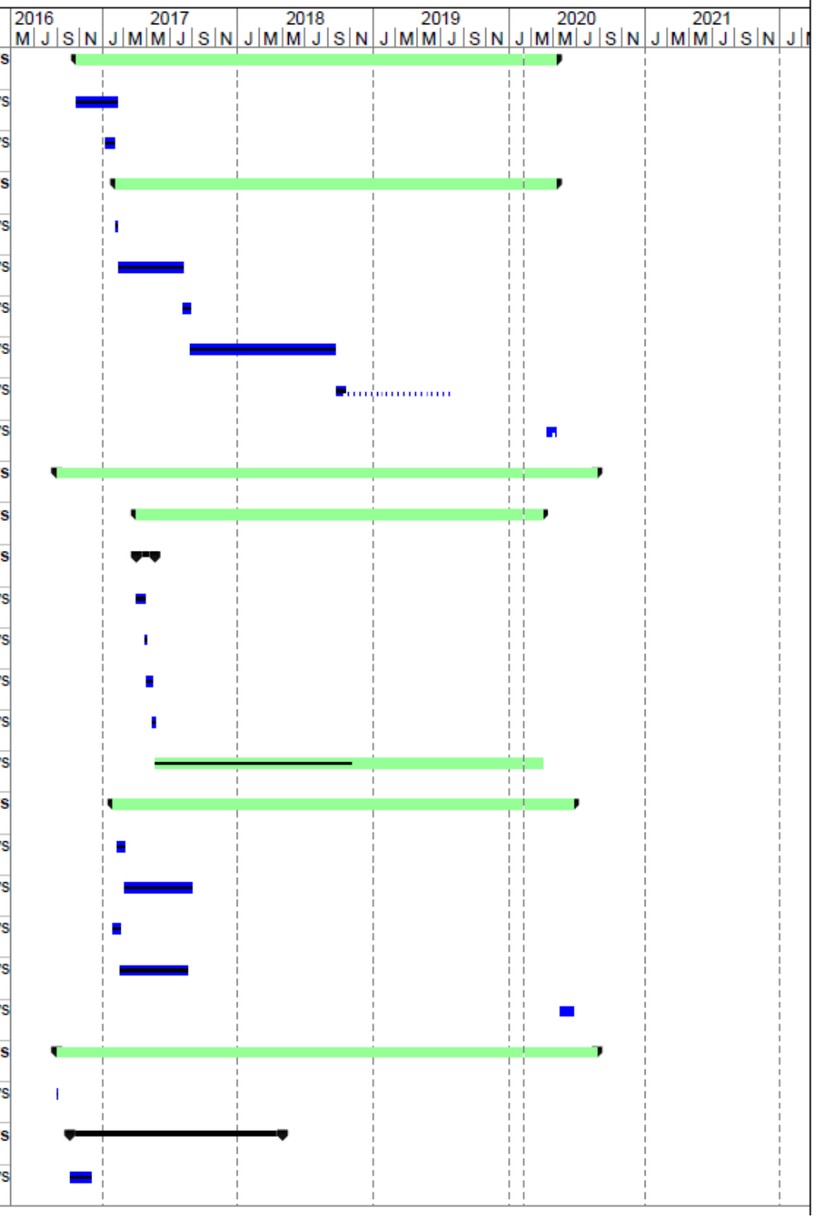
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
980	441	**MAP Message DB Development (TransCore)**	97%	**889 days**	**10/24/16**	**5/8/20**	**181 days**
981	442	Tools & Methods Determined - MAP Message DB	100%	73 days	10/24/16	2/8/17	0 days
982	1142	Prepare Initial Instructions and Priority List - MAP Message DB	100%	15 days	1/11/17	2/1/17	0 days
983	443	**MAP Data Collection**	97%	**819 days**	**2/6/17**	**5/8/20**	**181 days**
984	1146	Orientation to Tool - MAP Message DB	100%	5 days	2/6/17	2/10/17	0 days
985	1542	Develop Entry Procedures and Work through tool issues - MAP Message DB	100%	122 days	2/13/17	8/4/17	0 days
986	1543	Enter Priority Locations -MAP Message DB	100%	15 days	8/7/17	8/25/17	0 days
987	1145	Enter MAP Location Information for All Sites - MAP Message DB	100%	269 days	8/28/17	9/21/18	0 days
988	3141	Fine tune and adjust - MAP Message DB	100%	217 days	9/24/18	8/5/19	0 days
989	1743	Validation - MAP Message DB	0%	20 days	4/13/20	5/8/20	181 days
990	99	**Task 2F: Participant and Staff Training**	79%	**999 days**	**9/1/16**	**8/25/20**	**106 days**
991	1335	**Training Implementation Schedule (TIS)**	53%	**752 days**	**4/3/17**	**3/31/20**	**84 days**
992	33	**Initial Training Implementation Schedule (TIS)**	100%	**36 days**	**4/3/17**	**5/22/17**	**0 days**
993	240	Prepare the Initial TIS	100%	19 days	4/3/17	4/27/17	0 days
994	448	Submit the TIS to USDOT	100%	2 days	4/28/17	5/1/17	0 days
995	1352	USDOT Review of TIS	100%	10 days	5/2/17	5/15/17	0 days
996	1353	Address USDOT Questions/Comments - TIS	100%	5 days	5/16/17	5/22/17	0 days
997	35	Updated TIS with Progress/Risk Summary (LOE)	51%	716 days	5/23/17	3/31/20	84 days
998	929	**Training Facility Planning**	98%	**855 days**	**1/30/17**	**6/23/20**	**105 days**
999	930	Determine What Training Facilities are needed for NYC Installers Training	100%	14 days	2/9/17	3/1/17	0 days
1000	933	Reservation Period for Training Room - NYC Installers Training	100%	180 edays	3/1/17	8/28/17	0 edays
1001	932	Determine what facilities are needed for Fleet Installers Training	100%	15 days	1/30/17	2/17/17	0 days
1002	934	Reservation Period for Training Room - Fleet Installers Training	100%	180 edays	2/17/17	8/16/17	0 edays
1003	2966	Determine What Training Facilities are needed for Fleet Driver Training	0%	25 days	5/19/20	6/23/20	105 days
1004	505	**IRB Approval**	80%	**999 days**	**9/1/16**	**8/25/20**	**106 days**
1005	507	Initial Application Approval focused on Drivers	100%	1 day	9/1/16	9/1/16	0 days
1006	506	**Initial Approval IRB Amendment - Pedestrians**	100%	**392 days**	**10/6/16**	**5/1/18**	**0 days**
1007	1249	Prepare High Level Pedestrian App design documentation	100%	37 days	10/6/16	11/30/16	0 days



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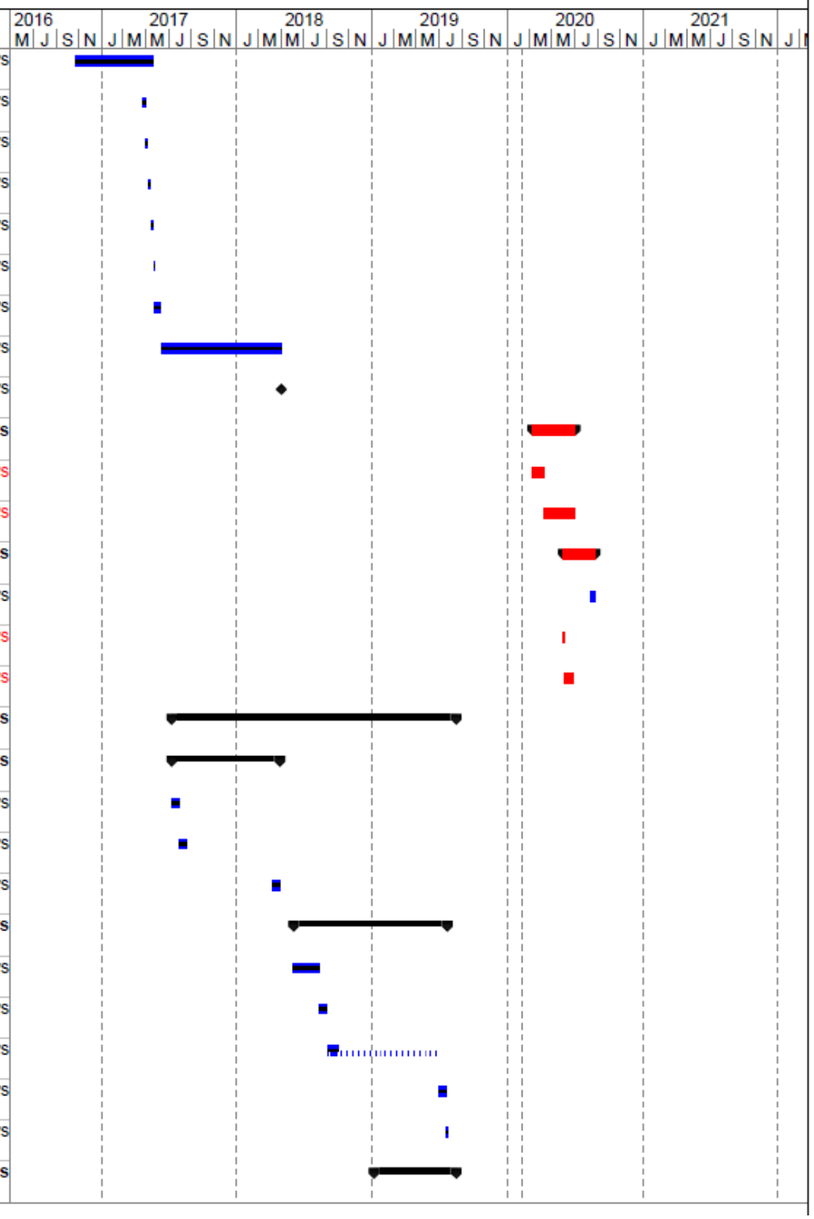
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1008	512	Finalize Consent Form	100%	144 days	10/24/16	5/19/17	0 days
1009	1247	Data Management Plan	100%	5 days	4/24/17	4/28/17	0 days
1010	1246	Data Use Agreement	100%	5 days	5/1/17	5/5/17	0 days
1011	513	Finalize Recruitment Plan	100%	5 days	5/8/17	5/12/17	0 days
1012	1245	Finalize IRB Submission Documentation	100%	5 days	5/15/17	5/19/17	0 days
1013	515	Initial IRB Board Review and Approval	100%	3 days	5/22/17	5/24/17	0 days
1014	1359	Finalize Recruitment Letter	100%	9 days	5/25/17	6/7/17	0 days
1015	1248	Certificate of Confidentiality - Excluded from Scope	100%	223 days	6/12/17	5/1/18	0 days
1016	1601	Receive Approved Certificate of Confidentiality (No longer included)	100%	0 days	5/1/18	5/1/18	0 days
1017	**1729**	**Pedestrian Recruitment - PID - NYU**	**0%**	**82 days**	**3/10/20**	**7/2/20**	**-198 days**
1018	1354	Finalize Pedestrian Recruitment Material - PID - NYU	0%	22 days	3/10/20	4/8/20	-198 days
1019	514	Recruit and Consent Pedestrians - PID - NYU	0%	60 days	4/9/20	7/2/20	-143 days
1020	**36**	**Pre-Training Human Use Approval Confirmation Materials**	**0%**	**61 days**	**6/1/20**	**8/25/20**	**-134 days**
1021	450	Pre-Training Human Use Approval Confirmation Materials - Drivers (if needed)	0%	10 days	8/12/20	8/25/20	106 days
1022	2421	Determine if IRB submission is needed prior to device distribution	0%	3 days	6/1/20	6/3/20	-134 days
1023	449	IRB Confirmation Materials - Pedestrians (if needed)	0%	17 days	6/4/20	6/26/20	-134 days
1024	**1277**	**ASD Installation Training**	**100%**	**530 days**	**7/10/17**	**8/16/19**	**0 days**
1025	**1281**	**Prepare High-Level ASD Installer Training Plan**	**100%**	**202 days**	**7/10/17**	**4/27/18**	**0 days**
1026	1282	Prepare Draft Trainig Plan- ASD Installer Training	100%	15 days	7/10/17	7/28/17	0 days
1027	1283	Review Training Plan - ASD Installer Training	100%	15 days	7/31/17	8/18/17	0 days
1028	1284	Finalize Training Plan - ASD Installer Training	100%	15 days	4/9/18	4/27/18	0 days
1029	**1285**	**Prepare ASD Installer Training Materials**	**100%**	**286 days**	**6/4/18**	**7/23/19**	**0 days**
1030	1288	Prepare Draft Materials - ASD Installer Training	100%	49 days	6/4/18	8/10/18	0 days
1031	1287	Review Training Materials- ASD Installer Training	100%	15 days	8/13/18	8/31/18	0 days
1032	1286	Finalize Training Materials- ASD Installer Training	100%	206 days	9/3/18	6/28/19	0 days
1033	1435	USDOT Reviews Training Materials - ASD Installer Training	100%	14 days	7/1/19	7/19/19	0 days
1034	1434	Finalize Training Materials - ASD Installer Training	100%	2 days	7/22/19	7/23/19	0 days
1035	**1289**	**Train ASD Installers**	**100%**	**156 days**	**1/7/19**	**8/16/19**	**0 days**



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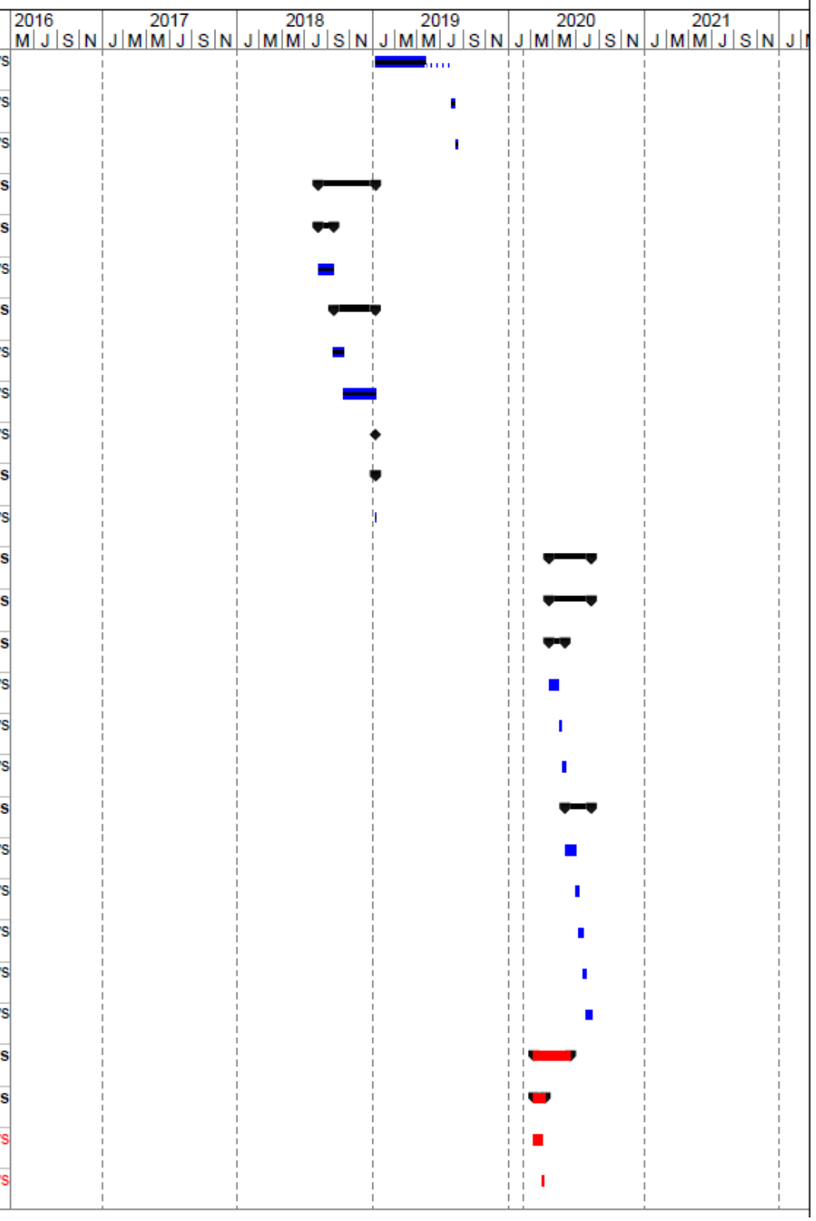
1036	1290	Train NYC ASD Installers	100%	144 days	1/7/19	7/31/19	0 days
1037	1291	Train Fleet Installer Trainers	100%	7 days	8/1/19	8/9/19	0 days
1038	1292	Fleet Trainers Train Their Installers	100%	5 days	8/12/19	8/16/19	0 days
1039	**1278**	**RSU Installation Training**	**100%**	**105 days**	**8/7/18**	**1/8/19**	**0 days**
1040	**1293**	**Prepare High-Level RSU Installer Training Plan**	**100%**	**29 days**	**8/7/18**	**9/17/18**	**0 days**
1041	1294	Prepare Plan (not a formal document) RSU Installer Training	100%	29 days	8/7/18	9/17/18	0 days
1042	**1297**	**Prepare RSU Installer Training Materials**	**100%**	**75 days**	**9/18/18**	**1/8/19**	**0 days**
1043	1298	Prepare Draft RSU Installer Training Materials	100%	19 days	9/18/18	10/15/18	0 days
1044	1299	USDOT Reviews RSU Installer Training Materials	100%	56 days	10/16/18	1/7/19	0 days
1045	1300	Finalize RSU Installer Training Materials (not required)	100%	0 days	1/8/19	1/8/19	0 days
1046	**1301**	**Train RSU Installers**	**100%**	**1 day**	**1/8/19**	**1/8/19**	**0 days**
1047	1302	Train NYC Installers - RSU	100%	1 day	1/8/19	1/8/19	0 days
1048	**1323**	**Driver Training**	**0%**	**80 days**	**4/20/20**	**8/11/20**	**71 days**
1049	**1261**	**Prepare Driver Training Materials**	**0%**	**80 days**	**4/20/20**	**8/11/20**	**71 days**
1050	**1305**	**Prepare High-Level Driver Training Plan**	**0%**	**30 days**	**4/20/20**	**6/1/20**	**71 days**
1051	1306	Prepare Draft High-Level Driver Training Plan	0%	20 days	4/20/20	5/15/20	71 days
1052	1307	Review High-Level Driver Training Plan	0%	5 days	5/18/20	5/22/20	71 days
1053	1308	Finalize High-Level Driver Training Plan	0%	5 days	5/25/20	6/1/20	71 days
1054	**1317**	**Prepare Driver Training Materials**	**0%**	**50 days**	**6/2/20**	**8/11/20**	**71 days**
1055	1318	Prepare Draft Driver Training Materials	0%	20 days	6/2/20	6/29/20	71 days
1056	1319	Review 1 Driver Training Materials	0%	5 days	6/30/20	7/7/20	71 days
1057	1320	Draft 2 Driver Training Materials	0%	10 days	7/8/20	7/21/20	71 days
1058	1322	Review 2 Driver Training Materials	0%	5 days	7/22/20	7/28/20	71 days
1059	1321	Finalize Driver Training Materials	0%	10 days	7/29/20	8/11/20	71 days
1060	**1324**	**Pedestrian Training Materials**	**0%**	**70 days**	**3/10/20**	**6/16/20**	**-134 days**
1061	**1325**	**Prepare Pedestrian Training Plan**	**0%**	**23 days**	**3/10/20**	**4/9/20**	**-134 days**
1062	1326	Prepare Draft Pedestrian Training Plan	0%	15 days	3/10/20	3/30/20	-134 days
1063	1327	Review Pedestrian Training Plan	0%	5 days	3/31/20	4/6/20	-134 days



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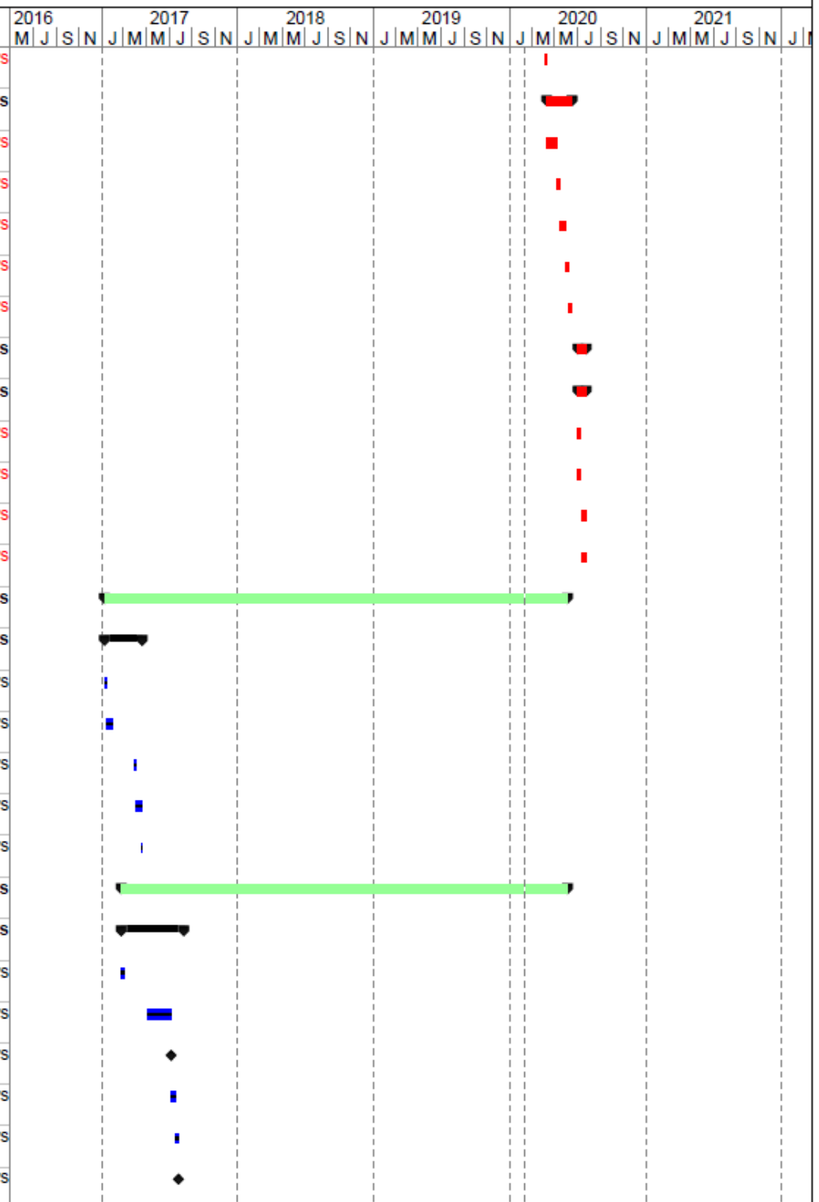
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1064	1328	Finalize Pedestrian Training Plan	0%	3 days	4/7/20	4/9/20	-134 days
1065	1329	**Prepare Pedestrian Training Materials**	0%	47 days	4/10/20	6/16/20	-134 days
1066	1330	Prepare Draft Pedestrian Training Materials	0%	20 days	4/10/20	5/7/20	-134 days
1067	1331	Review 1 Pedestrian Training Materials	0%	5 days	5/8/20	5/14/20	-134 days
1068	1332	Draft 2 Pedestrian Training Materials	0%	10 days	5/15/20	5/29/20	-134 days
1069	1333	Review 2 Pedestrian Training Materials	0%	5 days	6/1/20	6/5/20	-126 days
1070	1334	Finalize Pedestrian Training Materials	0%	7 days	6/8/20	6/16/20	-126 days
1071	551	**Pedestrian Device Distribution & Training**	0%	15 days	7/3/20	7/24/20	-143 days
1072	1604	**Prepare and Distribute PID**	0%	15 days	7/3/20	7/24/20	-143 days
1073	2978	Receive and Prepare PID Devices for Distribution (NYU)	0%	5 days	7/3/20	7/10/20	-143 days
1074	1374	Receive and Prepare PID Location Devices for Distribution (Savari)	0%	5 days	7/3/20	7/10/20	-143 days
1075	546	Distribute PID	0%	10 days	7/13/20	7/24/20	-143 days
1076	1442	Train Peds	0%	10 days	7/13/20	7/24/20	-143 days
1077	100	**Task 2G: Operational Readiness Test and Demonstration Planning**	98%	856 days	1/9/17	6/4/20	373 days
1078	37	**Operational Readiness Concept Briefing**	100%	71 days	1/9/17	4/19/17	0 days
1079	1110	Prepare RACI Chart - Operational Readiness Concept Briefing	100%	5 days	1/9/17	1/13/17	0 days
1080	1213	Review Template and Prepare Initial Draft - Operational Readiness Concept Briefing	100%	9 days	1/16/17	1/27/17	0 days
1081	1212	Test Planning Meeting - Operational Readiness Concept Briefing	100%	2 days	3/30/17	3/31/17	0 days
1082	496	Prepare Briefing - Operational Readiness Concept Briefing	100%	12 days	4/3/17	4/18/17	0 days
1083	497	Briefing Presentation to USDOT - Operational Readiness Concept Briefing	100%	1 day	4/19/17	4/19/17	0 days
1084	245	**Operation Readiness Plan (ORP)**	98%	825.5 days	2/22/17	6/4/20	373 days
1085	255	**Draft Operation Readiness Plan (ORP)**	100%	118 days	2/22/17	8/9/17	0 days
1086	943	Prepare RACI Chart - Operation Readiness Plan (ORP)	100%	5 days	2/22/17	3/1/17	0 days
1087	254	Prepare Draft - Operation Readiness Plan (ORP)	100%	43.5 days	5/4/17	7/6/17	0 days
1088	946	Submit Draft for Internal Review - Operation Readiness Plan (ORP)	100%	0 days	7/6/17	7/6/17	0 days
1089	945	Internal Review - Operation Readiness Plan (ORP)	100%	9 days	7/6/17	7/19/17	0 days
1090	944	Final Updates to Draft - Operation Readiness Plan (ORP)	100%	5 days	7/19/17	7/26/17	0 days
1091	253	Submit Draft Operation Readiness Plan (ORP)	100%	0 days	7/26/17	7/26/17	0 days



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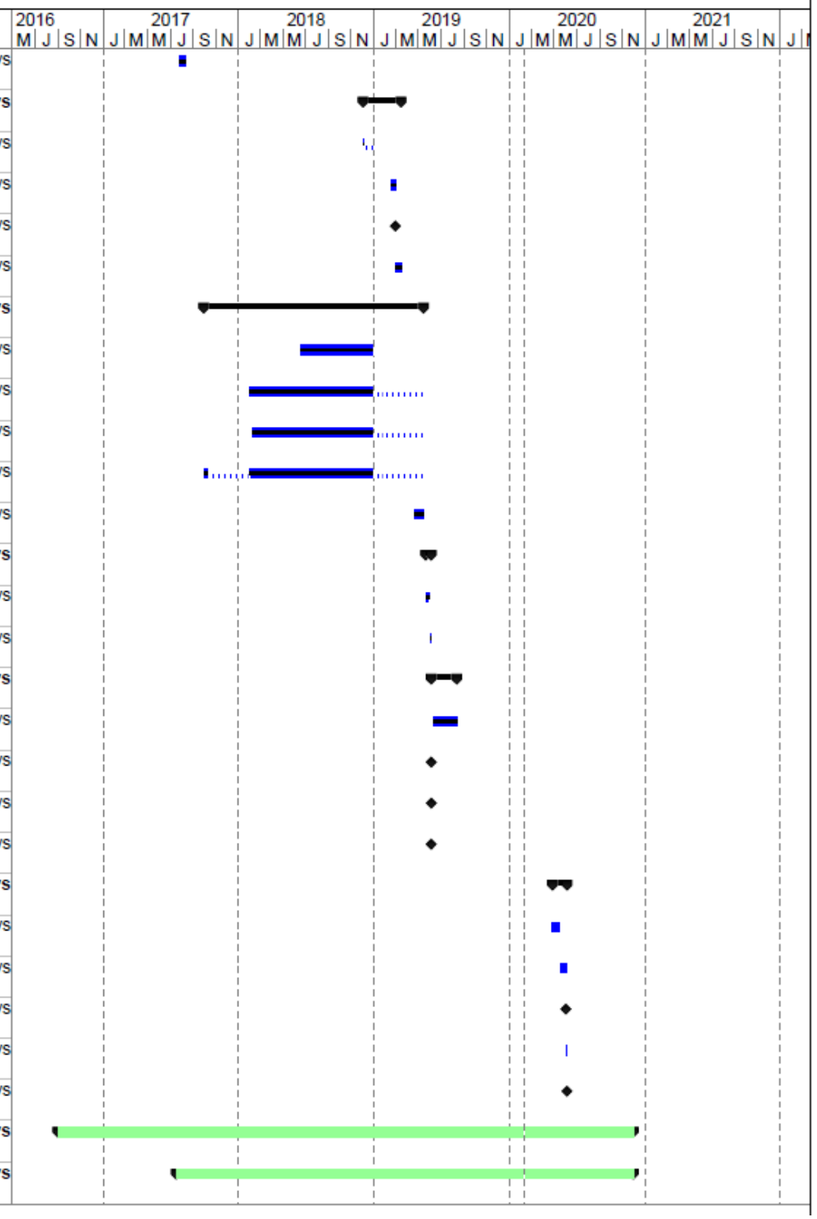
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1092	252	USDOT Review of Draft Operation Readiness Plan (ORP)	100%	10 days	7/26/17	8/9/17	0 days
1093	**1533**	**Refine Test Design Documents & Finalize Operation Readiness Plan (ORP)**	**100%**	**70 days**	**12/3/18**	**3/14/19**	**0 days**
1094	1529	Refine Test Design Documents - Operation Readiness Plan (ORP)	100%	23 days	12/3/18	1/4/19	0 days
1095	1530	Finalize Operation Readiness Plan (ORP)	100%	7 days	2/16/19	2/27/19	0 days
1096	1527	Submit Draft Operation Readiness Plan (ORP) (with ORDP and Test Design Documentation)	100%	0 days	2/27/19	2/27/19	0 days
1097	1528	USDOT Review of Draft Operation Readiness Plan (ORP)	100%	11 days	2/28/19	3/14/19	0 days
1098	**1523**	**Operation Readiness Plan (ORP) - Test Procedures and Scripts**	**100%**	**406 days**	**9/29/17**	**5/14/19**	**0 days**
1099	1524	Prepare ORDP Component of Operation Readiness Plan (ORP)	100%	138 days	6/18/18	1/4/19	0 days
1100	1785	Prepare Test Design Specification Details - Operation Readiness Plan (ORP)	100%	323 days	2/1/18	5/14/19	0 days
1101	1534	Prepare Test Procedures - Operation Readiness Plan (ORP)	100%	318 days	2/8/18	5/14/19	0 days
1102	1526	Prepare Test Case Specifications - Operation Readiness Plan (ORP)	100%	406 days	9/29/17	5/14/19	0 days
1103	1822	Incorporate Vendor Test Documentation into Operation Readiness Plan (ORP)	100%	16 days	4/23/19	5/14/19	0 days
1104	**251**	**Operation Readiness Plan (ORP) Walkthrough and Workbook**	**100%**	**10 days**	**5/21/19**	**6/4/19**	**0 days**
1105	250	Prepare Walkthrough Workbook - Operation Readiness Plan (ORP) (powerpoint)	100%	8 days	5/21/19	5/31/19	0 days
1106	249	Hold Operation Readiness Plan (ORP) Walkthrough	100%	2 days	6/3/19	6/4/19	0 days
1107	**261**	**Revised Operation Readiness Plan (ORP) with Comment Resolution Report**	**100%**	**48 days**	**6/4/19**	**8/12/19**	**0 days**
1108	260	Prepare Revised Draft Operation Readiness Plan (ORP)	100%	45 days	6/10/19	8/12/19	0 days
1109	790	Editor Review of Revised Draft Operation Readiness Plan (ORP) (no comments-not required)	100%	0 days	6/4/19	6/4/19	0 days
1110	259	Submit Revised Draft Operation Readiness Plan (ORP) with Comment Resolution Report (no comments-not required)	100%	0 days	6/4/19	6/4/19	0 days
1111	258	USDOT Review of Revised Draft Operation Readiness Plan (ORP) - Not Required (no comments-not required)	100%	0 days	6/4/19	6/4/19	0 days
1112	**262**	**Final Operation Readiness Plan (ORP)**	**0%**	**28 days**	**4/27/20**	**6/4/20**	**163 days**
1113	257	Prepare Final Operation Readiness Plan (ORP)	0%	15 days	4/27/20	5/15/20	163 days
1114	256	USDOT Review and Approval of Final Operation Readiness Plan (ORP)	0%	10 days	5/18/20	6/1/20	163 days
1115	1814	Operation Readiness Plan (ORP) Approved	0%	0 days	6/1/20	6/1/20	376 days
1116	248	Final Section 508 Edits of Operation Readiness Plan (ORP)	0%	3 days	6/2/20	6/4/20	163 days
1117	247	Operation Readiness Plan (ORP) Complete	0%	0 days	6/4/20	6/4/20	163 days
1118	**101**	**Task 2H: Installation and Operational Readiness Testing**	**74%**	**1064 days**	**9/1/16**	**11/30/20**	**41 days**
1119	**1824**	**Key Installation Milestones**	**0%**	**847 days**	**7/17/17**	**11/30/20**	**41 days**



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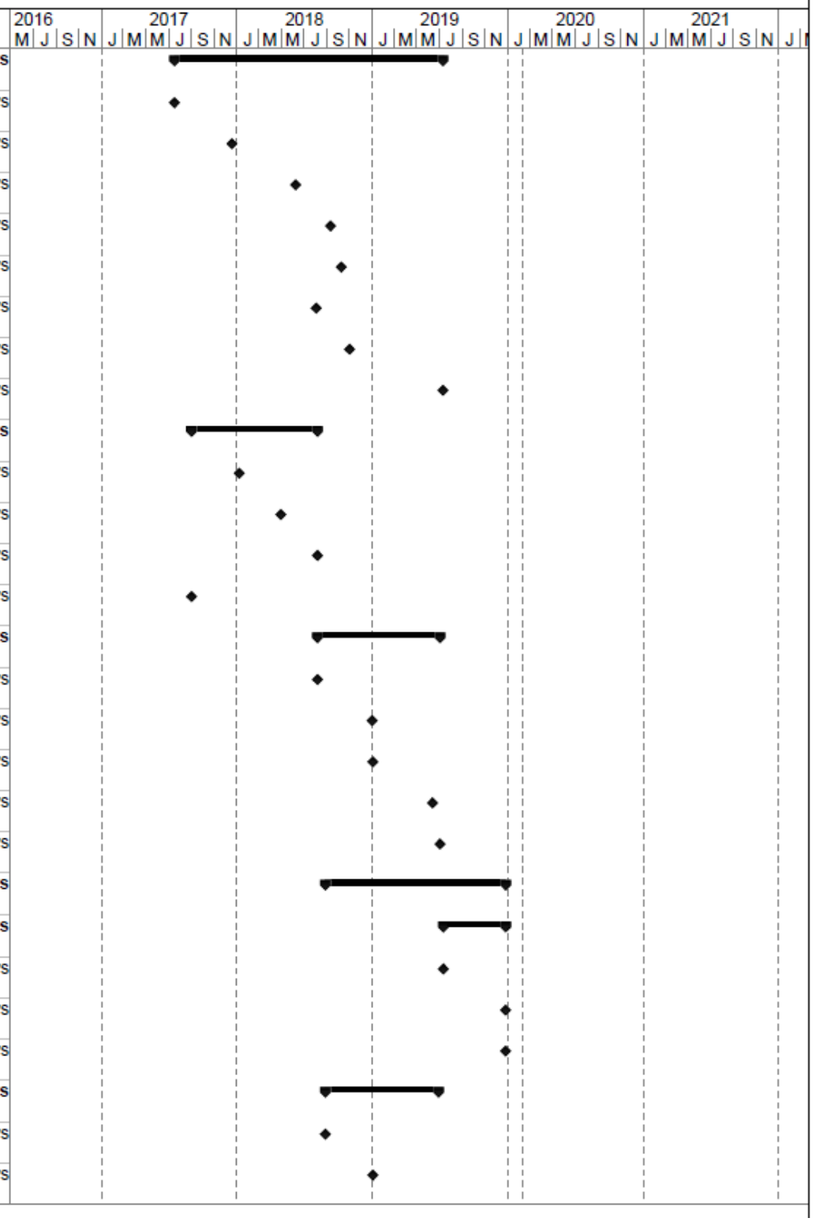
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1120	**2930**	**Vendor Selection Milestones**	**100%**	**498 days**	**7/17/17**	**7/11/19**	**0 days**
1121	2271	Milestone: ASD Vendors Selected	100%	0 days	7/17/17	7/17/17	0 days
1122	2270	Milestone: RSU Vendor Selected	100%	0 days	12/19/17	12/19/17	0 days
1123	2003	Milestone: OTA Design Finalized	100%	0 days	6/8/18	6/8/18	0 days
1124	2980	Milestone: Aerolink Release with Encryption Support (external constraint) - Danlaw	100%	0 days	9/11/18	9/11/18	0 days
1125	1892	Milestone: Aerolink Release with Encryption Support (external constraint) - TransCore	100%	0 days	10/10/18	10/10/18	0 days
1126	2015	Siemens NTP or Similar Assurance of Payment in Place	100%	0 days	8/3/18	8/3/18	0 days
1127	1893	Danlaw NTP or Similar Assurance of Payment in Place	100%	0 days	11/1/18	11/1/18	0 days
1128	2347	Savari NTP or Similar Assurance of Payment in Place (PID Only)	100%	0 days	7/11/19	7/11/19	0 days
1129	**2991**	**Sample Devices - Procurement Milestones**	**100%**	**232 days**	**9/1/17**	**8/6/18**	**0 days**
1130	2919	Milestone: Sample Devices Received - ASD - Savari	100%	0 days	1/8/18	1/8/18	0 days
1131	2918	Milestone: Sample Devices Received - ASD - Danlaw	100%	0 days	4/30/18	4/30/18	0 days
1132	2241	Milestone: Sample Devices Received - RSU - Siemens	100%	0 days	8/6/18	8/6/18	0 days
1133	2242	Milestone: Production Certificate SCMS required - Samples Testing	100%	0 days	9/1/17	9/1/17	0 days
1134	**2992**	**Prototype Devices Procurement Milestones**	**100%**	**227 days**	**8/6/18**	**7/2/19**	**0 days**
1135	2995	Milestone: Prototype Devices Received - RSU - Siemens	100%	0 days	8/6/18	8/6/18	0 days
1136	2994	Milestone: Prototype Devices Received - ASD - Danlaw	100%	0 days	12/31/18	12/31/18	0 days
1137	3005	Milestone: Test Certificate required - Prototype Test Phase 1 and 2	100%	0 days	1/2/19	1/2/19	0 days
1138	3056	Milestone: Hardware Ready for Production Component Order - Danlaw - ASD (After USDOT Concurrance and Prototype Buy-Off)	100%	0 days	6/12/19	6/12/19	0 days
1139	2996	Milestone: CV Pilot Certificate (for SCMS) required - Production Installation	100%	0 days	7/2/19	7/2/19	0 days
1140	**2931**	**Production Milestones**	**100%**	**333 days**	**8/27/18**	**12/26/19**	**0 days**
1141	**1894**	**Production ASD Milestones - ASD Receipt - Danlaw - 20% and 50% (Installation will be Phased)**	**100%**	**115 days**	**7/11/19**	**12/26/19**	**0 days**
1142	1895	Milestone: Equipment Delivered for Start of 20% Installation ASDs Received - Danlaw - For 20%	100%	0 days	7/11/19	7/11/19	0 days
1143	1898	Milestone: Equipment Delivered for Start of 50% Installation ASDs Received - Danlaw - For 50%	100%	0 days	12/26/19	12/26/19	0 days
1144	2027	Milestone: Equipment Delivered for 20% and 50% Installation Production ASDs Available - Danlaw	100%	0 days	12/26/19	12/26/19	0 days
1145	**1896**	**Production RSU Receipt**	**100%**	**210 days**	**8/27/18**	**6/28/19**	**0 days**
1146	2938	Milestone: 1st Batch Production RSUs Received - Siemens - for Installation Facilities	100%	0 days	8/27/18	8/27/18	0 days
1147	3073	Milestone: Equipment Delivered for 20% Installation RSUs Received - Siemens - for 20%	100%	0 days	1/2/19	1/2/19	0 days



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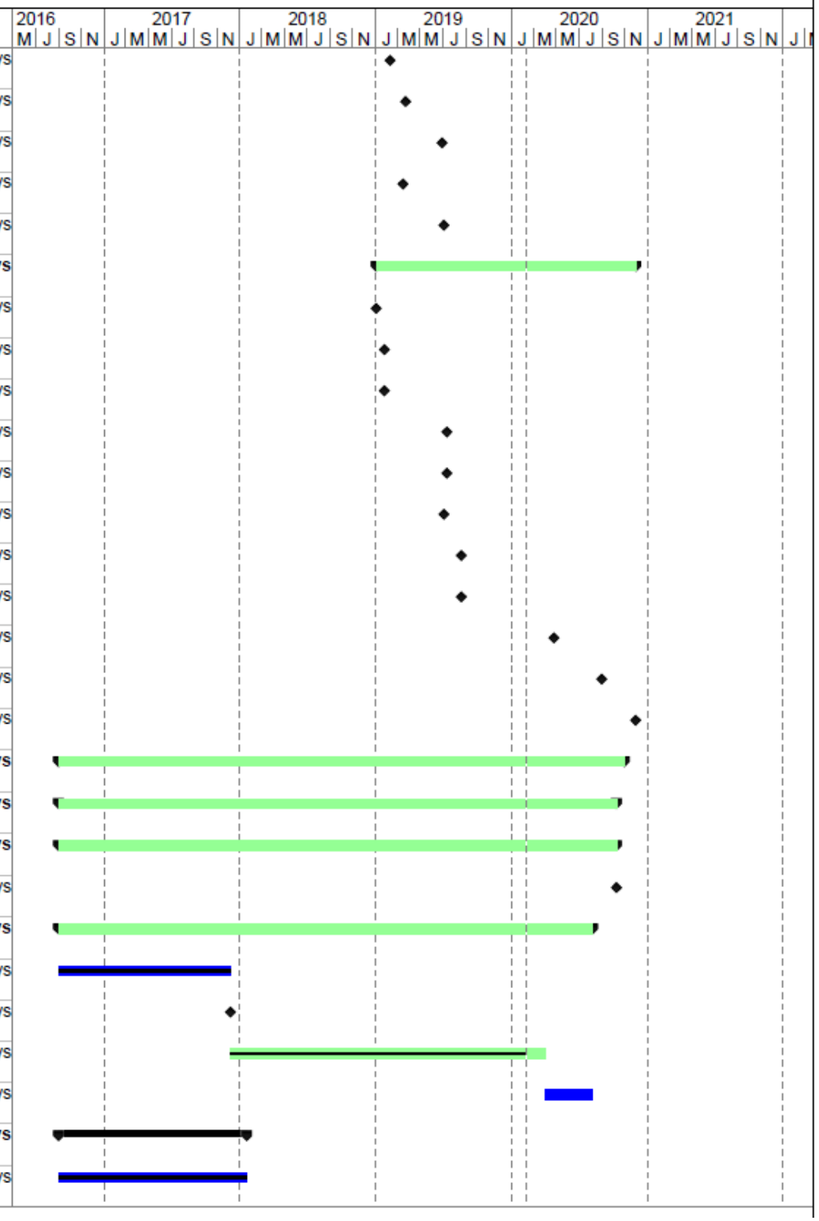
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1148	1897	Milestone: Equipment Delivered for 50% Installation RSUs Received - Siemens - for 50%	100%	0 days	2/8/19	2/8/19	0 days
1149	2939	Milestone: Equipment Delivered for 80% Installation RSUs Received - Siemens - for 80%	100%	0 days	3/22/19	3/22/19	0 days
1150	2940	Milestone: Equipment Delivered for 100% Installation RSUs Received - Siemens - for 100%	100%	0 days	6/28/19	6/28/19	0 days
1151	2307	Milestone: All Production Device Orders Placed	100%	0 days	3/15/19	3/15/19	0 days
1152	1900	Milestone: Approval to Use Production Certs - Operational Readiness Test	100%	0 days	7/3/19	7/3/19	0 days
1153	**2932**	**Installation Milestones**	**0%**	**480 days**	**1/2/19**	**11/30/20**	**41 days**
1154	3061	Milestone: Production Certificates Ready for Installation	100%	0 days	1/2/19	1/2/19	0 days
1155	3055	Milestone: Software Ready for Prototype Test - RSU	100%	0 days	1/24/19	1/24/19	0 days
1156	3060	Milestone: Software Ready for Prototype Test - ASD	100%	0 days	1/24/19	1/24/19	0 days
1157	2941	Milestone: Software Ready for Installation - RSU	100%	0 days	7/11/19	7/11/19	0 days
1158	3006	Milestone: Software Ready for Installation - ASD (excluding DOT and MTA)	100%	0 days	7/11/19	7/11/19	0 days
1159	1889	Milestone: Production Certificates Ready for Operational Readines Test	100%	0 days	7/3/19	7/3/19	0 days
1160	3053	Milestone: Software Ready for Operational Readiness Test (Post Prototype) - RSU	100%	0 days	8/19/19	8/19/19	0 days
1161	3054	Milestone: Software Ready for Operational Readiness Test (Post Prototype) - ASD	100%	0 days	8/19/19	8/19/19	0 days
1162	1899	Milestone: Operation Readiness Testing and Demonstration Complete	0%	0 days	4/24/20	4/24/20	-167 days
1163	3059	Milestone: Installation Complete - 80% ASDs	0%	0 days	8/31/20	8/31/20	-213 days
1164	1906	Milestone: All Installations Complete (All Devices) - 100%	0%	0 days	11/30/20	11/30/20	41 days
1165	**3075**	**Installation Management**	**78%**	**1045 days**	**9/1/16**	**10/30/20**	**60 days**
1166	**1678**	**Partner Commitments & Fleet Data Collection**	**82%**	**1031 days**	**9/1/16**	**10/9/20**	**74 days**
1167	**1731**	**MOU/MOA Execution**	**74%**	**1031 days**	**9/1/16**	**10/9/20**	**74 days**
1168	1695	All MOUs Executed	0%	0 days	10/9/20	10/9/20	74 days
1169	**1680**	**MTA**	**87%**	**986 days**	**9/1/16**	**8/6/20**	**119 days**
1170	1686	Coordination MTA and NYCDOT Legal	100%	316 days	9/1/16	12/6/17	0 days
1171	1679	MTA MOU Signed	100%	0 days	12/6/17	12/6/17	0 days
1172	3129	MTA Installation Contract Negotiations	93%	580 days	12/7/17	3/31/20	119 days
1173	3127	MTA Installation Contracts Executed and Registered	0%	90 days	4/1/20	8/6/20	119 days
1174	**1681**	**UPS**	**100%**	**345 days**	**9/1/16**	**1/19/18**	**0 days**
1175	1685	Coordination UPS and NYCDOT Legal	100%	345 days	9/1/16	1/19/18	0 days



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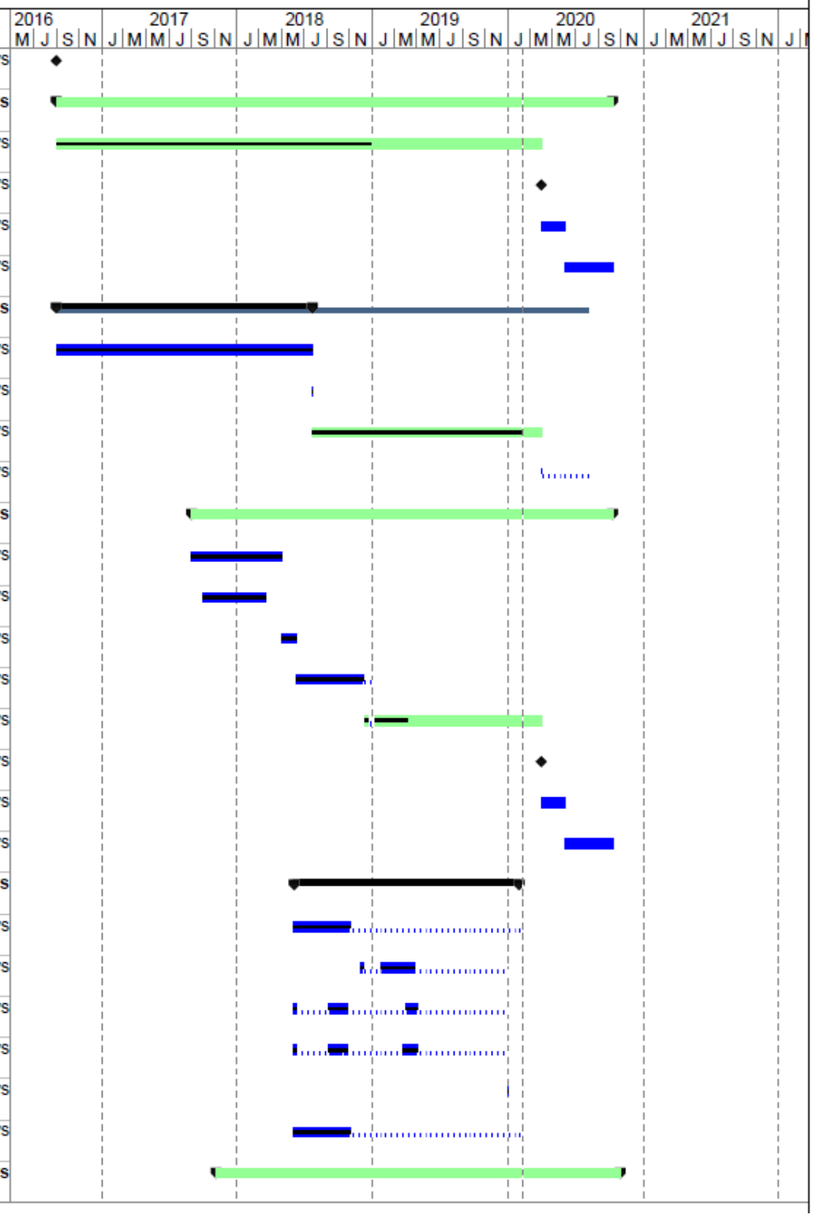
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1176	1684	UPS MOU Signed	100%	0 days	9/1/16	9/1/16	0 days
1177	**1682**	**Sanitation**	**56%**	**1031 days**	**9/1/16**	**10/9/20**	**74 days**
1178	1687	Coordination Sanitation and NYCDOT Legal	65%	896 days	9/1/16	3/31/20	74 days
1179	1688	Sanitation MOU Signed	0%	0 days	3/31/20	3/31/20	74 days
1180	3130	Sanitation Installation Contract Negotiations	0%	45 days	4/1/20	6/3/20	74 days
1181	3128	Sanitation Installation Contracts Executed and Registered	0%	90 days	6/4/20	10/9/20	74 days
1182	**2838**	**DCAS**	**87%**	**473 days**	**9/1/16**	**7/23/18**	**632 days**
1183	2837	Coordination DCAS and NYCDOT Legal	100%	473 days	9/1/16	7/23/18	0 days
1184	2842	DCAS MOU Signed	100%	1 day	7/23/18	7/23/18	0 days
1185	3132	DCAS Installation Contract Negotiations	91%	423 days	7/24/18	3/31/20	119 days
1186	3131	DCAS Installation Contracts Executed and Registered	0%	90 days	3/31/20	8/6/20	119 days
1187	**1683**	**Taxi Garage Owners' Agreements**	**57%**	**780 days**	**9/1/17**	**10/9/20**	**74 days**
1188	1689	Finalize Compensation Plan	100%	164 days	9/1/17	4/30/18	0 days
1189	1690	Develop Material to Share with Garage Owners	100%	115 days	10/2/17	3/20/18	0 days
1190	1691	Finalize Draft MOU Languate with TLC	100%	29 days	5/1/18	6/11/18	0 days
1191	1693	At Least One MOU Finalized and Signed	100%	143 days	6/12/18	1/7/19	0 days
1192	1692	Execute MOUs with all Garage Owners	21%	324 days	12/14/18	3/31/20	74 days
1193	1694	Full Complement of MOUs executed with Garage Owners	0%	0 days	3/31/20	3/31/20	74 days
1194	3134	Taxi Garage Owners Installation Contract Negotiations	0%	45 days	4/1/20	6/3/20	74 days
1195	3133	Taxi Garage Owners Installation Contracts Executed and Registered	0%	90 days	6/4/20	10/9/20	74 days
1196	**1732**	**Fleet Identification and Details Finalization**	**100%**	**417 days**	**6/4/18**	**1/31/20**	**0 days**
1197	1735	Fleet Identification and Details Finalization - MTA	100%	417 days	6/4/18	1/31/20	0 days
1198	1734	Fleet Identification and Details Finalization - DCAS	100%	272 days	11/30/18	12/31/19	0 days
1199	1733	Fleet Identification and Details Finalization - Sanitation	100%	396 days	6/4/18	12/31/19	0 days
1200	1736	Fleet Identification and Details Finalization - Taxi	100%	396 days	6/4/18	12/31/19	0 days
1201	3138	Fleet Identification and Details Finalization - Alternate Vehicles	100%	1 day	1/1/20	1/2/20	0 days
1202	1737	Fleet Identification and Details Finalization - NYCDOT	100%	417 days	6/4/18	1/31/20	0 days
1203	**42**	**Installation and Operational Readiness Schedule (IORS)**	**75%**	**749.5 days**	**11/6/17**	**10/30/20**	**60.5 days**



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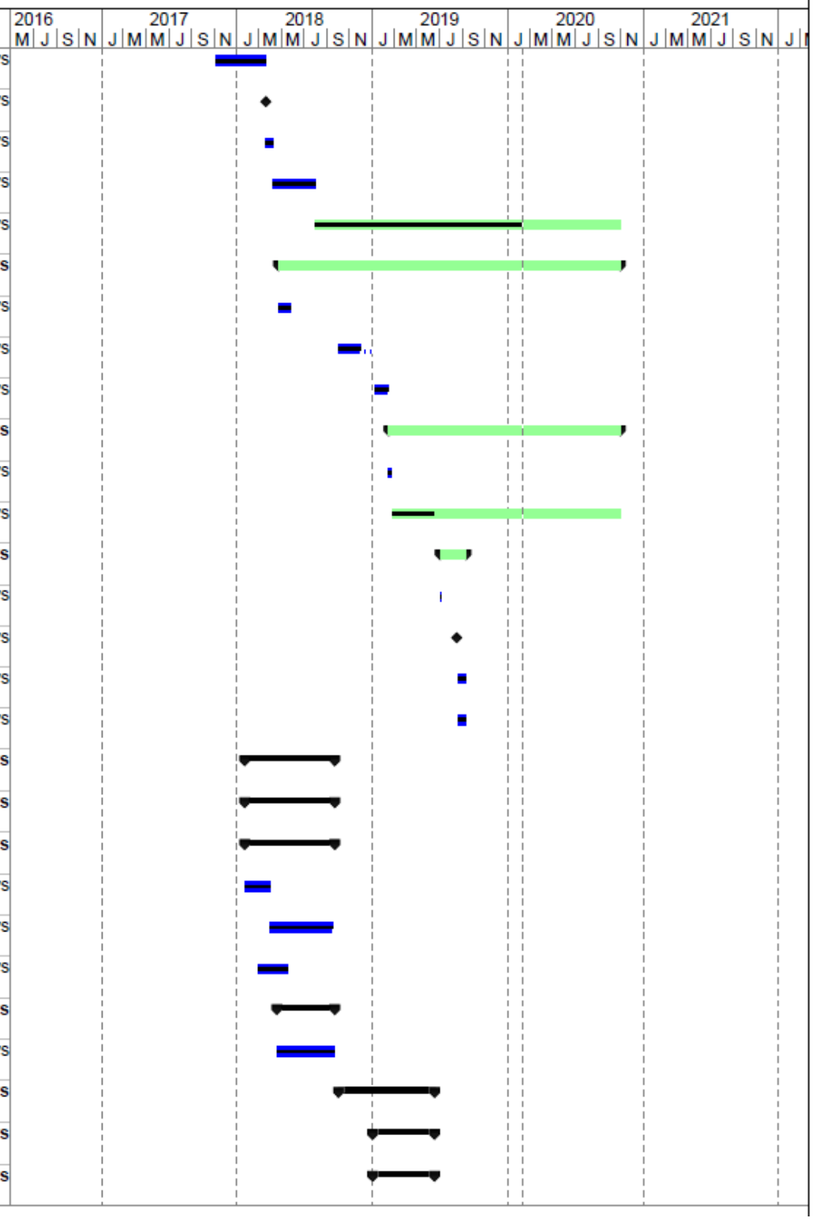
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1204	264	Prepare IORS	100%	90.5 days	11/6/17	3/20/18	0 days
1205	263	Submit IORS	100%	0 days	3/20/18	3/20/18	0 days
1206	2338	USDOT Review of IORS	100%	14 days	3/20/18	4/9/18	0 days
1207	2339	Update IORS	100%	78 days	4/9/18	7/30/18	0 days
1208	43	Updated IORS with Progress/Risk Summary (LOE)	67%	567 days	7/30/18	10/30/20	60.5 days
1209	2033	**Installation Tracking & Final Planning**	37%	636 days	4/23/18	10/30/20	60 days
1210	2034	Develop Tools to Track & Summarize Daily Installation Progress	100%	25 days	4/23/18	5/25/18	0 days
1211	2035	Develop methodology for status reporting from installers	100%	66 days	10/1/18	1/7/19	0 days
1212	2037	Develop weekly schedule for each installation team and finalize inventory distribution plan (LOE)	100%	27 days	1/8/19	2/14/19	0 days
1213	2036	**Provide installation progress reports**	19%	431 days	2/15/19	10/30/20	60 days
1214	2040	Baseline plan - Installation Progress Reports	100%	5 days	2/15/19	2/22/19	0 days
1215	2039	Provide weekly installation progress reports (LOE)	19%	426 days	2/25/19	10/30/20	60 days
1216	583	**Test Results Summary Documentation**	99%	48 days	7/3/19	9/10/19	0 days
1217	3078	Prototype Test - Test Result Summary	100%	2 days	7/3/19	7/5/19	0 days
1218	2022	Operational Readiness Dry Run - Test Results Summary (Not Required)	100%	0 days	8/16/19	8/16/19	0 days
1219	3114	Operational Readiness Testing Final Test Results Summary	100%	15 days	8/20/19	9/10/19	0 days
1220	2389	Operational Readiness Demonstration Final Test Results Summary	100%	15 days	8/20/19	9/10/19	0 days
1221	2274	**Install Sample Devices**	100%	171 days	1/22/18	9/21/18	0 days
1222	2275	**Install ASD Sample Devices**	100%	171 days	1/22/18	9/21/18	0 days
1223	2276	**Install Sample Devices - ASD - Savari**	100%	171 days	1/22/18	9/21/18	0 days
1224	2277	Install Sample Devices - ASD - Savari (Initial Batch)	100%	49 days	1/22/18	3/30/18	0 days
1225	2278	Install Sample Devices - ASD - Savari (Remaining Batch)	100%	122 days	4/2/18	9/21/18	0 days
1226	2279	Configure Netway Boxes for Sample Devices - ASD - Savari	100%	60 days	2/26/18	5/18/18	0 days
1227	2280	**Install Sample Devices - ASD - Danlaw**	100%	109 days	4/19/18	9/21/18	0 days
1228	2281	Install Sample Devices - ASD - Danlaw	100%	109 days	4/19/18	9/21/18	0 days
1229	3074	**Install Prototype Devices**	100%	177 days	10/2/18	6/17/19	0 days
1230	2984	**Install ASD Prototype Devices**	100%	116 days	1/2/19	6/17/19	0 days
1231	2989	**Install Prototype Devices - ASD - Danlaw**	100%	116 days	1/2/19	6/17/19	0 days



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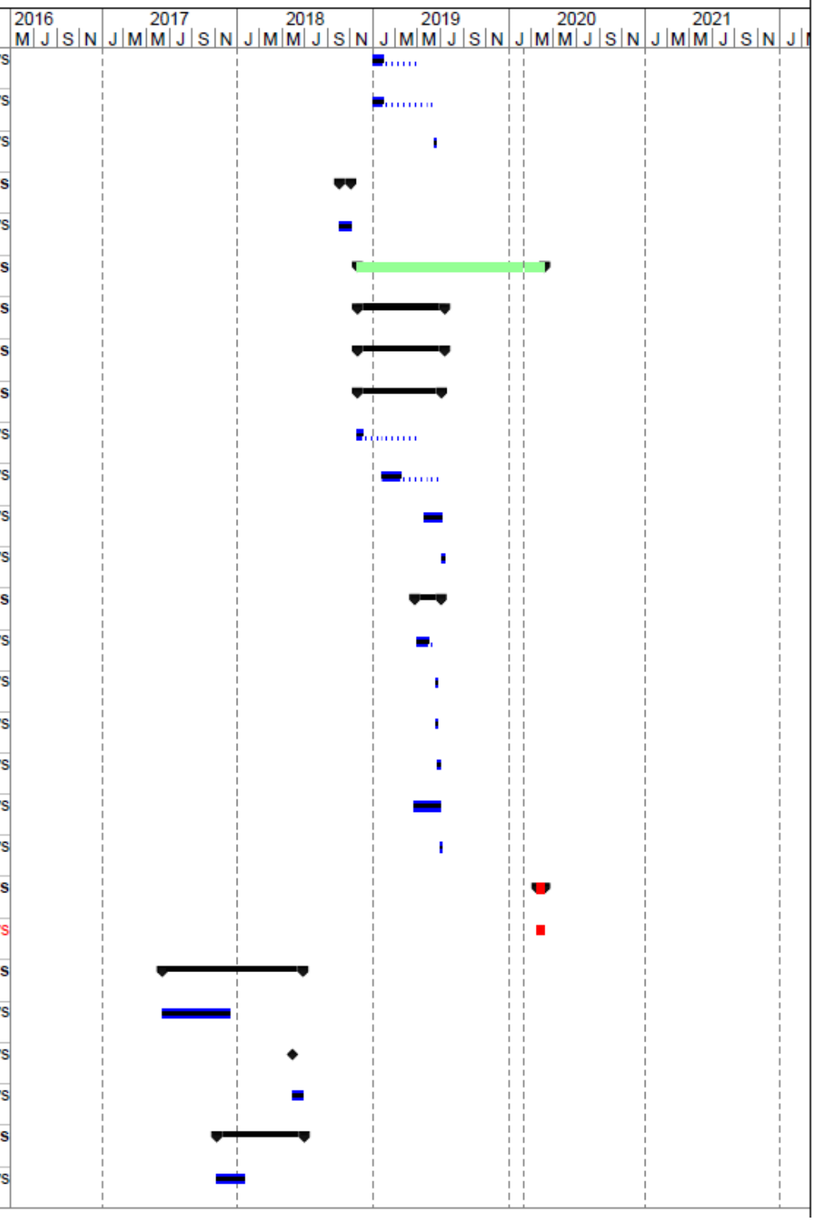
1232	3105	Install Prototype Devices - ASD - Danlaw (excluding Buses)	100%	83 days	1/2/19	4/30/19	0 days
1233	2990	Install Prototype Devices - ASD - Danlaw (Remaining Buses Only)	100%	115 days	1/2/19	6/14/19	0 days
1234	2282	Reinstall/Update ASDs between Prototype Test Phases - Danlaw	100%	1 day	6/15/19	6/17/19	0 days
1235	**2283**	**Install Prototype RSU Devices (10) - Siemens**	**100%**	**22 days**	**10/2/18**	**11/1/18**	**0 days**
1236	2284	Install Prototype Devices - RSU - Siemens	100%	22 days	10/2/18	11/1/18	0 days
1237	**2240**	**Test Prototype Devices**	**96%**	**345 days**	**11/20/18**	**4/6/20**	**-183 days**
1238	**2244**	**Execute Prototype Test**	**100%**	**162 days**	**11/20/18**	**7/12/19**	**0 days**
1239	**2245**	**Prototype Test Phase 1 - Install Procedure Verification, HW, Start Vendor Test Document Verification, Start Safety Apps (V2V)**	**100%**	**162 days**	**11/20/18**	**7/12/19**	**0 days**
1240	**2246**	**Validate HW - Prototype Test Phase 1**	**100%**	**156 days**	**11/20/18**	**7/3/19**	**0 days**
1241	2249	Validate RSU HW - Siemens - Prototype Test Phase 1	100%	108 days	11/20/18	4/25/19	0 days
1242	2248	Validate ASD HW - Danlaw - Prototype Test Phase 1	100%	115 days	1/21/19	7/3/19	0 days
1243	2251	Begin validating V2V Safety Apps - Prototype Test Phase 1	100%	33 days	5/17/19	7/3/19	0 days
1244	2252	Preliminary Data Collection - Prototype Test Phase 1	100%	6 days	7/4/19	7/12/19	0 days
1245	**2253**	**Prototype Test Phase 2-Validate Safety Apps, OTA, Data Collection**	**100%**	**50 days**	**4/23/19**	**7/2/19**	**0 days**
1246	2258	ASTC Test - Prototype Test Phase 2	100%	34 days	4/29/19	6/14/19	0 days
1247	2254	OTA Test - Prototype Test Phase 2	100%	5 days	6/18/19	6/24/19	0 days
1248	2255	Certificate Signing Processing Test - Prototype Test Phase 2	100%	5 days	6/18/19	6/24/19	0 days
1249	2256	Data Logging and Collection Test - Prototype Test Phase 2	100%	5 days	6/25/19	7/1/19	0 days
1250	2257	Validate Vendor Safety Application Tests - Prototype Test Phase 2	100%	49 days	4/23/19	7/1/19	0 days
1251	2259	Formal Prototype Test Phase 2	100%	1 day	7/2/19	7/2/19	0 days
1252	**3135**	**Obfuscation Test**	**0%**	**15 days**	**3/17/20**	**4/6/20**	**-332 days**
1253	2382	Obfuscation Test - Prototype Test Phase 2	0%	15 days	3/17/20	4/6/20	-332 days
1254	**2306**	**TMC Installation**	**100%**	**261 days**	**6/12/17**	**6/25/18**	**0 days**
1255	1093	Install Hardware, Network, Etc - TMC Installation	100%	125 days	6/12/17	12/8/17	0 days
1256	1590	HSM Device Installation Complete - TMC Installation	100%	0 days	5/28/18	5/28/18	0 days
1257	1671	Finalize Firewall Settings & Network Configurations - TMC Installation	100%	20 days	5/29/18	6/25/18	0 days
1258	**1658**	**Interoperability Test**	**100%**	**163 days**	**11/6/17**	**6/29/18**	**0 days**
1259	1728	Prepare for Interoperability Test (Postponed)	100%	50 days	11/6/17	1/19/18	0 days



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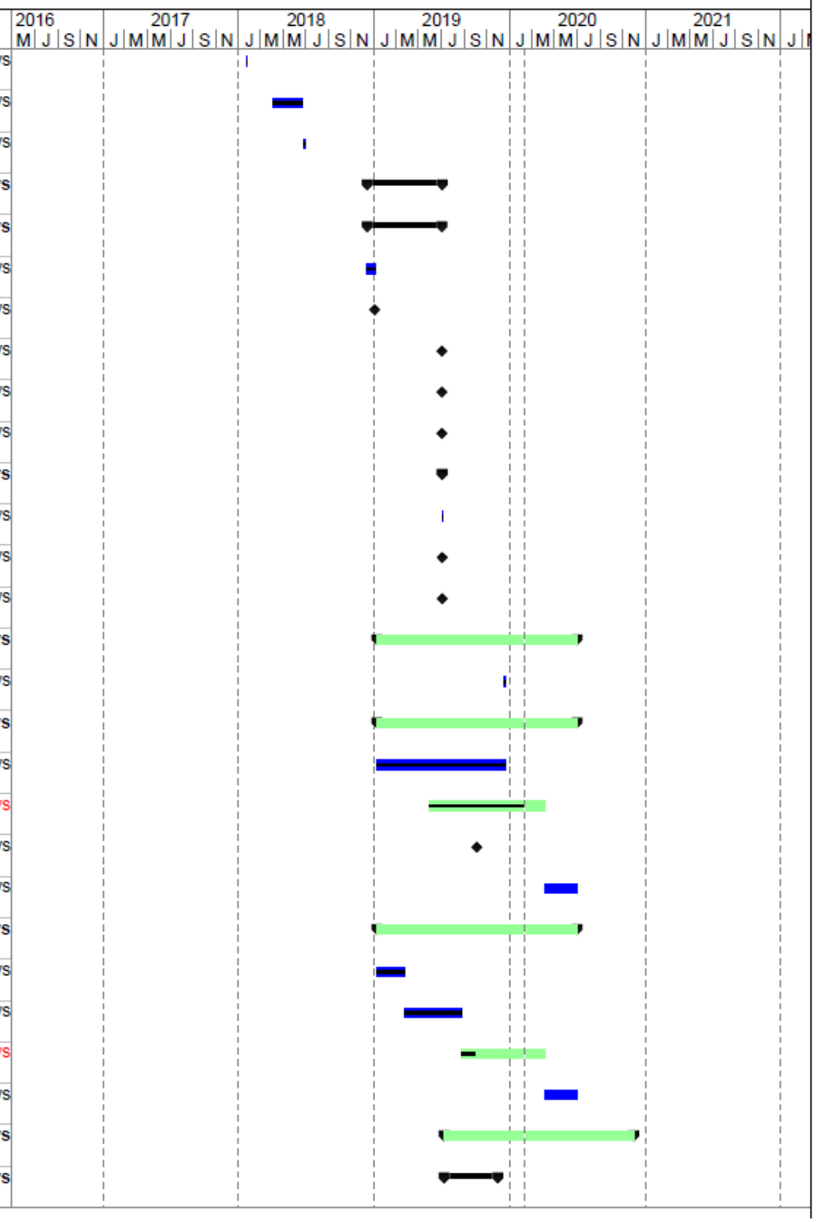
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1260	1635	Interoperability Test - Postponed	100%	3 days	1/22/18	1/24/18	0 days
1261	2321	Prepare for Interoperability Test	100%	58 days	4/3/18	6/22/18	0 days
1262	2320	Interoperability Test	100%	5 days	6/25/18	6/29/18	0 days
1263	**2260**	**Production Certificate Validation**	**100%**	**139 days**	**12/14/18**	**7/3/19**	**0 days**
1264	**2264**	**Certificate Integration for Prototype Devices**	**100%**	**138 days**	**12/14/18**	**7/2/19**	**0 days**
1265	2265	Request and Install Test Certificates on Prototype Devices	100%	12 days	12/14/18	1/2/19	0 days
1266	3004	Milestone: Production Certificate Validation - Test Certificates for Prototype Devices Complete	100%	0 days	1/2/19	1/2/19	0 days
1267	2261	Install CV Pilot Certificates on Prototype Devices (not required)	100%	0 days	7/2/19	7/2/19	0 days
1268	2262	Validate Prototype Devices with CV Pilot Certificate (for SCMS) (not required)	100%	0 days	7/2/19	7/2/19	0 days
1269	2263	Milestone: CV Pilot Certificate Validation for Prototype Devices Complete (for SCMS) (not required)	100%	0 days	7/2/19	7/2/19	0 days
1270	**2266**	**Production Certificates**	**100%**	**1 day**	**7/3/19**	**7/3/19**	**0 days**
1271	2267	Prepare production certificate request	100%	1 day	7/3/19	7/3/19	0 days
1272	2268	USDOT Review & Approval of Production Certificate Request (not required)	100%	0 days	7/3/19	7/3/19	0 days
1273	2269	Milestone: Production Certificate Approved	100%	0 days	7/3/19	7/3/19	0 days
1274	**580**	**Install, Integrate, Test & Tune RSUs**	**67%**	**372 days**	**1/9/19**	**6/30/20**	**145 days**
1275	3137	FCC Issues Directive to Halt DSRC Licensing	100%	1 day	12/19/19	12/19/19	0 days
1276	**1709**	**Install RSUs at ASD Installation Sites**	**80%**	**372 days**	**1/9/19**	**6/30/20**	**145 days**
1277	1713	Install RSU at NYCDOT Install Facility - Siemens	100%	239 days	1/9/19	12/19/19	0 days
1278	1711	Install RSU in Taxi/Bus Install Facility - Siemens	81%	213 days	5/30/19	4/3/20	-109 days
1279	1714	Install RSU in UPS Install Facility - Siemens (dropped out/not required)	100%	0 days	10/4/19	10/4/19	0 days
1280	1712	Install RSU at Sanitation Install Facility - Siemens	0%	61 days	4/6/20	6/30/20	145 days
1281	**1710**	**`Install RSUs at Roadway and Support Locations**	**49%**	**372 days**	**1/9/19**	**6/30/20**	**145 days**
1282	3072	Install RSUs at Roadway and Support Locations - Siemens (20%)	100%	51 days	1/9/19	3/22/19	0 days
1283	2020	Install RSUs at Roadway and Support Locations - Siemens (50%)	100%	108 days	3/22/19	8/23/19	0 days
1284	2019	Install RSUs at Roadway and Support Locations - Siemens (80%)	16%	152 days	8/26/19	4/3/20	-109 days
1285	2377	Install RSUs at Roadway and Support Locations - Siemens (100%)	0%	61 days	4/6/20	6/30/20	145 days
1286	**3076**	**Install, Integrate, Test & Tune ASDs**	**31%**	**351 days**	**7/9/19**	**11/30/20**	**41 days**
1287	**3019**	**Install ASDs (20%)**	**100%**	**100 days**	**7/9/19**	**11/30/19**	**0 days**



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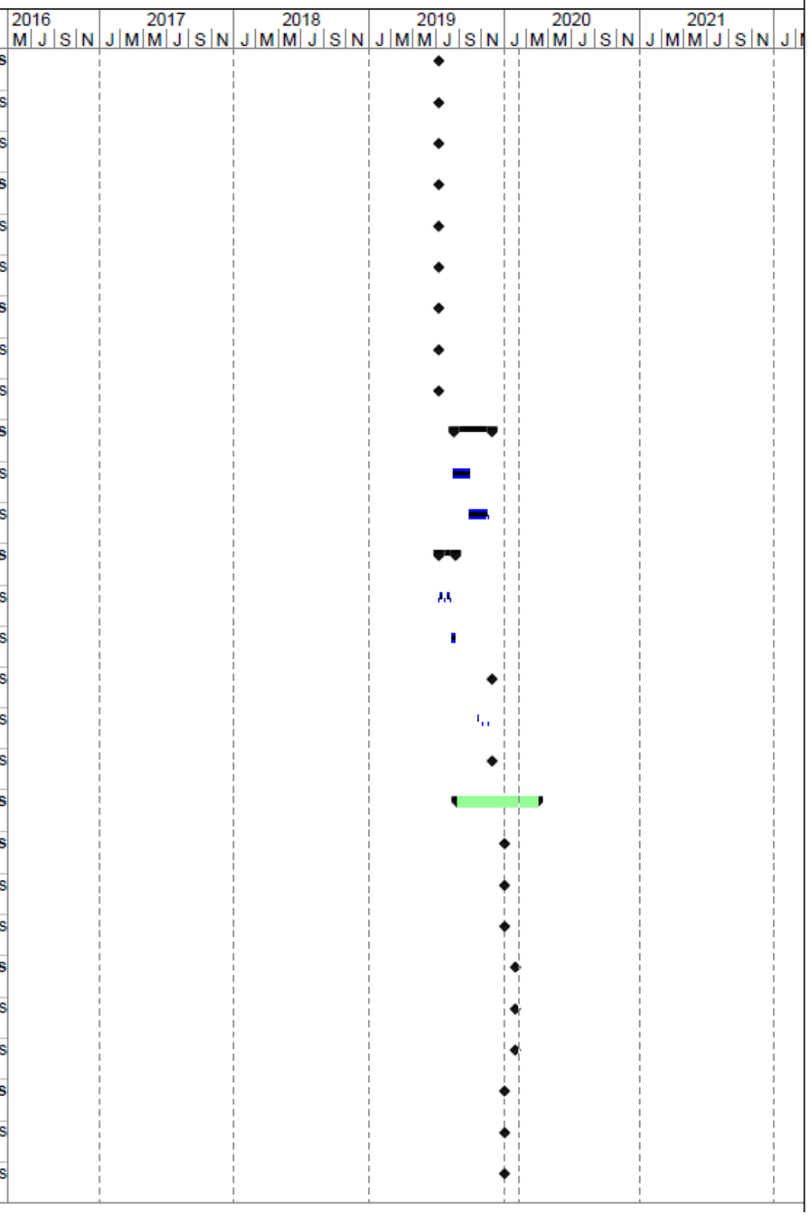
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1288	**3020**	**Install ASDs in Taxis (20%)**Removed per Amendment 6****	**100%**	**0 days**	**7/9/19**	**7/9/19**	**0 days**
1289	3021	Install ASDs in Taxis (20%) - Danlaw - Ship Lot 1**Removed per Amendment 6**	100%	0 days	7/9/19	7/9/19	0 days
1290	3022	Install ASDs in Taxis (20%) - Danlaw - Ship Lot 2**Removed per Amendment 6**	100%	0 days	7/9/19	7/9/19	0 days
1291	**3025**	**Install ASDs in MTA Buses (20%)**No Installation in 20% Phase****	**100%**	**0 days**	**7/9/19**	**7/9/19**	**0 days**
1292	3026	Install ASDs in MTA Buses (20%) - Danlaw - Ship Lot 1**No Installation in 20% Phase**	100%	0 days	7/9/19	7/9/19	0 days
1293	3027	Install ASDs in MTA Buses (20%) - Danlaw - Ship Lot 2**No Installation in 20% Phase**	100%	0 days	7/9/19	7/9/19	0 days
1294	**3030**	**Install ASDs in Sanitation (20%)**Removed per Amendment 6****	**100%**	**0 days**	**7/9/19**	**7/9/19**	**0 days**
1295	3031	Install ASDs in Sanitation (20%) - Danlaw - Ship Lot 1**Removed per Amendment 6**	100%	0 days	7/9/19	7/9/19	0 days
1296	3032	Install ASDs in Sanitation (20%) - Danlaw - Ship Lot 2**Removed per Amendment 6**	100%	0 days	7/9/19	7/9/19	0 days
1297	**3035**	**Install ASDs in DCAS Vehicles (20%)**	**100%**	**71 days**	**8/19/19**	**11/29/19**	**0 days**
1298	3036	Install ASDs in DCAS Vehicles (20%) - Danlaw - Ship Lot 1	100%	30 days	8/19/19	9/30/19	0 days
1299	3037	Install ASDs in DCAS Vehicles (20%) - Danlaw - Ship Lot 2	100%	41 days	10/1/19	11/29/19	0 days
1300	**3040**	**Install ASDs in NYC Fleet Vehicles (20%)**	**100%**	**33 days**	**7/9/19**	**8/22/19**	**0 days**
1301	3041	Install ASDs in NYC Fleet Vehicles (20%) - Danlaw - Ship Lot 1	100%	27 days	7/9/19	8/14/19	0 days
1302	3042	Install ASDs in NYC Fleet Vehicles (20%) - Danlaw - Ship Lot 2	100%	6 days	8/15/19	8/22/19	0 days
1303	3045	ASD Installation Complete - 20%	100%	0 days	11/29/19	11/29/19	0 days
1304	3046	Integrate, Tune & Test - ASDs 20%	100%	25 days	10/24/19	11/30/19	0 days
1305	3047	Installation Testing/Verification/Risk Mitigation/Weather - ASDs 20%	100%	0 days	11/30/19	11/30/19	0 days
1306	**265**	**Install ASDs (50%)**	**70%**	**148 days**	**8/27/19**	**3/31/20**	**0 days**
1307	**2944**	**Install ASDs in Taxis (50%)**Removed per Amendment 6****	**100%**	**0 days**	**1/2/20**	**1/2/20**	**0 days**
1308	2945	Install ASDs in Taxis (50%) - Danlaw - Ship Lot 1**Removed per Amendment 6**	100%	0 days	1/2/20	1/2/20	0 days
1309	2946	Install ASDs in Taxis (50%) - Danlaw - Ship Lot 2**Removed per Amendment 6**	100%	0 days	1/2/20	1/2/20	0 days
1310	**2948**	**Install ASDs in MTA Buses (50%)**No Installation in 50% Phase****	**100%**	**0 days**	**1/31/20**	**1/31/20**	**0 days**
1311	2951	Install ASDs in MTA Buses (50%) - Danlaw - Ship Lot 1**No Installation in 50% Phase**	100%	0 days	1/31/20	1/31/20	0 days
1312	2950	Install ASDs in MTA Buses (50%) - Danlaw - Ship Lot 2**No Installation in 50% Phase**	100%	0 days	1/31/20	1/31/20	0 days
1313	**2952**	**Install ASDs in Sanitation (50%)**Removed per Amendment 6****	**100%**	**0 days**	**1/2/20**	**1/2/20**	**0 days**
1314	2955	Install ASDs in Sanitation (50%) - Danlaw - Ship Lot 1**Removed per Amendment 6**	100%	0 days	1/2/20	1/2/20	0 days
1315	2954	Install ASDs in Sanitation (50%) - Danlaw - Ship Lot 2**Removed per Amendment 6**	100%	0 days	1/2/20	1/2/20	0 days



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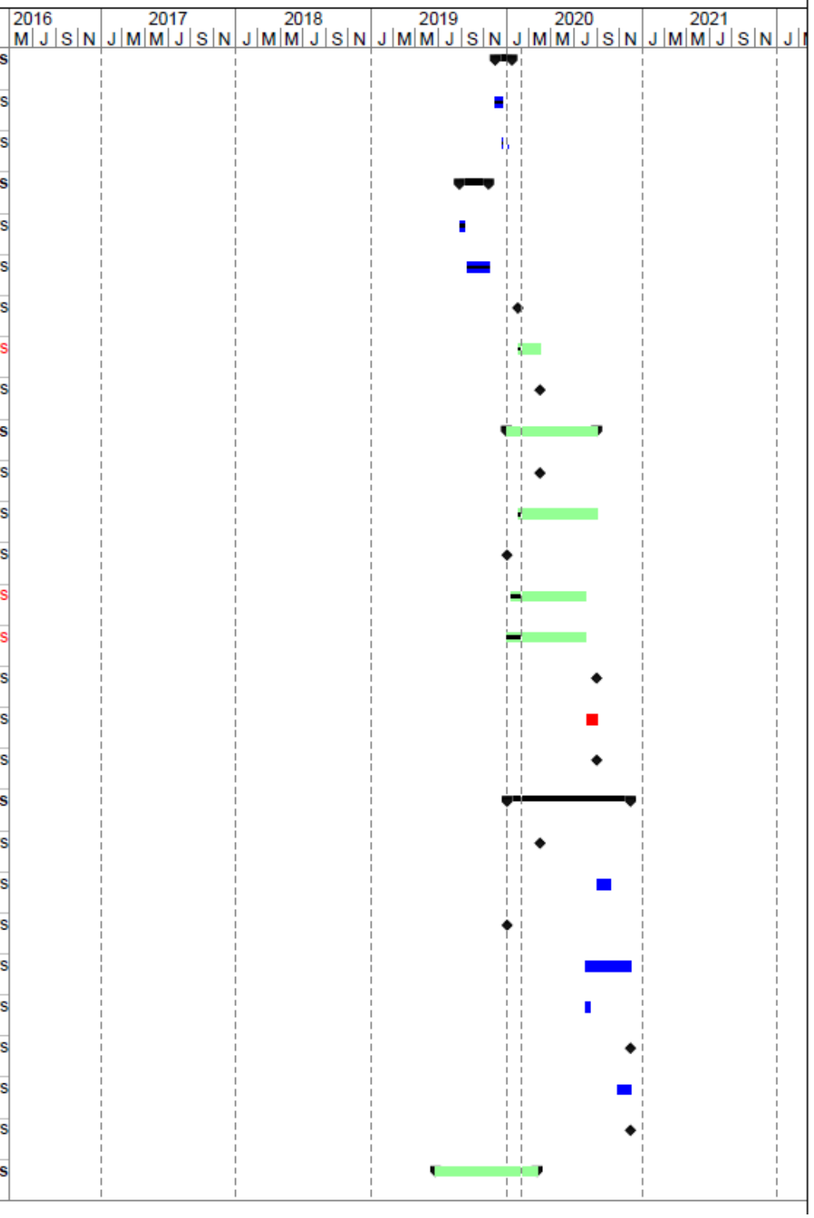
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1316	2956	**Install ASDs in DCAS Vehicles (50%)**	100%	31 days	12/2/19	1/15/20	0 days
1317	2959	Install ASDs in DCAS Vehicles (50%) - Danlaw - Ship Lot 1	100%	15 days	12/2/19	12/20/19	0 days
1318	2958	Install ASDs in DCAS Vehicles (50%) - Danlaw - Ship Lot 2	100%	16 days	12/21/19	1/15/20	0 days
1319	2960	**Install ASDs in NYC Fleet Vehicles (50%)**	100%	54 days	8/27/19	11/13/19	0 days
1320	2963	Install ASDs in NYC Fleet Vehicles (50%) - Danlaw - Ship Lot 1	100%	15 days	8/27/19	9/17/19	0 days
1321	2962	Install ASDs in NYC Fleet Vehicles (50%) - Danlaw - Ship Lot 2	100%	39 days	9/18/19	11/13/19	0 days
1322	1715	ASD Installation Complete - 50%	100%	0 days	1/31/20	1/31/20	0 days
1323	302	Integrate, Tune & Test - ASDs 50%	7%	41 days	2/3/20	3/31/20	-126 days
1324	1467	Installation Testing/Verification/Risk Mitigation/Weather - ASDs 50%	0%	0 days	3/31/20	3/31/20	-122 days
1325	500	**Install ASDs (80%)**	9%	169 days	1/1/20	8/31/20	0 days
1326	1708	Install ASDs in Taxis (80%)**Removed per Amendment 6**	0%	0 days	3/31/20	3/31/20	-106 days
1327	1707	Install ASDs in MTA Buses (80%)	2%	148 days	2/3/20	8/31/20	-213 days
1328	1706	Install ASDs in Sanitation (80%)**Removed per Amendment 6**	0%	0 days	1/2/20	1/2/20	-45 days
1329	1705	Install ASDs in DCAS Vehicles (80%)	10%	138 days	1/16/20	7/31/20	-192 days
1330	1704	Install ASDs in NYC Fleet Vehicles (80%)	16%	148 days	1/1/20	7/31/20	-192 days
1331	2924	ASD Installation Complete (80%)	0%	0 days	8/31/20	8/31/20	-213 days
1332	499	Integrate, Tune & Test as installed - ASDs (80%)	0%	20 days	8/4/20	8/31/20	-213 days
1333	3011	Installation Testing/Verification/Risk Mitigation/Weather - ASDs (80%)	0%	0 days	8/31/20	8/31/20	-213 days
1334	2356	**Install ASDs (100%)**	0%	229 days	1/2/20	11/30/20	41 days
1335	2357	Install ASDs in Taxis (100%)**Removed per Amendment 6**	0%	0 days	3/31/20	3/31/20	209 days
1336	2358	Install ASDs in MTA Buses (100%)	0%	25 days	9/1/20	10/6/20	77 days
1337	2359	Install ASDs in Sanitation (100%)**Removed per Amendment 6**	0%	0 days	1/2/20	1/2/20	270 days
1338	2360	Install ASDs in DCAS Vehicles (100%)	0%	82 days	8/3/20	11/30/20	41 days
1339	2361	Install ASDs in NYC Fleet Vehicles (100%)	0%	8 days	8/3/20	8/12/20	115 days
1340	2925	ASD Installation Complete (100%)	0%	0 days	11/30/20	11/30/20	41 days
1341	2362	Integrate, Tune & Test as installed (100%)	0%	21 days	10/29/20	11/30/20	41 days
1342	3012	Installation Testing/Verification/Risk Mitigation/Weather (100%)	0%	0 days	11/30/20	11/30/20	41 days
1343	2929	**Install, Integrate, Test & Tune - PED and PID**	18%	187 days	6/24/19	3/23/20	-32 days



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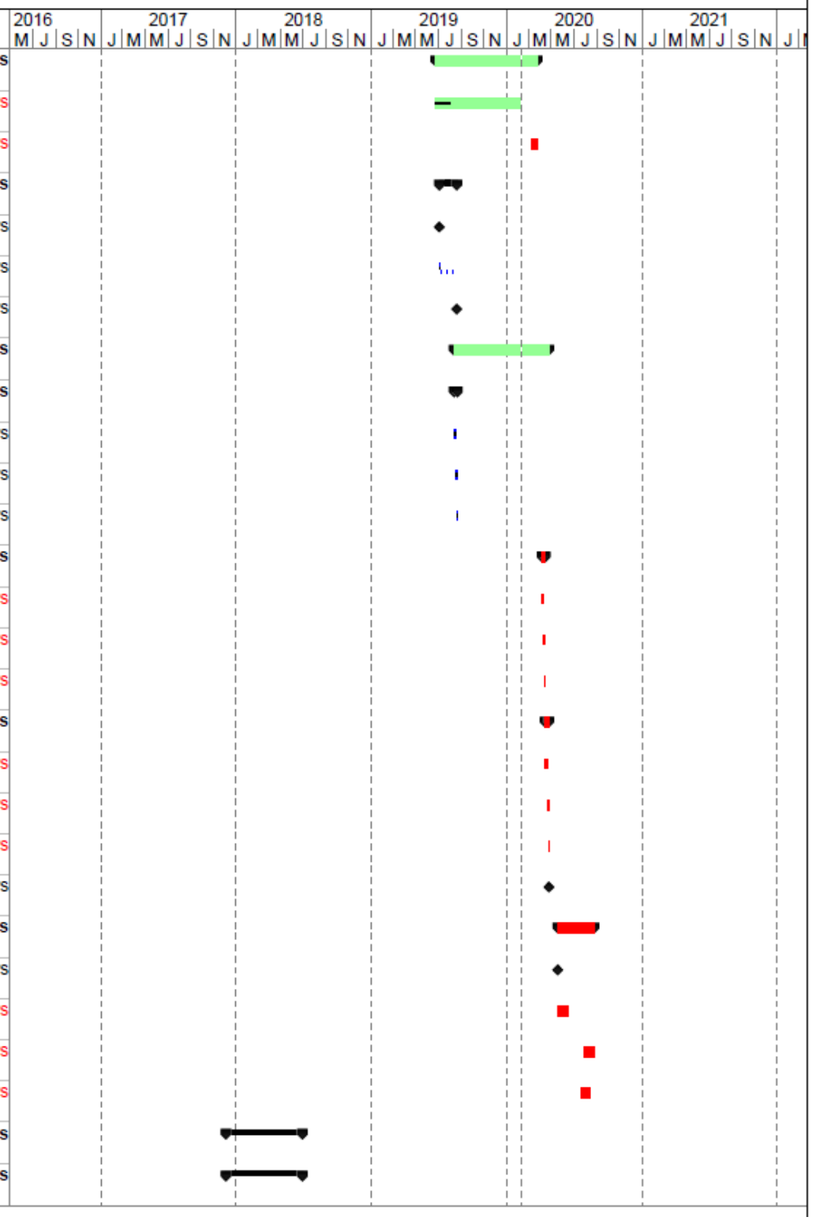
ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1344	594	**Pedestrian Configuration, Integration & Tuning**	18%	187 days	6/24/19	3/23/20	-32 days
1345	705	PED Detection Configuration, Installation & Testing	19%	155 days	6/24/19	2/5/20	-126 days
1346	596	Integrate, Test and Tune Ped App (PID) and Device	0%	10 days	3/10/20	3/23/20	-187 days
1347	3108	**Operational Readiness Testing (After Prototype ASD Installs)**	100%	32 days	7/3/19	8/19/19	0 days
1348	3109	Operational Readiness Testing - Dry Run (Not Required)	100%	0 days	7/3/19	7/3/19	0 days
1349	3110	Operational Readiness Testing	100%	32 days	7/4/19	8/19/19	0 days
1350	3112	Operational Readiness Testing Complete	100%	0 days	8/19/19	8/19/19	0 days
1351	1531	**Operational Readiness Demonstration (After 20% ASD Installs)**	36%	176 days	8/13/19	4/24/20	-169 days
1352	3117	**Operational Readiness Demonstration - Part 1**	100%	7 days	8/13/19	8/21/19	0 days
1353	1532	Operational Readiness Demonstration - Part 1 - Dry Run	100%	4 days	8/13/19	8/16/19	0 days
1354	45	Operational Readiness Demonstration - Part 1 - Punchlist Validation	100%	3 days	8/16/19	8/19/19	0 days
1355	3107	Operational Readiness Demonstration - Part 1	100%	2 days	8/20/19	8/21/19	0 days
1356	3118	**Operational Readiness Demonstration - Part 2 (ASD RF Monitoring/PEDx)**	0%	6 days	4/7/20	4/14/20	-332 days
1357	3119	Operational Readiness Demonstration - Part 2 - Dry Run	0%	4 days	4/7/20	4/10/20	-332 days
1358	3120	Operational Readiness Demonstration - Part 2 - Punchlist Validation	0%	3 days	4/11/20	4/13/20	-484 days
1359	3121	Operational Readiness Demonstration - Part 2	0%	1 day	4/14/20	4/14/20	-332 days
1360	3123	**Operational Readiness Demonstration - Part 3 (PID/PED)**	0%	8 days	4/15/20	4/24/20	-332 days
1361	3124	Operational Readiness Demonstration - Part 3 - Dry Run	0%	4 days	4/15/20	4/20/20	-332 days
1362	3125	Operational Readiness Demonstration - Part 3 - Punchlist Validation	0%	3 days	4/21/20	4/23/20	-483 days
1363	3126	Operational Readiness Demonstration - Part 3	0%	1 day	4/24/20	4/24/20	-332 days
1364	1379	Operational Readiness Demonstration Complete	0%	0 days	4/24/20	4/24/20	-332 days
1365	581	**Final Shake Down Period (RSU/ASD/PID/PED) (After 50% ASD Installs)**	0%	68 days	5/18/20	8/24/20	-156 days
1366	723	Start Shake Down - RSU/ASD - 20% (combined w/50% below)	0%	0 days	5/18/20	5/18/20	-156 days
1367	300	Final Shake Down - RSU/ASD - 20 & 50%	0%	20 days	5/19/20	6/16/20	-95 days
1368	550	Final Shake Down - Ped App (PID)/Device Shake Down Period - PID	0%	21 days	7/27/20	8/24/20	-143 days
1369	308	Final Privacy Analysis Period - RSU/ASD - 50% for CV Data Collection	0%	20 days	7/20/20	8/14/20	-198 days
1370	104	**Task 2I: Maintenance and Operations Planning**	100%	143.5 days	12/5/17	6/29/18	0 days
1371	289	**Comprehensive Maintenance and Operations Plan (CMOP)**	100%	143.5 days	12/5/17	6/29/18	0 days



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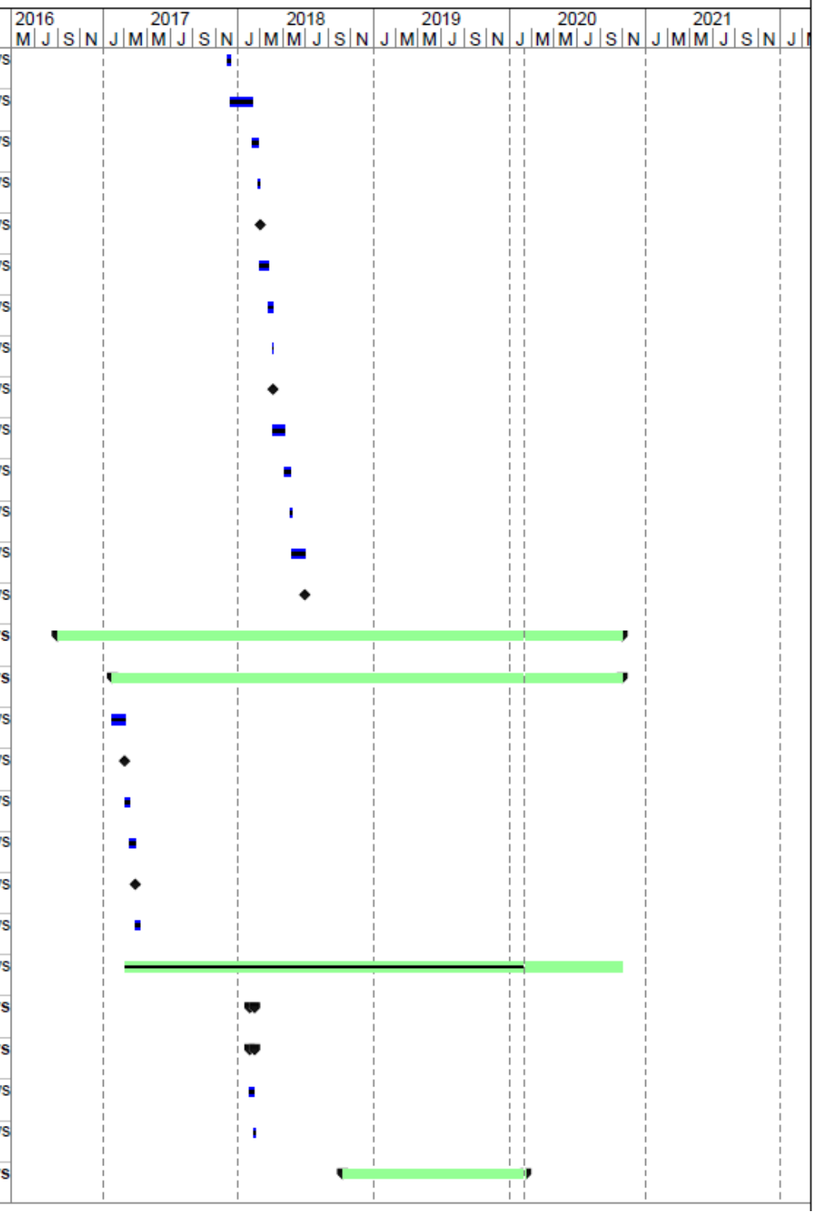
1372	1107	Prepare RACI Chart	100%	5.5 days	12/5/17	12/12/17	0 days
1373	288	Prepare Draft CMOP for Internal Review	100%	39 days	12/12/17	2/8/18	0 days
1374	1109	Review Draft CMOP	100%	9 days	2/8/18	2/22/18	0 days
1375	1108	Make final updates to Draft CMOP	100%	5 days	2/22/18	3/1/18	0 days
1376	287	Submit Draft CMOP	100%	0 days	3/1/18	3/1/18	0 days
1377	286	USDOT Review of Draft CMOP	100%	14 days	3/1/18	3/21/18	0 days
1378	285	Prepare Revised Draft CMOP	100%	8 days	3/21/18	4/2/18	0 days
1379	791	Editor Review of Revised Draft CMOP	100%	2 days	4/2/18	4/4/18	0 days
1380	284	Submit Revised Draft CMOP with Comment Resolution Report	100%	0 days	4/4/18	4/4/18	0 days
1381	283	USDOT Review of Revised Draft CMOP	100%	22 days	4/4/18	5/4/18	0 days
1382	282	Prepare Final CMOP	100%	11 days	5/4/18	5/21/18	0 days
1383	281	USDOT Review and Approval of Final CMOP	100%	3 days	5/21/18	5/24/18	0 days
1384	280	Final Section 508 Edits of CMOP	100%	25 days	5/24/18	6/29/18	0 days
1385	279	Final CMOP Complete	100%	0 days	6/29/18	6/29/18	0 days
1386	**106**	**Task 2K: Performance Measurement and Independent Evaluation Support**	**74%**	**1045 days**	**9/1/16**	**10/30/20**	**60 days**
1387	**54**	**Draft Perf. Meas. and Eval. Support Schedule (PMESS)**	**81%**	**946 days**	**1/27/17**	**10/30/20**	**60 days**
1388	298	Draft PMESS	100%	22 days	1/27/17	2/28/17	0 days
1389	299	Submit Draft PMESS	100%	0 days	2/28/17	2/28/17	0 days
1390	1218	USDOT Review of PMESS	100%	11 days	3/1/17	3/15/17	0 days
1391	1219	Address PMESS Comments	100%	10 days	3/16/17	3/29/17	0 days
1392	1220	Submit PMESS with Comment Resolution	100%	0 days	3/29/17	3/29/17	0 days
1393	1236	USDOT Review and Approval PMESS	100%	9 days	3/30/17	4/11/17	0 days
1394	55	Updated PMESS with Progress/Risk Summary (LOE)	80%	924 days	3/1/17	10/30/20	60 days
1395	**1778**	**PM Roundtable Presentation**	**100%**	**9 days**	**2/1/18**	**2/13/18**	**0 days**
1396	**1779**	**Obfuscation Strategy Presentation**	**100%**	**9 days**	**2/1/18**	**2/13/18**	**0 days**
1397	1780	Prepare PM Roundtable Presentation - Obfuscation Strategy	100%	8 days	2/1/18	2/12/18	0 days
1398	1781	Deliver PM Roundtable Presentation - Obfuscation Strategy	100%	1 day	2/13/18	2/13/18	0 days
1399	**2028**	**Data Collection**	**98%**	**339 days**	**10/9/18**	**2/14/20**	**0 days**



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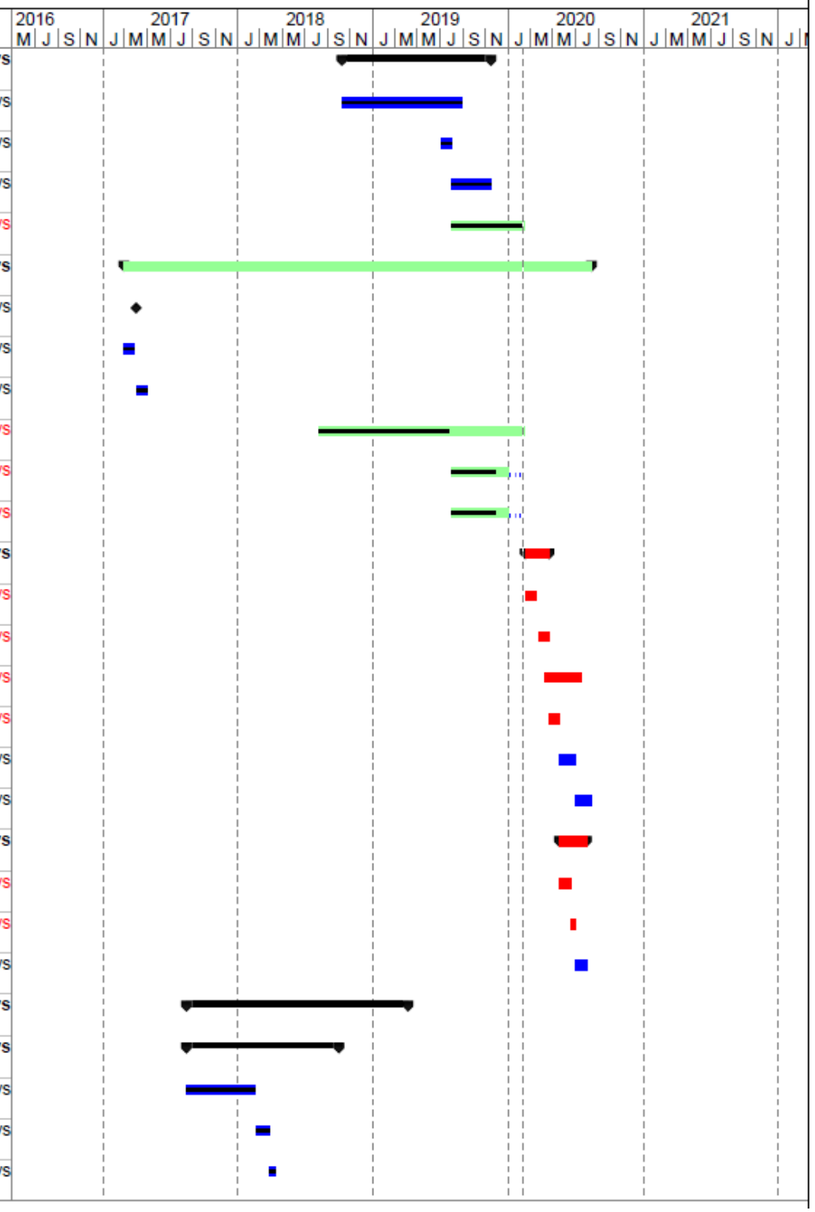
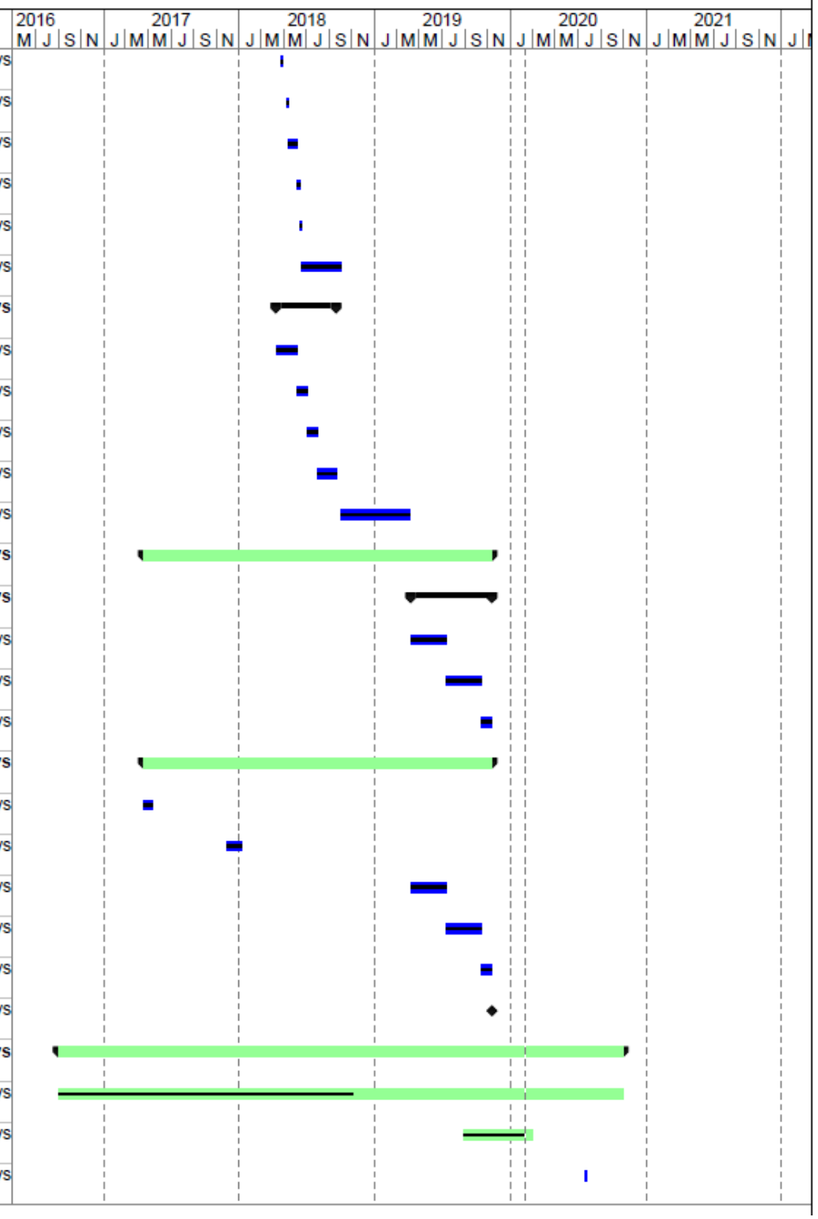
1400	2029	**Early Data Collection**	100%	278 days	10/9/18	11/15/19	0 days
1401	2031	Finalize Methodology	100%	226 days	10/9/18	8/30/19	0 days
1402	2030	Collect Early Device Data	100%	20 days	7/5/19	8/1/19	0 days
1403	2308	Share early data with IE	100%	73 days	8/1/19	11/15/19	0 days
1404	2032	Pre-Install Data Collection with Vehicle Obfuscation Operational	95%	134 days	8/2/19	2/14/20	-184 days
1405	1174	**Develop PM Algorithms & System Reports**	55%	872 days	2/27/17	8/13/20	114 days
1406	1186	Initial TMC Warehouse Design Complete	100%	0 days	3/31/17	3/31/17	0 days
1407	1199	Initial Design Planning including Obfuscation	100%	20 days	2/27/17	3/24/17	0 days
1408	529	Develop Data Handling Protocols and TMC Data Warehouse (Design)	100%	20 days	4/3/17	4/28/17	0 days
1409	528	Develop Time and Location Obfuscation Procedures	63%	379 days	8/10/18	2/14/20	-141 days
1410	527	Develop RSU Mobility (Breadcrumb) Processing Automation - May be Removed or Modified	77%	135 days	8/1/19	2/14/20	-142 days
1411	1187	Develop ASD Mobility (Breadcrumb) Processing Automation - May be Removed	77%	135 days	8/1/19	2/14/20	-142 days
1412	526	**Develop Confounding Data Stream Archiving**	0%	45 days	2/17/20	4/20/20	-187 days
1413	726	Confounding Data Stream Archiving Design	0%	22 days	2/17/20	3/18/20	-184 days
1414	727	Confounding Data Stream Archiving Development	0%	20 days	3/24/20	4/20/20	-187 days
1415	1196	Obtain Pedestrian (PID) Specific PM Algorithms from NYU (maybe only on 10 prototypes)	0%	70 days	4/9/20	7/17/20	-198 days
1416	525	Develop ASD PM algorithms and automation protocols	0%	20 days	4/21/20	5/18/20	-187 days
1417	1178	Develop System Performance Reports	0%	30 days	5/19/20	6/30/20	114 days
1418	1188	Develop dashboards	0%	31 days	7/1/20	8/13/20	114 days
1419	1175	**Test & Configure PM Algorithms**	0%	51 days	5/19/20	7/30/20	-187 days
1420	524	PM Calculation Methodologies	0%	21 days	5/19/20	6/17/20	-187 days
1421	523	Determine Control Group Size and Time/Location Bins	0%	10 days	6/18/20	7/1/20	-187 days
1422	1179	Test and Finalize System Performance Reports & Dashboard	0%	21 days	7/1/20	7/30/20	124 days
1423	1176	**Preparation for Simulation Evaluation**	100%	411 days	8/15/17	4/5/19	0 days
1424	1655	**AMS (Non-Safety) Plan**	100%	283 days	8/15/17	9/30/18	0 days
1425	1225	Develop AMS (non-safety) Plan	100%	127 days	8/15/17	2/16/18	0 days
1426	1227	USDOT/IE Review AMS (non-safety) Plan	100%	26 days	2/19/18	3/26/18	0 days
1427	2318	Address USDOT Comments AMS (non-safety) Plan	100%	10 days	3/27/18	4/9/18	0 days



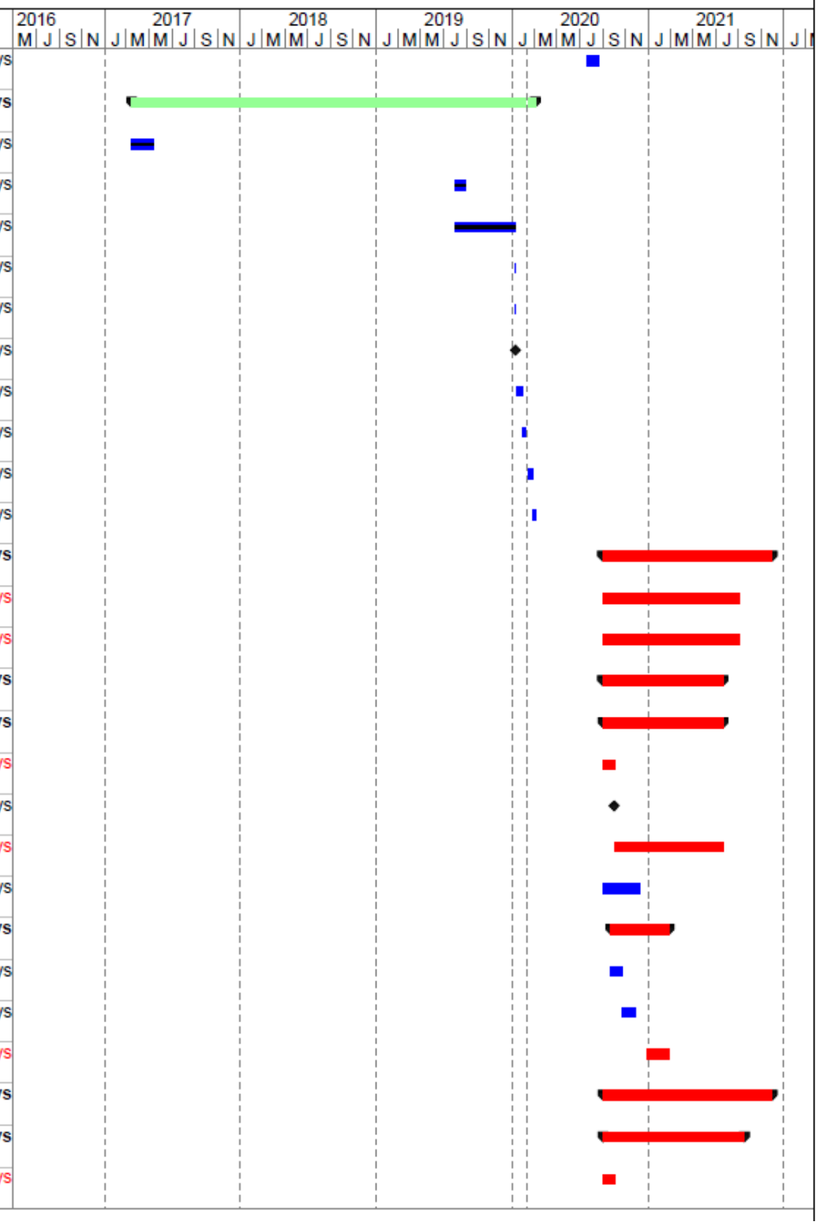
NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1428	1664	Schedule AMS (Non-Safety) Review Meeting	100%	3 days	4/25/18	4/27/18	0 days
1429	2340	Schedule AMS (Non-Safety) Review Meeting (if needed)	100%	1 day	5/11/18	5/11/18	0 days
1430	1226	Finalize and resubmit the AMS non-Safety Plan	100%	16 days	5/14/18	6/4/18	0 days
1431	2399	USDOT Review and Approval AMS Non-Safety Plan	100%	7 days	6/5/18	6/13/18	0 days
1432	2432	Address final questions AMS Non-Safety Plan	100%	4 days	6/14/18	6/19/18	0 days
1433	2431	USDOT Review and Approval AMS Non-Safety Plan	100%	71 days	6/20/18	9/30/18	0 days
1434	**1654**	**AMS (Safety) Simulation Plan**	**100%**	**113 days**	**4/10/18**	**9/18/18**	**0 days**
1435	521	Develop AMS (safety) Plan	100%	39 days	4/10/18	6/4/18	0 days
1436	1229	USDOT/IE Review AMS Safety Plan	100%	21 days	6/5/18	7/3/18	0 days
1437	1228	Finalization AMS Safety Plan	100%	19 days	7/4/18	7/31/18	0 days
1438	2400	USDOT Review and Approval AMS Safety Plan	100%	34 days	8/1/18	9/18/18	0 days
1439	1656	Update and recalibrate Systemwide Simulation Model (MTM) AMS Safety Plan	100%	128 days	10/1/18	4/5/19	0 days
1440	**1183**	**Survey Development**	**99%**	**646 days**	**4/18/17**	**11/12/19**	**0 days**
1441	**1190**	**Driver Survey Development**	**100%**	**152 days**	**4/8/19**	**11/12/19**	**0 days**
1442	1184	Driver Survey Development	100%	67 days	4/8/19	7/11/19	0 days
1443	1191	IE Review Driver Survey	100%	65 days	7/12/19	10/14/19	0 days
1444	1192	Finalization Driver Survey	100%	20 days	10/15/19	11/12/19	0 days
1445	**1185**	**Pedestrian Survey Development**	**99%**	**646 days**	**4/18/17**	**11/12/19**	**0 days**
1446	1250	Initial Version for IRB Pedestrian Survey	100%	19 days	4/18/17	5/12/17	0 days
1447	1252	Survey Administration Schedule/Plan Pedestrian Survey	100%	25 days	12/1/17	1/8/18	0 days
1448	1251	Finalized Version of Pedestrian Survey	100%	67 days	4/8/19	7/11/19	0 days
1449	1194	IE Review Pedestrian Survey	100%	65 days	7/12/19	10/14/19	0 days
1450	1195	Finalization Pedestrian Survey	100%	20 days	10/15/19	11/12/19	0 days
1451	1657	IRB Confirmation of Pedestrian Survey (not required)	100%	0 days	11/12/19	11/12/19	0 days
1452	**1180**	**IE Support**	**54%**	**1045 days**	**9/1/16**	**10/30/20**	**60 days**
1453	519	Ongoing IE Support (LOE)	52%	1045 days	9/1/16	10/30/20	60 days
1454	1230	Data Transfer to IE (Preliminary Data) with Vehicle Obfuscation Operational	87%	123 days	8/30/19	2/28/20	231 days
1455	1181	Onsite IE Data Review (Tentative Time) with Vehicle Obfuscation Operational	0%	3 days	7/20/20	7/22/20	130 days



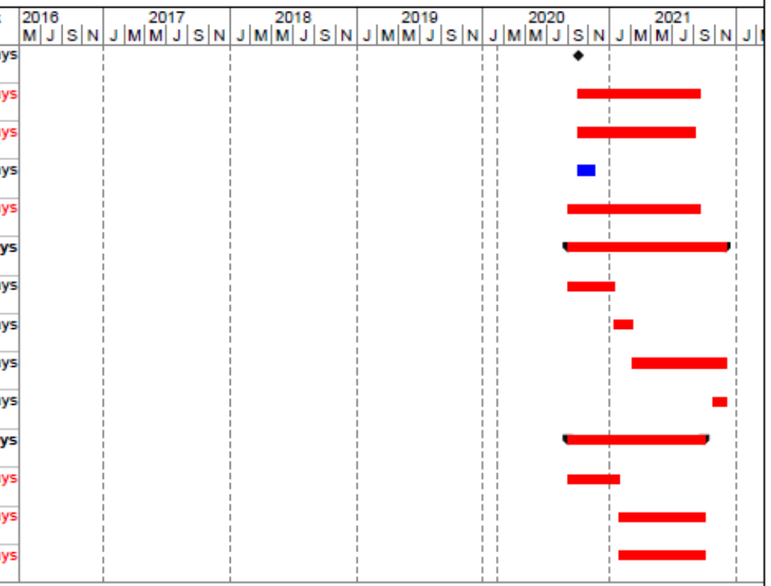
NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1456	1231	Data Transfer to IE (Final Shakedown Data) - ASD & PID with Vehicle Obfuscation Operational	0%	25 days	7/20/20	8/21/20	108 days
1457	58	**Update Phase 1 Perf. Meas. And Eval. Support Plan**	82%	745 days	3/15/17	3/3/20	229 days
1458	1217	Update Perf. Meas. And Eval. Support Plan (Update 1)	100%	43 days	3/15/17	5/12/17	0 days
1459	2312	Analyze Early Device Data	100%	20 days	8/2/19	8/29/19	0 days
1460	2309	Update Document	100%	108 days	8/2/19	1/8/20	0 days
1461	2310	Review	0%	1 day	1/9/20	1/9/20	229 days
1462	2311	Finalize	0%	1 day	1/10/20	1/10/20	229 days
1463	2313	Submit Updated Phase 1 Perf. Meas. And Eval. Support Plan to USDOT	0%	0 days	1/10/20	1/10/20	229 days
1464	2315	USDOT Review	0%	10 days	1/13/20	1/27/20	229 days
1465	2316	Address Comments	0%	10 days	1/28/20	2/10/20	229 days
1466	2314	USDOT Review	0%	10 days	2/11/20	2/25/20	229 days
1467	2317	Finalize	0%	5 days	2/26/20	3/3/20	229 days
1468	2342	**Phase 3**	0%	312 days	9/1/20	11/30/21	-209 days
1469	2344	Operations at 80% - 1 Year Data Collection Period (ASD)	0%	365 edays	9/1/20	9/1/21	-213 edays
1470	2997	Operations at 80% - 1 Year Data Collection Period (PID)	0%	365 edays	9/1/20	9/1/21	-213 edays
1471	2443	**3B: System Operations and Maintenance**	0%	222 days	9/1/20	7/21/21	-119 days
1472	2444	**Initial System Operations and Maintenance Schedule (SOMS)**	0%	221 days	9/2/20	7/21/21	-120 days
1473	2445	Prepare Initial System Operations and Maintenance Schedule (SOMS)	0%	21 days	9/2/20	10/1/20	-120 days
1474	2446	Submit Initial System Operations and Maintenance Schedule (SOMS)	0%	0 days	10/1/20	10/1/20	-120 days
1475	2447	Updated SOMS with Progress/Risk Summary	0%	200 days	10/2/20	7/21/21	-120 days
1476	2448	Silent Period - Initial System Operations and Maintenance Schedule (SOMS)	0%	68 days	9/1/20	12/9/20	244 days
1477	2449	**Train Drivers**	0%	106 days	9/23/20	2/26/21	-19 days
1478	2450	Train Fleet Driver Trainers	0%	20 days	9/23/20	10/21/20	42 days
1479	2451	Fleet Owners Train Drivers	0%	25 days	10/22/20	11/27/20	42 days
1480	2452	Train TMC Operations and Data Analysts (as per Transition Plan)	0%	40 days	12/30/20	2/26/21	-19 days
1481	2462	**3D: Performance Measurement and Independent Evaluation Support**	0%	311 days	9/2/20	11/30/21	-210 days
1482	2463	**Perf. Meas. and Eval. Support Schedule (PMESS)**	0%	261 days	9/2/20	9/16/21	-160 days
1483	2464	Prepare PMESS	0%	21 days	9/2/20	10/1/20	-160 days



NYC DOT CV Phase 2&3 Schedule 20160621.1 - U06.0.S 020520DD 2020-02-10 FINAL

ID	Unique ID	Task Name	% Complete	Duration	Start	Finish	Total Slack
1484	2465	Submit PMESS	0%	0 days	10/1/20	10/1/20	-160 days
1485	2466	Updated PMESS with Progress/Risk Summary	0%	240 days	10/2/20	9/16/21	-160 days
1486	2474	Updated PMESP and DMP documents	0%	230 days	10/2/20	9/1/21	-150 days
1487	2473	System Performance Reports	0%	30 days	10/2/20	11/16/20	50 days
1488	2472	IE Support	0%	260 days	9/2/20	9/15/21	-159 days
1489	2942	**CV Data Collection**	0%	311 days	9/2/20	11/30/21	-210 days
1490	2467	CV (Before) Data Collection - Silent Mode	0%	91 days	9/2/20	1/14/21	-210 days
1491	3140	CV Data Collection - Transition from Silent Mode to Treatment Period	0%	33 days	1/15/21	3/4/21	-210 days
1492	2468	With CV (After) Data Collection & Evaluation (Treatment Period)	0%	271 days	3/5/21	11/30/21	-305 days
1493	3013	Prepare/Submit Performance Measurement and Independent Evaluation Report	0%	25 days	10/25/21	11/30/21	-210 days
1494	2943	**SSM Simulation**	0%	270 days	9/2/20	9/29/21	-169 days
1495	2469	SSM Simulation Model Development	0%	100 days	9/2/20	1/28/21	-169 days
1496	2470	SSM Simulation Model Evaluations	0%	170 days	1/29/21	9/29/21	-169 days
1497	2471	Systemwide Performance Simulation Evaluations	0%	170 days	1/29/21	9/29/21	-169 days



Progress Schedule Update U06.0.S
Data Date: 2/5/20
Date: 2/10/20

Task | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Critical | In Progress | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Progress | Deadline

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