Mandan Hidatsa and Arikara (MHA) Nation Technical Solution & Infrastructure Development

MHA Nation GBSS

Prepared for
MHA Nation

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REVISION HISTORY

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APPROVALS

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Customer Approval (*if necessary*)				

External Acceptance (if Required)			
Approved by	**Role and Organization**	**Name**	**Date**

Contents

1.0 PURPOSE

The purpose of this document is to provide details regarding the design, development, and deployment of a Ground-based Surveillance (GBSS) for the MHA Nation to conduct BVLOS operations within a 50 nautical mile (nm) UAS corridor. The system will also enable flight operations to be conducted alongside the clinic in White Shield, as well as facilitate infrastructure inspections within the designated area. Furthermore, the expanded service volume will permit extension into the Williston area by leveraging the existing Vantis Service Volumes.

The following sections will describe the solution, surveillance sensor coverage analysis, and cost estimate, in turn.

2.0 SOLUTION

2.1 Corridor Location

The MHA Nation wishes to execute a BVLOS corridor between the Elbowood Clinic located in New Town, ND and the town of Twin Buttes, ND. This corridor is the highlighted green path between Elbowoods Clinic and Twin Buttes Clinic in Figure 1.

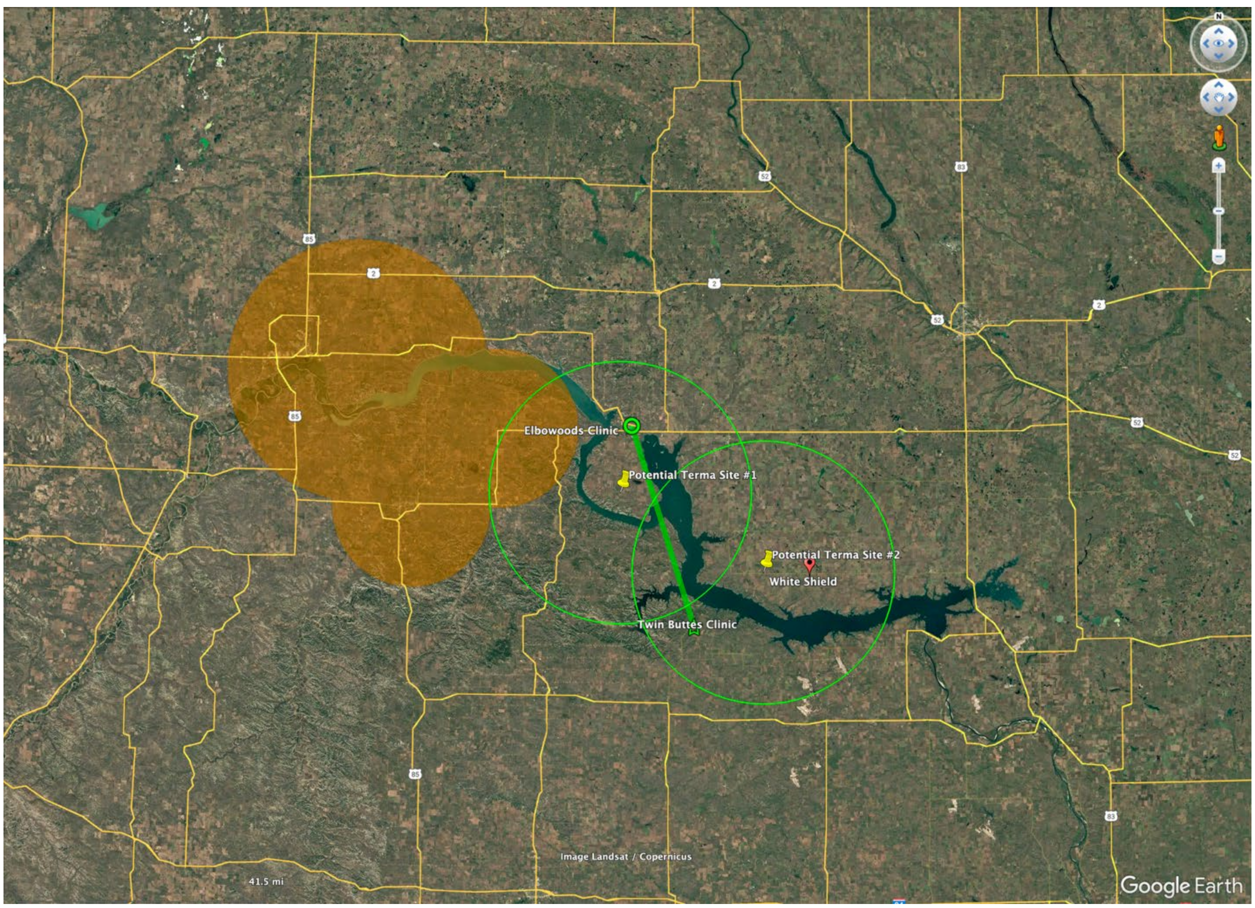

Figure 1: MHA Nation BVLOS Corridor Location

The current Vantis volume within the western part of the state is represented in orange shading. These “service volumes” are areas where Vantis surveillance and C2 systems meet performance requirements. The proposed service volumes (inclusive of only surveillance) outlined in green depict the 18.6 nm coverage ranges of two proposed Terma primary radars. Locations of these radars are represented by the yellow pins above. The Lat / Long coordinates of the proposed radar sites are in Table 1 below.

Table 1: Terma Radar Proposed Site Locations

Proposed Location Name	Lat / Long Coordinates
Potential Terma Site #1	47°50'1.09"N, 102°30'32.16"W
Potential Terma Site #2	47°38'50.24"N, 102° 00'21.21"W

Each location features existing physical infrastructures, including a communication tower with supplied power.

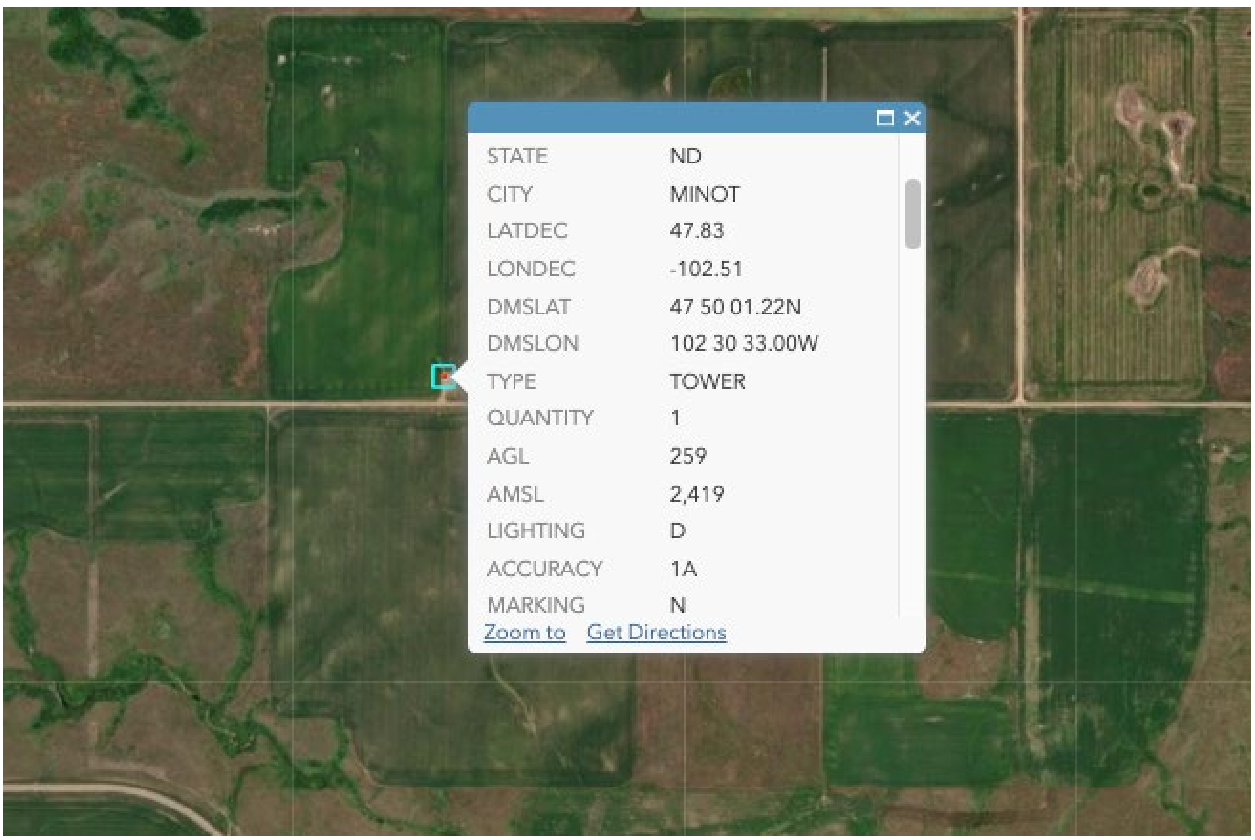

Figure 2: Potential Terma Site #1 Existing Infrastructure. Communications Tower Standing at 259' Above Ground Level (AGL)

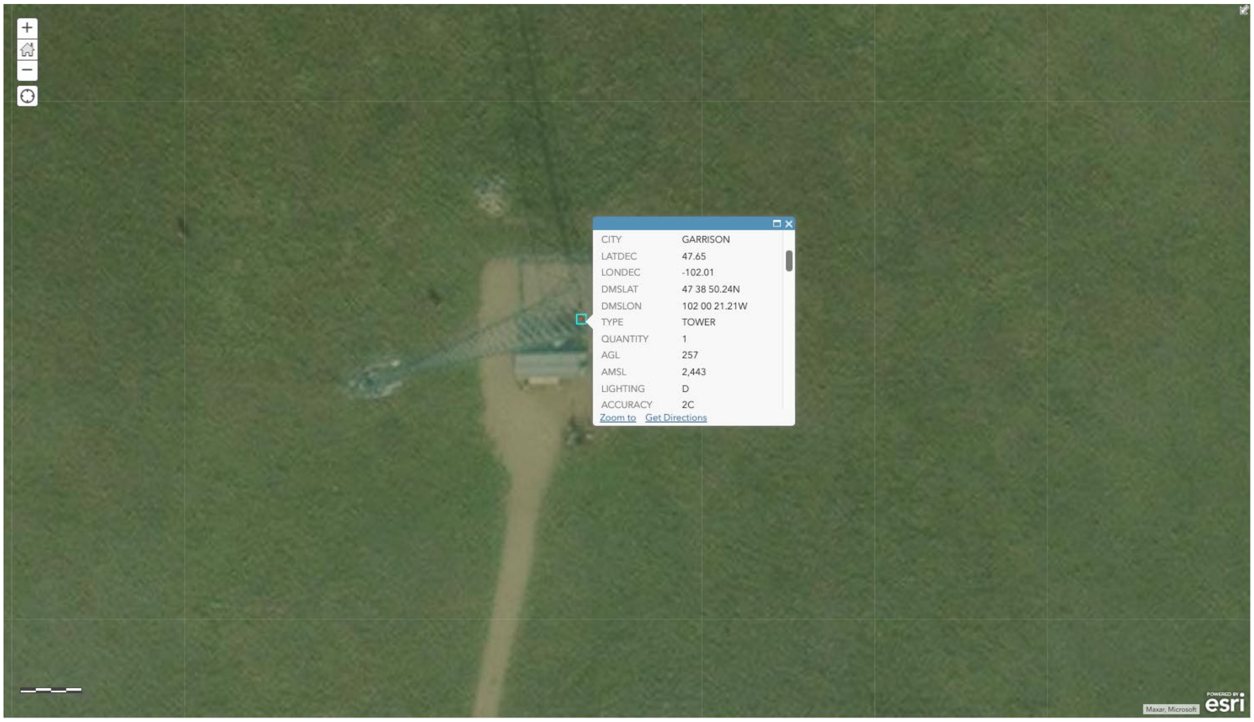

Figure 3: Potential Terma Site #2 Existing Infrastructure. Communications Tower Standing at 257' AGL

2.2 Solution Architecture

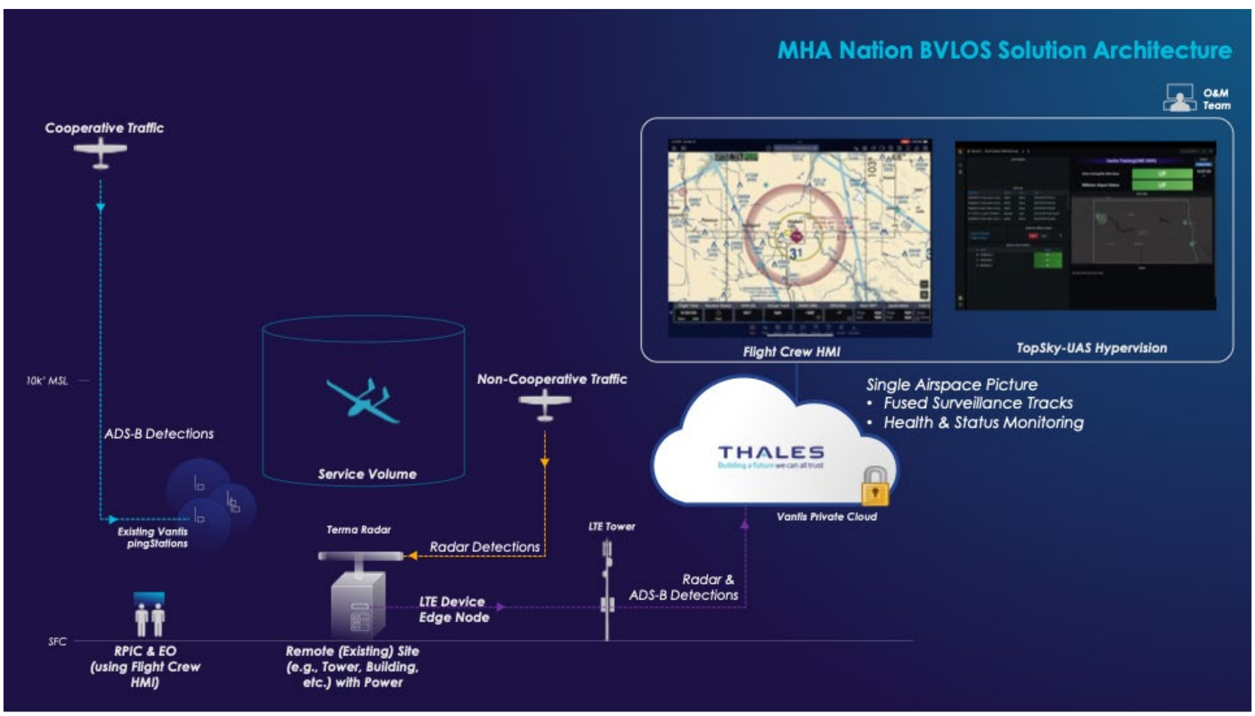

Figure 4: MHA Nation GBSS Solution Architecture

The GBSS solution comprises two key services:

- Traffic and Surveillance Service (TSS)
- Monitoring and Control Service (MCS)

Regarding the surveillance component of the system, the surveillance solution is made up of cooperative and non-cooperative surveillance sensors to detect manned aircraft. As depicted in Figure 1, it is necessary to deploy two primary radars to cover the entire BVLOS corridor between New Town and Twin Buttes, ND. Regarding cooperative surveillance, the existing ADS-B infrastructure in Vantis can potentially be leveraged as it already covers the area of interest for MHA.

The primary radar in this solution will be used to detect non-cooperative aircraft below 10,000 ft. MSL, as all cooperative aircraft are required to transmit their position via ADS-B at and above 10,000 ft. MSL (Figure 5). Thus, detection of all cooperative air traffic will be achieved using ADS-B receivers from this altitude and above (and wherever received at lower altitudes).

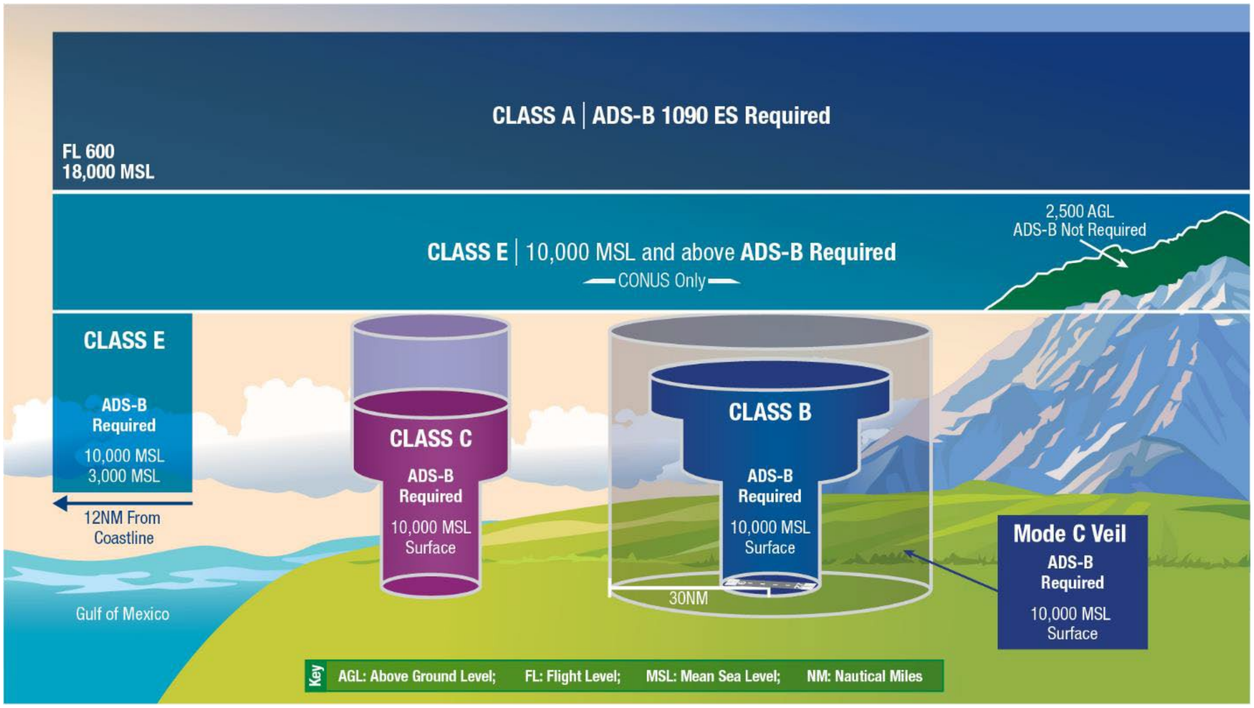

Figure 5: ADS-B Mandate in the NAS

As manned aircraft are detected by the surveillance sensors, these data, along with all health & statuses of the individual equipment are collected at an Edge Computing Device, known as the "Edge Node". This data is sent from the Edge Node to Thales' centralized data processing center (i.e., private cloud network) via LTE connectivity where both surveillance and health & status data are processed. This processed data comprises fused surveillance tracks and various statuses of the system. These data are supplied to two Human Machine Interfaces (HMIs):

- Flight Crew HMI
- Health & Status Dashboard (product known as *TopSky-UAS Hypervision*)

Only the Remote Pilot in Command (RPIC) and the co-located Electronic Observer (EO) in the field will need to use the Flight Crew HMI to conduct their BVLOS operations. During the in-flight phase, the Flight Crew controls the UAS. The solution will continuously provide the RPIC & EO situational awareness of the airspace through the ground-based surveillance components. Ownship can also be displayed to the EO on the Flight Crew HMI. When enabled, there are two additional range rings which will be displayed to represent the Detect and Avoid (DAA) Alert Volume and Well Clear Volume (Figure 6) around UAS ownship. These range rings are configurable from the Flight Crew HMI application (i.e., increase or decrease range in nautical miles).

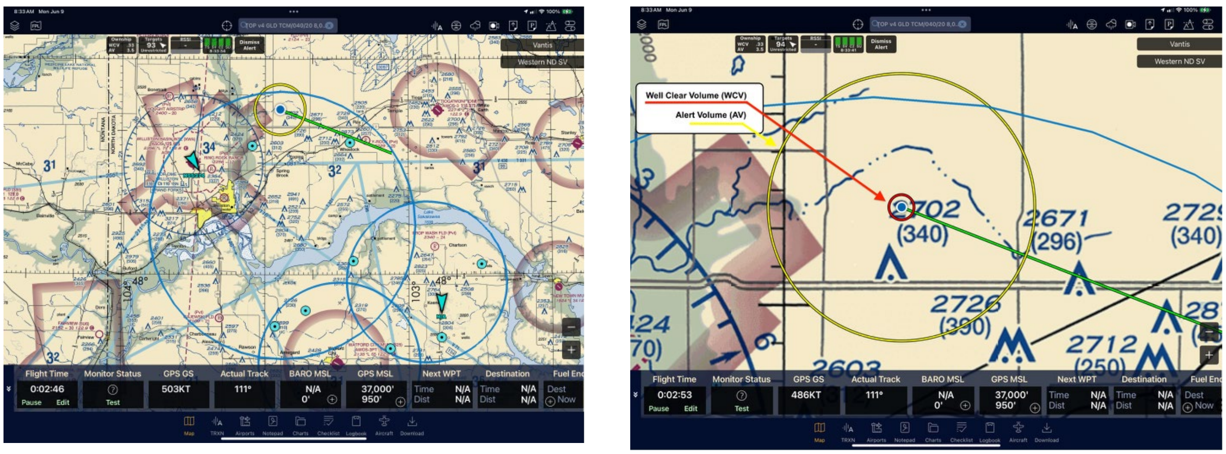

Figure 6: Examples of UAS Ownship Displayed on a Flight Crew HMI (left) and the DAA Alert Volume (yellow, outer ring) and the DAA Well Clear Volume (red, inner ring) (right)

When an aircraft is detected by the surveillance sensors and enter the UAS Operator's Alert Volume (outer ring), the Flight Crew HMI will alert the EO in real-time via audible sound, triggering the flight crew to take necessary actions (e.g., contingency maneuver) based on track data provided by the system in accordance with the Operator's standard operating procedures (SOPs). This alerting mechanism not only enhances the situational awareness of the Flight Crew and safety of flight but also enables a timely UAS maneuver by the RPIC, remaining well clear of the crewed aircraft as required by regulation. Additionally, this authoritative surveillance data is available for use by multiple end users to monitor the airspace for the respective missions they are managing without the addition of avionics.

Operations & Maintenance (O&M)

The GBSS capability is inclusive of the deployment and execution of the MCS and its core functions. The MCS is a monitored service and is supported by an integrated operations & maintenance team to guarantee that efficient and safe operations can be flown routinely.

The O&M team has developed extensive Standard Operating Procedures (SOPs) to ensure consistency in their approach. All O&M staff are trained in the use of these SOPs to monitor system health and respond to incidents if they arise. Today, staffers conduct status checkouts each workday to ensure proper system function. System health is monitored via the Health & Status Dashboard.

The includes tools that MHA Nation personnel and the O&M team can use to submit, track, and manage any incidents. Incidents are tracked and managed in the Incident Management System via Jira Service Manager (JSM). By using JSM, users and O&M staff can create incident tickets for investigation purposes (Figure 7).

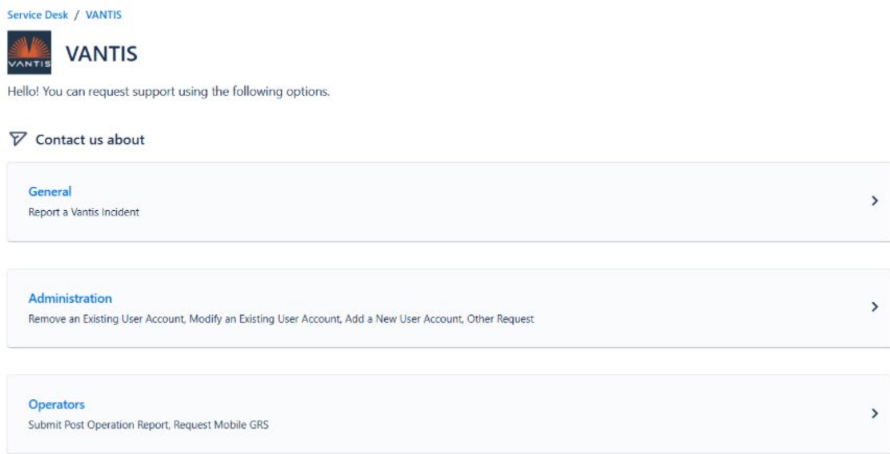

Figure 7: Example of the Vantis Incident Management System via Jira Service Management (JSM)

Thales can support the system using a three-tiered concept, Level 1, Level 2, and Level 3:

- Level 1 support is the initial support level responsible for basic customer issues reported to the Service Desk (web-based service). This is a function that can be fulfilled by the Vantis resource. Level 1 support gathers as much information as possible from end users and handles straightforward incidents.
- Level 2 support is more in-depth technical support provided by technicians with experience and knowledge of the system. Level 2 support is responsible for helping Level 1 support solve basic incidents and for investigating elevated issues. Level 2 support may order the replacement of hardware components from the onsite depot, perform diagnostic tests, and remotely access devices to troubleshoot and resolve incidents.
- Level 3 support handles the most difficult or advanced problems and is provided by experts at Thales or from our vendors/suppliers, if needed. Level 3 support is responsible for helping Level 1 and Level 2 support along with researching solutions to new or unknown incidents.

MHA Nation can take advantage of Vantis' well-defined lifecycle and change management process when subscribing to Thales' service model. This service sharing approach involves all elements of the solution including infrastructure, software, operations and maintenance support, and new feature development and enhancement, representing large cost savings to MHA Nation.

2.3 Surveillance Sensors & Infrastructure

Based on MHA Nation's needs and objectives, we have proposed the following equipment which provides the coverage, monitoring, and networking capabilities necessary for the proposed corridor.

Medium Range Primary Radar

The Thales team recommends the Terma Scanter 5202 radar to provide medium range surveillance in the region of interest. The Terma Scanter radars are proven commodities and are currently operating at hundreds of locations around the world. The radar is a 2D sensor, currently approved by the FAA as part of Vantis BVLOS service, and is capable of providing the accurate target range and information to safely fly BVLOS missions. A summary of the high-level specifications of the Scanter 5202 is provided:

Category	Specification
Frequency:	9-9.2, 9.25-9.5GHz
Dimensions:	2D
Detection Range:	22.2km Pd ≥ 0.85 on 1 m^2 target
Range Accuracy:	6m
Azimuth Accuracy:	0.0176 degrees
Elevation Accuracy:	NA
Clutter Cancellation:	35dB
Effective Field of View (Az x El):	360 deg x 2km
Export Control:	ECCN 6A008k
FCC ID:	N9MSC5000
TRL:	Level 9

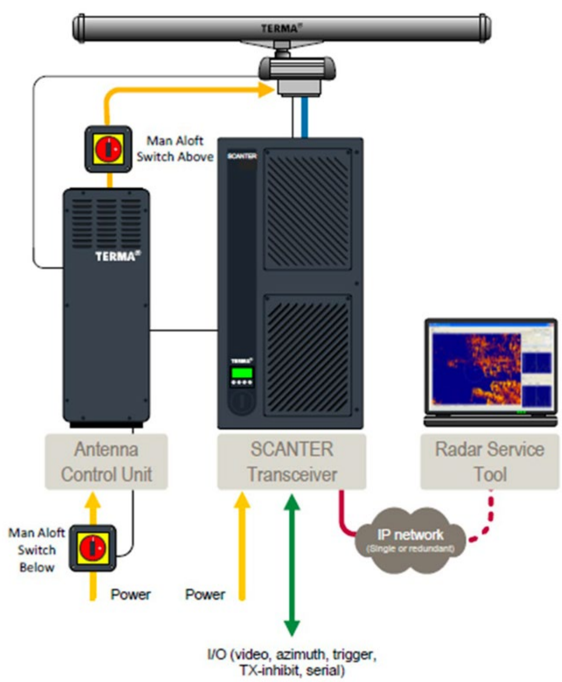

Figure 8: Terma Scanter High-Level Block Diagram

Figure 9: Installation of a Terma Radar in ND as Part of the Vantis System

Figure 10: Full View of the Installation of a Terma Radar in ND as Part of the Vantis System

ADS-B Receivers

As ADS-B Out is mandated from 10,000 ft. MSL and above, it is critical to ensure detection of cooperative aircraft at these altitudes. To satisfy the detection requirement of cooperative aircraft, we recommend MHA Nation to use pingStations supplied by uAvionix. With a detection range of 100nm and low latency performance, the pingStation is already a proven asset as part of the Vantis solution and will serve as the key cooperative sensor for the GBSS solution for MHA Nation.

Networking

There are several options to get data from the Edge Node to the Vantis cloud services, including LTE and fiber connectivity. Vantis currently leverages fiber connectivity through NDIT STAGEnet. The quality of the LTE signal will require further analysis to determine usability at any of the proposed sites.

The figure below represents the Edge Node that shall be co-located with the surveillance sensors at the customer's selected remote site.

Figure 11: (Example) Edge Node Comprising an Edge Server, Built-in LTE, and Power Supply

Figure 12: (Example) ADS-B Ground Receiver (uAvionix pingStation) & Edge Node

3.0 SURVEILLANCE SENSOR COVERAGE

This section describes the process of conducting a surveillance sensor coverage analysis using LiDAR data, which considers obstacles on the surface and not just elevation data / terrain. The goal of this analysis is to produce a viewshed of the Terma radars, from the vantage point specified in Table 1. More specifically, a geodesic viewshed is used to produce the surveillance coverage results. Figure 13 illustrates this process at a high level.

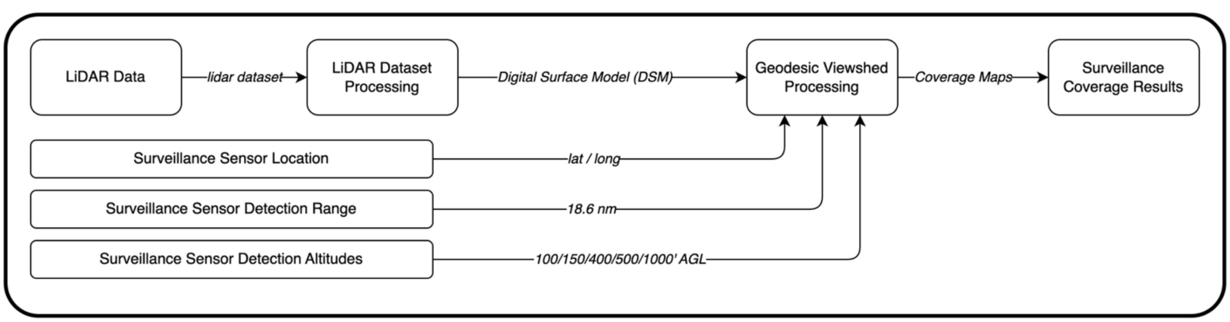

Figure 13: Surveillance Coverage Analysis Process Using LiDAR Data

Beginning with the area of interest (AOI)—in this case are the areas between New Town and Twin Buttes, ND—LiDAR data is collected / downloaded from an authoritative source[1] and is uploaded to a GIS application for LiDAR Dataset Processing. Digital Surface Model (DSMs) are used as an input to the Geodesic Viewshed process, where other inputs are required, including the location and detection range of the Terma radars to produce the coverage maps that characterize the ability for the Terma radars to detect manned aircraft at various altitudes (i.e., the coverage results).

Figures 14 and 15 below depict the Digital Surface Model (DSM) produced for the AOI.

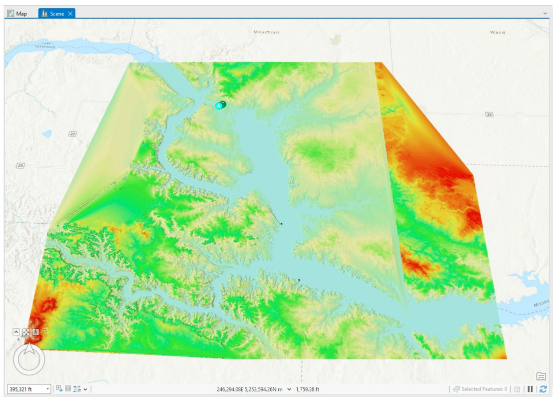

Figure 14: Lidar Data Characterizing the Area of Interest (AOI). Blue Dot Indicates New Town, ND

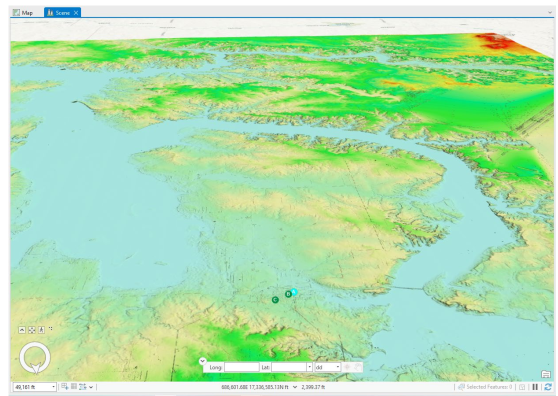

Figure 15: Lidar Data Characterizing the AOI, with the Perspective of the Terma Radar Site Facing South

[1] https://lidar.dwr.nd.gov/

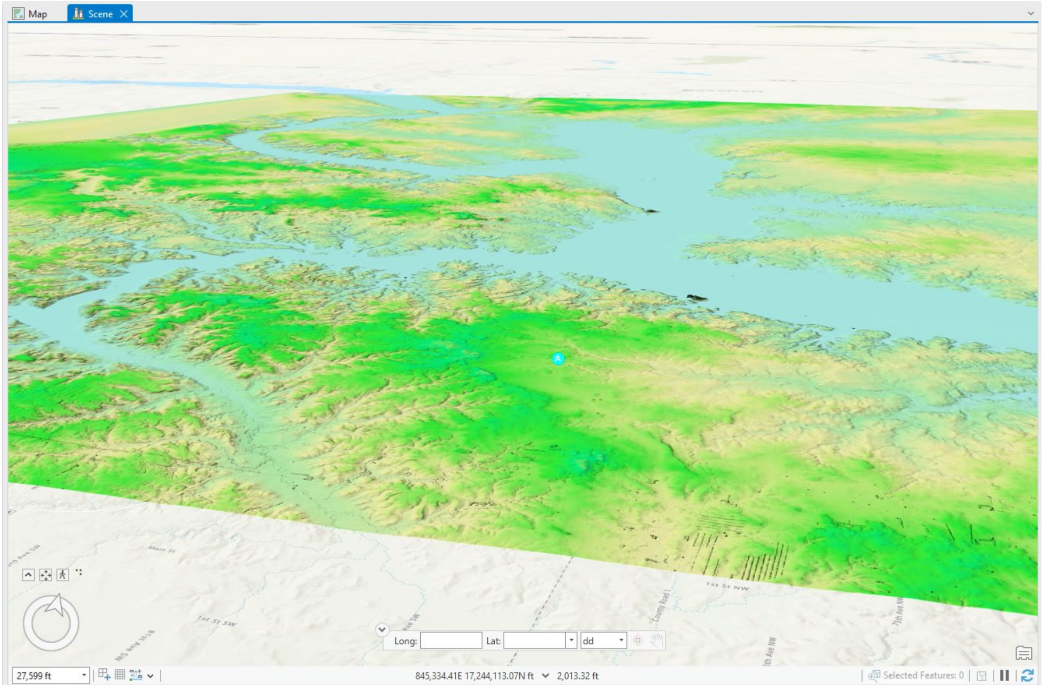

Figure 16: LiDAR Data Characterizing the AOI, from the Perspective of the Terma radar Site in Twin Buttes Facing North

It is apparent from the DSM that the AOI terrain is not undulating and for obstacles that are present within the AOI, some obstacles can extend from the surface to <150 feet in some areas.

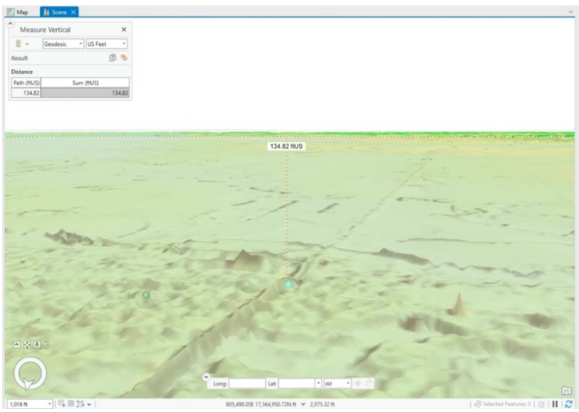

Figure 17: Obstacles in the New Town area can extend up to 134 ft (40m) into the airspace

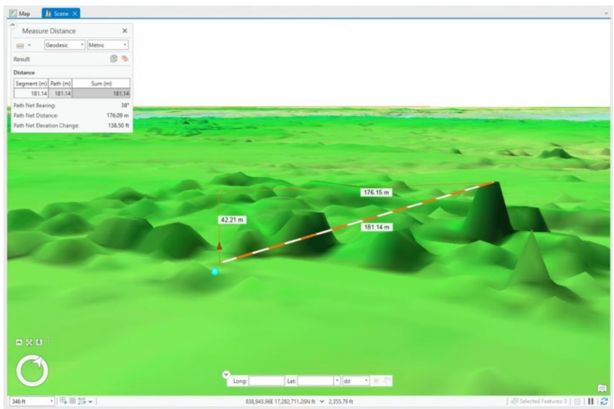

Figure 18: Obstacles in the Twin Buttes area can extend up to 137 ft (42m) into the airspace

Results of the coverage analysis are depicted below.

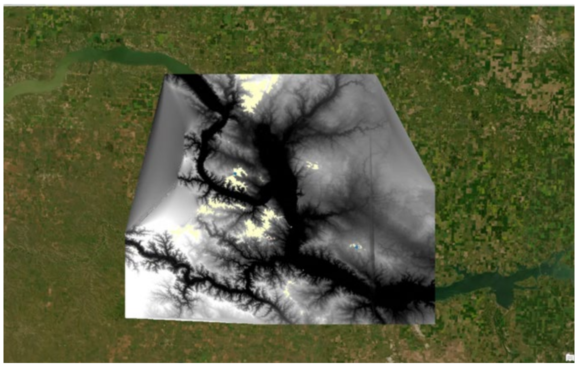

Figure 19: Surveillance coverage from a 30' Tower, detecting targets at 100' AGL. New Town and Twin Buttes are identified on the map with blue dots

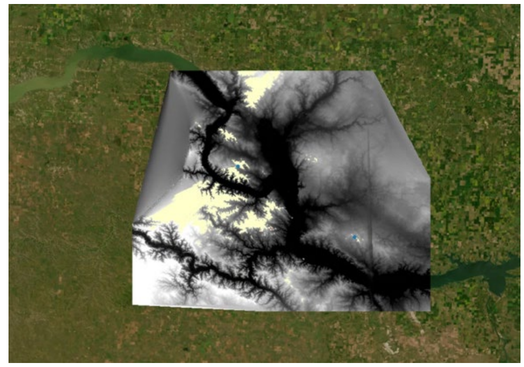

Figure 20: Surveillance coverage from a 90' Tower, detecting targets at 150' AGL. New Town and Twin Buttes are identified on the map with blue dots

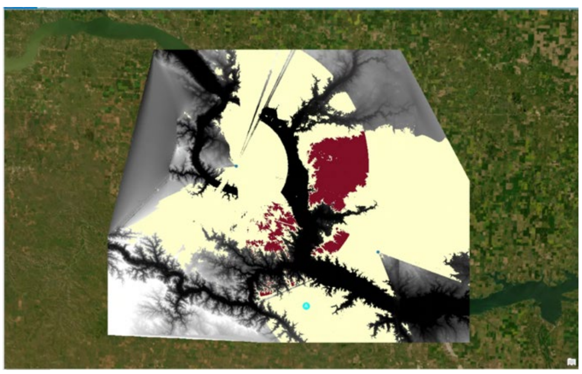

Figure 21: Surveillance coverage from a 30' Tower, detecting targets at 400' AGL. Twin Buttes, ND is identified in teal

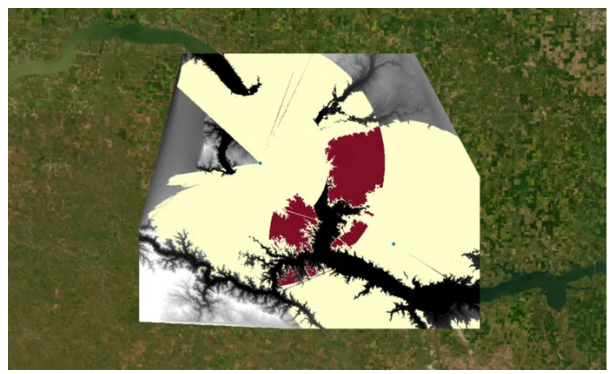

Figure 22: Surveillance coverage from a 90' Tower, detecting targets at 500' AGL

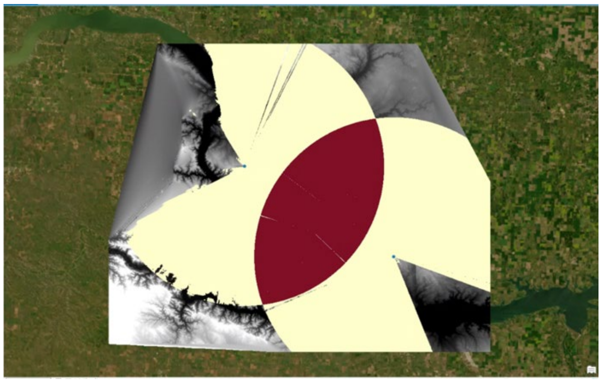

Figure 23: Surveillance coverage from a 30' Tower, detecting targets at 1000' AGL

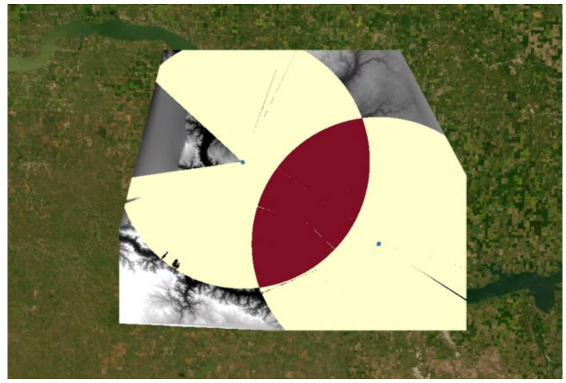

Figure 24: Surveillance coverage from a 90' Tower, detecting targets at 1000' AGL

Detection areas of each radar site are colored in tan. Overlapping detection areas of both radars are colored in maroon.

The analysis considered two tower heights from which a Terma radar can be installed (i.e., 30' and 90' towers). Additionally, it is important to note that in Figure 23 and Figure 24 there appears to be "wedges" (or gaps) in the coverage volume of each potential Terma site. However, this should not be perceived as a constraint. The wedges are present due to the placement of the "observation point" within the GIS application, which abuts the existing tower infrastructure at these locations (potential radar site #1 with an existing tower northwest of the observation point; potential radar site #2 with an existing tower southeast of the observation point). A way to mitigate against this could include the emplacement of the radar on the existing tower (though additional logistics, planning, and substantial costs would be required as these towers are erected well above 200' AGL). It is important to note that even with these locations selected, the coverage of the surveillance assets directly overlap the intended corridor between New Town and Twin Buttes.

Though the coverage analyses show the notional coverages at various altitudes when emplaced on a 30' tower, it is imperative for MHA Nation to conduct a formal site survey to assess optimal site locations that meet line-of-sight and other requirements, including local rules, regulations, and ordinances, as well as conduct necessary test flights to validate the coverage of these assets at these locations.

4.0 FAA SURVEILLANCE

As a larger effort to support varying use cases, Thales is working in collaboration with NPUASTS and FAA to integrate federal radar data, which may supplement the installation of additional equipment.

Thales and NPUASTS will keep MHA Nation informed with the progresses of the FAA Radar Enclave effort.

5.0 SITE SELECTION

Although two distinct potential installation sites have been identified and analyzed previously, conducting a Site Survey is crucial as part of the finalization process for the sites.

The success of any surveillance radar installation begins with a rigorous and strategic site selection process that balances operational performance and regulatory feasibility. Thales conducts in-person surveys of multiple candidate locations in and around New Town and Twin Buttes, ND, focusing on unobstructed line-of-sight (LOS) coverage. Using LiDAR GIS data and drone-assisted aerial imaging, we simulate and verify radar coverage at varying altitudes to identify the optimal site and tower height.

Unobstructed line-of-sight for surveillance assets is of the utmost importance when evaluating prospective sites. The areas of interest, in particular the physical environment, will be assessed (e.g., area contains an urban landscape, wooded areas, significant changes in ground level, etc.)

5.1.1 Criteria

Creation of overall criteria for the selection of a site will be critical when evaluating alternative solutions based on key factors, such as:

1. Recurring cost
2. Build complexity
3. Timeline to readiness
4. Accessibility to power
5. Accessibility to communications (e.g., fiber)
6. Surveillance radar Line-of-Sight (LOS) coverage & performance
7. Access to the site & access control
8. Land ownership
9. Environmental / cultural viability

To aid in properly evaluating the LOS characteristics, a drone may be deployed as necessary to verify the sight analysis. A drone can be used to take 360° high resolution videos and photographs at elevations deemed appropriate to the location.

5.1.2 Scorecard

In order to profile all options, varying buildout types and multiple areas around the areas of interest can be considered.

Examples of build types include:

1) Rooftop deployment of sensors
2) Sensor deployment on top of a pre-existing communications tower
3) Sensor deployment on top of a custom-built tower

For each area, only the most promising site can be listed in a solution table which can be utilized in an evaluation score card, such as the one below:

Table 2: Site Type and Description - Example

Solution:	Type	Description
SOL 1	Rooftop	Location 1
SOL 2	Rooftop	Location 2
SOL 3	LTE Tower	Location 3
SOL 4	Water Tower	Location 4
SOL 5	Rooftop	Location 5
SOL 6	Custom Tower	Location 6

Each solution is listed and scored in the table below.

Table 3: Site Evaluation Scorecard - Example

Criteria	Coefficient or mandatory	SOL1	SOL2	SOL3	SOL4	SOL5	SOL6
Cost (recurring)	3	5	5	5	5		
Build Complexity (build out cost, logistics, etc.)	3	4	6	8	3		2
Timeline to readiness	3	8	8	5	3		2
Power availability	5	9	10	10	6		
Communications availability	5	9	6	10	6		
Line-of-Sight analysis	9	2	10	10	9		
Accessibility	5	6	8	3	4		
Land ownership	5	8	9	6	6	2	2
Environmental / cultural viability	mandatory	yes	yes	yes	yes		
Total score		**229**	**312**	**289**	**224**	**175**	**157**

The top two recommendations are then examined in further detail.

6.0 SITE PREPARATION AND TOWER CONSTRUCTION

GBSS deployment requires site preparation and tower construction to be carried out through a structured and methodical process, from initial planning through final construction and execution.

6.1.1 Local Permits and applications

Once a suitable site has been selected, we must coordinate with local regulatory agencies to confirm compliance with zoning ordinances and environmental regulations. If building permits are required, the appropriate applications must be submitted and approved before any further action is taken. After all necessary permits are secured, a licensed surveyor should conduct a GIS and topographic survey to obtain precise site coordinates, which are essential for subsequent federal filings with the FAA and FCC.

During this phase, requests for utility services such as electrical power and optical communications fiber are submitted to the appropiate service providers to begin the approval process and schedule installation.

6.1.2 Federal Coordination (FAA 7460 - FCC Environmental Compliance and Transmit Licensing)

After securing local zoning permits and performing a licensed GIS/topographic survey for the installation sites, precise coordinates are established for federal filings.

The federal coordination process begins with frequency pre-screening using the FAA's WebFCR tool to identify potential conflicts with aviation navigation and surveillance systems. FAA Form 7460-1 is submitted regardless of tower height because the radar system will emit RF energy in aviation-sensitive bands. The FAA evaluates the project under Part 77 criteria, including tower height, airport proximity, and the potential for radio frequency interference (RFI) with protected aviation bands. Upon receiving a Determination of No Hazard (DoNH) from the FAA, required prior to FCC registration and construction, we initiate tribal and environmental reviews through the FCC's Tower Construction Notification System (TCNS). If the project doesn't qualify for a category exclusion, a FCC Form 620 is filed to address NEPA and historic preservation compliance with SHPO and THPO coordination.

Once FAA and environmental clearances are obtained, the tower is registered through the FCC's Antenna Structure Registration (ASR) system. This process includes providing local and national notice of the project's intentions to ensure transparency and compliance with community and regulatory stakeholders. To begin transmitting while the permanent license application is processed, we request Special Temporary Authority (STA) from the FCC, citing operations pending full licensing. Upon grant of the permanent license via the FCC's Universal Licensing System (ULS), the radar system operates under full regulatory compliance, completing the process from site selection through construction, registration, and authorized transmission.

6.1.3 Tower Construction and Radar Deployment

Building a foundation requires a carefully sequenced set of steps to ensure structural integrity and long-term durability. The process begins with the installation of a site access road to accommodate heavy equipment. Once access is established, excavation for the tower foundation can commence.

Following sufficient excavation, the steel-reinforced concrete foundation will be assembled and poured. This includes concrete compression testing to verify compliance with structural standards.

In addition to the tower foundation, a foundation for an H-frame will be constructed. The H-frame is a critical component of the project, housing all on-site power and communications equipment and enabling the necessary connections between the radar, support equipment, and utility services (power and fiber).

Grounding and lightning protection are essential for system safety by guarding against electrical surges. Before backfilling the foundation, a subsurface grounding halo will be installed per project specifications. Thales' requirements exceed standard tower grounding practices and align with FAA specifications outlined in FAA-STD-019F. Grounding leads will be connected to all tower legs, H-frame legs, and the lightning protection system.

Once the foundation is backfilled and the soil compacted, civil works will be considered complete, and utility connections can be made at the H-frame. Bringing utilities in before erecting the tower is crucial for both safety and operational readiness, allowing for the radar and transceiver cabinet to be installed and tested on the tower platform prior to final erection.

The main support section of the tower will be assembled at ground level and raised into place using a crane. After the support structure is secured, the tower platform, along with the radar and transceiver cabinet, will be installed on top. Final power and fiber connections will then be made, completing the installation.

Throughout the project, all necessary drawings will be provided.

7.0 TESTING OF GBSS INFRASTRUCTURE

The test and validation of GBSS infrastructure is a crucial element to establishing a UAS operational center with an end goal of obtaining a BVLOS waiver. The testing and validation approach is codified in the Test & Evaluation Master Plan (TEMP). Based on the FAA William J. Hughes Technical Center Test and Evaluation Handbook, the TEMP lays out approaches for functional and performance testing beginning with hardware production testing, software testing, integration testing, and finally formal verification & validation acceptance testing.

For this solution, Thales will deploy the following services to support the GBSS capability:

- Traffic & Surveillance Service (TSS)
- Monitoring and Control Service (MCS)

A partnership with Vantis represents not only an optimization of infrastructure but also an opportunity to leverage test plans and procedures that have been previously utilized in a safety case and BVLOS waiver request.

As the new Documents and procedures of substantial value that could be leveraged include:

- Test & Evaluation Master Plan
- Surveillance Requirements
- Integration Testing practices
- Site Acceptance Testing procedures and requirement evaluation
- Operations & Maintenance best practices

The following represents the Team’s approach to testing and validation of the GBSS.

Production Testing

Before deployment to the fielded locations, hardware components undergo evaluation using an Asset Management Process. Smaller items such as servers, ADS-B receivers, et cetera are evaluated per internal Production Test Procedures. Larger items such as radars are evaluated or functionality and performance per manufacturer’s specifications.

Software Testing

The product development workflow includes multiple stages of software testing. The first stage is unit testing performed by an individual software developer. The second stage is functional Verification, performed within the developed quality assurance environment. Following product testing, the software is tagged and released for deployment to project teams. Software releases are accompanied by release notes and test reports that highlight new enhancements, bug fixes, and any known limitations.

Integration Testing

As various assemblies and subsystems are installed, we perform informal integration testing to verify proper data flow and communication. The objective of this testing is to ensure the system under test is properly integrated and ready to enter formal acceptance testing.

Acceptance Testing

The acceptance testing approach leverages written, approved test procedures that verify and validate System/Sub-system (SSS) requirements. Requirement traceability, including verification results is tracked and maintained in a Verification Requirements Traceability Matrix (VRTM). The test procedures are organized into a series of test cases that were created to test the various services. The TEMP provides flexibility by organizing the test and evaluation strategy in a modular fashion and by providing guidance for what test activities and test cases will be executed based on scope of a given project.

Once all system components are integrated and the Site Acceptance Test (SAT) entry criteria as described in the TEMP are met, the system is ready for acceptance testing and validation. The objective of SAT is to demonstrate that the system meets requirements and is ready for operational evaluation. A test readiness review (TRR) will be conducted to brief the client and customers, about the following topics:

- Demonstrate system readiness
- Walk-through maintenance tickets that were closed during pre-SAT activities
- Walk-through maintenance tickets that are still open but not affecting SAT results
- Presentation of final SAT schedule (SAT are usually multi-day events)
- Presentation of SAT flights and acceptance procedures and criteria
- Final agreement on alternate schedule if testing cannot be conducted due to weather or other adverse environmental conditions

Flight operations, including crewed and/or uncrewed operations, as described by the system procedure book, will be planned and executed by a member or partner of the project Team.

Results, formal acceptance, and formal comments needing to be addressed at a later stage by the Team will be formally recorded in the SAT procedure book results. If required, daily SAT kickoff and recap meetings are held to prepare for the day, discuss potential observations, and record notes from the conduct of that day's SAT activities. This robust testing and validation process has been evaluated by the FAA and underscores the Team's high maturity level and pedigree in managing complex UAS operations.

8.0 REGULATORY COLLABORATION

The FAA Reauthorization Act of 2018, PL 115-254, Section 377, directed the FAA to develop a process to permit, authorize, or allow the use of Uncrewed Aircraft System (UAS) Traffic Management (UTM) Services. In response, the UAS Integration Office developed the Near-Term Approval Process (NTAP), for UTM services that ensures NAS safety and reduces UAS risk. NTAP is a process by which the FAA evaluates and approves a UTM safety mitigation for known hazards identified in FAA Order 8040.6 Appendix A that is being provided to operators. The FAA's emerging approval criteria includes:

- Clear concept of where and how the services will be used by operators; i.e. how does it help?
- Well defined architecture along with roles and responsibilities between both the service provider and the operator.
- Documented safety risk management plan
- Mature design, development, and testing of the system with associated artifacts
- Documented service level expectations between the provider and operator

A beneficial objective for the MHA system is to position itself to realize the benefits of NTAP and obtain broad approval for services. Thales recommends MHA leverage a partnership with Vantis to inherit mature processes as a starting point to align with FAA expectations and monitor the progress of the NTAP program for future participation.

9.0 NOTIONAL SCHEDULE

Thales is providing a notional schedule for the installation of a GBSS based on previous installations.

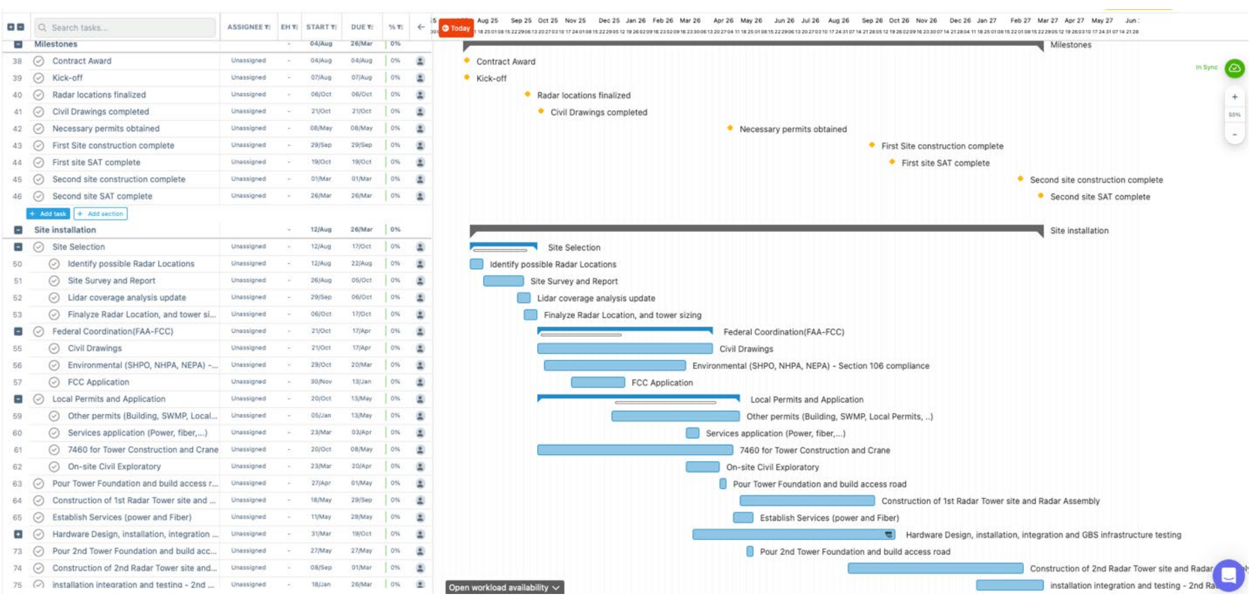

Figure 25: Notional Schedule for GBSS

The schedule outlines the activities required to determine the installation locations, create the necessary drawings, obtain construction permits, apply for and install services, and carry out construction, installation, validation, and verification tasks for each site.

The key project milestones are:

- Contract Award – August 1, 2025
- Kick-off – August 7, 2025
- Radar locations finalized – October 6, 2025
- Civil Drawings completed – October 21, 2025
- Necessary permits obtained – May 8, 2025
- First site construction complete – September 29, 2026
- First site SAT complete – October 19, 2026
- Second site construction complete - March 1, 2027
- Second site SAT complete – March 26, 2027

It is important to note that the project schedule is impacted by various factors, including weather conditions and the selected installation sites. A definitive schedule will be provided based on the project's start date and the results of the site survey.

10.0 COST ESTIMATION

Thales provides the following Rough Order of Magnitude (ROM) for a GBSS, broken into two phases: 1) Implementation and 2) Service fees. The successful establishment of a GBSS requires a multitude of activities related to procurement, delivery, permits, site works, installation, integration, testing, safety case support, O&M, and program management that will be needed to successfully meet the operational objectives.

Implementation

The implementation cost of the GBSS based on previous installations is ***$4-$6M**** USD. This includes:

1) Project Management and oversight for the implementation period
2) Site Survey to determine final site location and necessary site work
3) Tailoring of the system architecture to ensure all project requirements are addressed
4) Provisioning and shipment of the necessary material and infrastructure installation. This includes:
   a. 2 Radar
   b. 2 Radar tower
   c. 2 Foundation
   d. 2 Electrical Disconnects
   e. Ice bridge

   f. 2 Edge Node hardware and H Frame
   g. Radar software gateways
   h. 1 Flight Crew HMI (iPad)

5) Permitting and Transmission licenses
6) Integration, and internal FAT of the infrastructure into Vantis Network
7) Site Acceptance Test
8) Customer support to obtain waiver

Service fees

The annual service delivery and operating expense for an on-premises deployment is ***$0.5-$1M**** USD/year. This includes:

1) Provide **project management** support through the term of the agreement
2) Perform **scheduled network checks** to verify system integrity
3) Perform **System preventive and corrective maintenance**
4) Perform **Critical system upgrades**
    - Incident management and resolution. Manage unplanned events and outages with the goal of safely restoring the service to an operational state. Provide system to log, track, and audit issues
    - Perform corrective maintenance activities for line replaceable units (LRU) to include necessary configuration and verification
    - 3rd Party support - Facilitation, management, and oversight of third-party suppliers for Level 3 support and maintenance
5) **Provide licensing and Hosting**

   Provide all necessary software license and fees needed to support the accepted system monthly. This includes:

    - Third party components
        - Hypervisor – This is the health and status monitoring service that monitors health and on or offline status of the components that make up the MDEC solution
        - Flight Crew HMI – The flight crew HMI is a solution provided by Appareo.
        - Sensor data fusion – The multi-sensor tracker system (MSTS) combines surveillance information from multiple sources including ADS-B data
    - Hosting fees for the centralized infrastructure

**The ROM provided is for budgetary purposes only and does not constitute a binding or firm offer from Thales to provide the solutions and/or services described in this report.*

11.0 REFERENCED DOCUMENTS

[01] [15] Minimum Operational Performance Standards for Ground Based Surveillance Systems for Traffic Surveillance, RTCA DO-381, 26 March 2020

[02] [12] FAA William J. Hughes Technical Center Test and Evaluation Handbook, VVSPT-A2-PDD-013, Ver. 4.0, 16 May 2017

[03] Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) Systems, RTCA DO-365C, 15 September 2022

[04] Minimum Operational Performance Standards (MOPS) for Air-to-Air Radar for Traffic Surveillance, RTCA DO-366, 31 March 2017

[05] Title 14 CFR Part 87, Aviation Services

[06] Title 14 CFR Part 91, General Operating and Flight Rules

[07] FAA Reauthorization Act of 2018, PL 115-254, Section 377

[08] Order 8040.6A - Uncrewed Aircraft Systems (UAS) Safety Risk Management (SRM) Policy