Intelligent Transportation Systems
at the
2002 Salt Lake City Winter Olympic Games

Event Study
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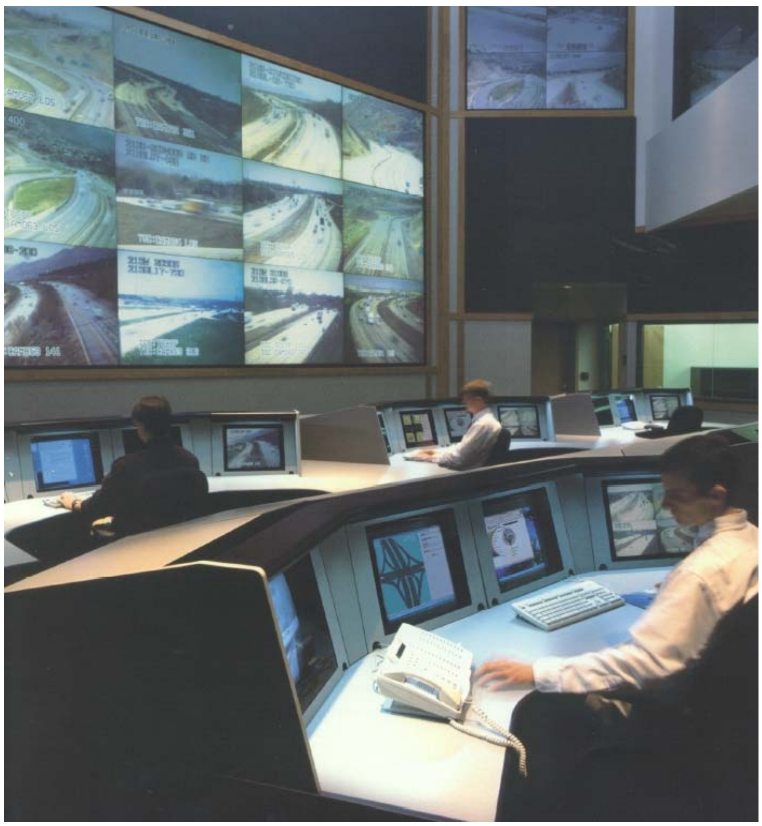
Traffic Management and Traveler Information



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The principal authors of this report are Lawrence Jesse Glazer and Roberto Cruz, of Iteris, Inc., in Anaheim, California. Assisting in the study were S. Edwin Rowe and Mark Nuaimi of Iteris, plus Drs. Peter Martin and Joseph Perrin, of the University of Utah Traffic Lab.

All information, findings, and opinions expressed herein are the opinions of the principal authors and do not necessarily represent opinions or policies of the Utah Department of Transportation.

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1 Executive Summary

As billions of eyes around the world were attentively watching the world's best athletes competing for the most prestigious sports awards and international recognition, several hundred eyes were quietly and carefully monitoring the streets, highways, buses and trains in Salt Lake City during the 2002 Winter Olympic Games. They did this not seeking awards or recognition, but simply to ensure that the transportation system functioned so smoothly that nobody had reason to notice it. And that it did.

1.1 Background Information

First "Mature" ITS Deployment at a U.S. Olympics

The 2002 Salt Lake City Winter Games were the first Olympics in the United States with an established Intelligent Transportation System (ITS) deployment in full operation. The Salt Lake City ITS installation was among the most comprehensive in the nation. Deployed largely over the past 5 years, it included the following ITS elements:

- 120 miles of instrumented freeways continuously monitoring traffic flow
- 218 closed-circuit television cameras (CCTV) on freeways and surface streets
- 63 variable message signs (VMS) spread across the region
- 12 highway advisory radio (HAR) transmitters
- 30 roadway-weather information system (RWIS) data-collection stations
- a centralized control system encompassing 608 traffic signals, with over 1200 special signal-timing plans for regular traffic plus Olympic venues and events
- freeway on-ramp metering at 23 locations
- 350 miles of fiber-optics cable, plus extensive telephone and wireless links
- the CommuterLink Web site delivering traffic, Olympics, and other information
- an innovative "5-1-1" telephone service delivering traffic and other information
- a new light-rail system (TRAX) with traffic-signal preemption and other ITS features
- a Traffic Operations Center (TOC) serving as the nerve center for all the above, linked to satellite Traffic Control Centers serving other transportation agencies.

Thus, the Salt Lake City ITS installation was certainly among the most comprehensive such deployments in the nation, and was fully operational well before the Games began.

Largest Winter Olympics to date

The 2002 Salt Lake City Games were the largest Winter Olympics Games ever held. They included 78 events in 15 disciplines and seven sports. The events took place at 12 venues spread across the valley and mountains in the Salt Lake City area. They involved almost 2,400 athletes, over 10,000 members of the media, a staff of over 9,000 people plus a comparable number of security personnel and several times that number of volunteers. Over 1.5 million tickets were sold to the Olympic events, and 850,000 ticket holders attended the Games along with many Utah residents.

In addition to the Olympic Games, there was an extensive number of cultural and entertainment activities taking place concurrently. Several of these were attended by as many people as the major Olympic events (e.g. the Rodeo). Many of these events were in the downtown area, which was also the location of several major Olympics venues. These events also generated a great deal of travel.

Essentially all of the commercial lodging within 100 miles of Salt Lake City was sold out, along with temporary accommodations at many private residences across the region. This generated additional travel requirements.

In summary, the 2002 Winter Olympic Games created unprecedented travel needs – both for the Winter Games and for Salt Lake City.

Intense security concerns

Since 1972, security has been a major concern at Olympic Games. However, after the tragic events of September 11, 2001, security concerns grew to unprecedented levels. Olympic preparations included extensive contingency planning, and this encompassed the transportation elements supporting the Games. This heightened awareness of security needs certainly influenced transportation-management actions. Even situations like an abandoned car on the freeway – which would have been routine in previous times – were necessarily treated as a potential safety threat. This additional layer of security added complexity to the already-challenging task of managing the unprecedented demands on the transportation system in the Salt Lake City area.

Good fortune attended the Games

It was fortunate indeed that there were no major problems affecting the Olympic Games. However, there were major transportation incidents, including fatal crashes and major roadway blockages – but none of them occurred at times and places that directly impacted the Games. The weather was much better than in typical February – there were only two snowstorms during the Games, both relatively modest by Utah standards. Although there were a large number of ***potential*** safety/security threats and some minor incidents, there were no major public-safety incidents that directly affected the Games.

Objectives and methodology of this study

This assessment study is written for two audiences:

- Local readers – This includes UDOT staff and other Salt Lake City transportation professionals, who were present during the Games and are familiar with the region and the ITS elements.
- National and world readers – This includes other cities hosting future Olympics or other major events that generate large transportation requirements, as well as other

ITS professionals who are planning or operating similar traffic-management or traveler-information systems.

The purpose of the study is to document and assess the performance of the UDOT advanced traffic management system (ATMS) and advanced traveler information system (ATIS) during the 2002 Winter Olympic Games. An additional purpose is to document and assess the results of the Travel Demand Management (TDM) program created and implemented for the Games. This study did not examine the advanced public transportation systems (APTS) operating during the Games, except where they interfaced with the ATMS. A related study (see Ref. 1) examines those APTS elements and should also be read by those wishing a complete picture of all the major ITS components (ATMS, ATIS, and APTS) operating during the Games. Other reports are available describing many aspects of transportation during the Games that are beyond the ATMS/ATIS/TDM scope of this study. **This study did <u>not</u> cover the 2002 Paralympic Games.**

The study methodology encompassed both subjective and objective techniques. The wide array of data-collection activities, included the following:
- Observations in the TOC by the Study Team for 5-8 hours each day of the Games
- Collection of a variety of traffic data, primarily using UDOT monitoring systems
- Independent observation and testing of the CommuterLink Website and "511" service
- Surveys of SLC residents (by telephone) and visitors (interviews at venues)
- Follow-up interviews with UDOT and other agency staff
- Monitoring of news coverage regarding the ATMS and ATIS elements

Key Study Findings

Key findings are summarized in terms of the three major topics: ATMS, ATIS and TDM. This summary is organized with the same structure as the full report, so that readers who wish full information on a specific topic can access that material directly by going to the section of the same number in the full report.

This study was designed and conducted by Iteris, Inc., under the sponsorship and funding of the Utah Department of Transportation (UDOT) and the FHWA. All information and findings expressed herein are the opinions of the authors, and do not necessarily represent the opinions or official policy of UDOT.

The **<u>overarching finding</u>** of this study is that the traffic-management and traveler-information systems in the Salt Lake City area performed all of their mission-critical functions fully, with no significant problems that drew public attention. There were substantial reductions in background traffic in the downtown area – exceeding the 20% goal of the TDM Program – but the results in outlying areas cannot be estimated reliably. Although there was extensive media coverage of traffic conditions and travel information for Olympic events, there was very little coverage of the ***performance*** of the transportation system or of the many ITS elements in operation. Perhaps this was because smoothly-operating highway and transit systems offer few photo-opportunities or human-interest stories. From the media perspective, there was no big story to report.

1.2 ATMS Findings

The UDOT **TOC** is the center of the ATMS and ATIS operations, both organizationally and architecturally. All ATMS and ATIS field elements throughout the Salt Lake City region are connected to the TOC. The TOC contained several dozen staff members and over 40 computer servers that performed almost all of the traffic-management and traveler-information functions during the Games. This included one system for arterial management, and another for freeway management. (Note that UDOT staff refer to the freeway management system as "the ATMS," while this study uses the term more generically to include both freeway management and surface-street management.) The Utah Highway Patrol (UHP) dispatch center is also located within the TOC, along with a media center used by a traffic reporter serving a number of commercial radio and television channels. (For further information, see Section 3.1.)

There are several **satellite workstations** at other locations. Two of these enable Salt Lake City and County to perform traffic-management functions within their jurisdictions. During the Games, all traffic management was centralized at the TOC. A third is located at Utah Transit Authority (UTA) and a fourth at University of Utah Traffic Lab (UUTL). Full ATMS functionality is available at each workstation, but is limited by login codes. (See Section 3.2.)

There were over 600 **traffic signals** under electronic control by the ATMS. Most were on surface streets, but a few were at metered freeway on-ramps. Normal maintenance and repair situations did arise, but there were no unusual problems during the Games. (Section 3.3.)

Traffic detectors that measured both volume and speed were located at half-mile intervals on all freeways and were connected to the TOC. Speed data from some detectors was incorrect, and data was missing from a small number of detector sites, but the number of sites involved was small enough that it did not seriously hamper any mission-critical functions. (Section 3.1.4)

Closed Circuit Television (CCTV) cameras were located on all freeways at approximately six-tenth mile intervals, and also at many downtown locations and some mountain roadways. All allowed full control (pan/tilt/zoom), and almost all displayed high-quality, full-motion video images. The cameras were strategically located, and the breadth coverage during the Games was exceptional. There were very few situations that arose – either on freeways or surface streets – where there was not a camera available to watch it. Other than normal maintenance, there were no unusual reliability problems observed. The only problem noted by the Study Team was the lack of azimuth (direction) labels on the displays. While they may not be needed by experienced operators who are very familiar with the area, it was a hindrance to those who came from elsewhere to support the Olympics effort. It likely would slow the response time for new operators, and it was also observed to be a problem for experienced operators in some locations at night, when all they could see is headlights. However, the Study Team felt that ***the CCTV system was clearly the most valuable surveillance tool*** during the Games and the azimuth-labels issue was truly minor in the overall assessment. In a world where public safety of the transportation system is becoming of greater importance, CCTV will become and even more important surveillance tool even in “normal” times. (3.1.5)

Variable Message Signs (VMS) equipment was located at 63 sites, almost all of which were on freeways. They were used for both traffic-management and traveler information functions. The Study Team observers felt VMS was second only to CCTV as the most valuable ATMS tool. They worked very well overall, with only one or two instances when one of the (few) dial-up VMS units could not be accessed because of excessive cell-phone traffic. (3.1.6)

Highway Advisory Radio (HAR) transmitters were placed at 12 locations around the region. They were also a valuable traveler-information tool, but several problems were encountered. Because of the proximity of sites and the heavy use of each transmitter, there was sometimes overlap of transmissions in some areas. The user interface for changing recorded messages was very difficult, requiring a lot of time and occasionally resulting in errors. The HAR units were connected via wireless phones, and heavy cell-phone traffic sometimes delayed the message updating. All HAR phones were battery powered and recharged by solar cells. Finally, because of the frequent updating some batteries discharged making the unit inaccessible temporarily. Some of these problems were related to the unique Games environment, others were not. (3.1.7)

Roadway Weather Information System (RWIS) stations were located at 30 sites, and worked normally except for one location that could not be reached frequently because of heavy cell-phone traffic. (3.1.8)

Traffic signal integration with TRAX light-rail system includes both signal preemption at some intersections, and signal priority request at others. Structured data collection was not done for this subject. However, the study team noted that when a train was stopped in a station near to where the tracks crossed a major arterial, the crossing arms on the cross street were lowered as soon as the train entered the station rather than when it departed. In follow-up interviews, there were different opinions on whether this was correct operation. (3.1.9)

Organization for transportation management was based upon a 3-level decision-making structure within the TOC, with the “levels” residing in three different rooms.

- The **Control Room** was responsible for ***tactical traffic control*** (e.g. responding to “minor” incidents). It was staffed primarily by system operators and supervisors.

- **Room 125** was responsible for ***strategic traffic management*** (e.g. preparing for the President’s motorcade). It was staffed by senior UDOT traffic engineers.

- **<u>Room 230</u>** was responsible for ***regional transportation management*** (e.g. coordinating multi-modal or multi-agency actions). It was staffed by representatives of several divisions of UDOT plus UTA, FHWA/FTA, and SLOC. These people were authorized to make a wide range of decisions, and they knew exactly who to call regarding the remaining types of decisions.

The flow of information and actions through the three levels is depicted in Figure 1.1. In addition to these levels within the TOC, the Area Traffic Engineers and other staff in the field were authorized to make a wide range of decisions autonomously and they often coordinated with TOC staff for the remaining decisions. It could also be said that there was one further "layer" in the TOC – the law-enforcement officials in Room 227 who were responsible for security issues related to the transportation system. For further explanation please see Section 3.2.

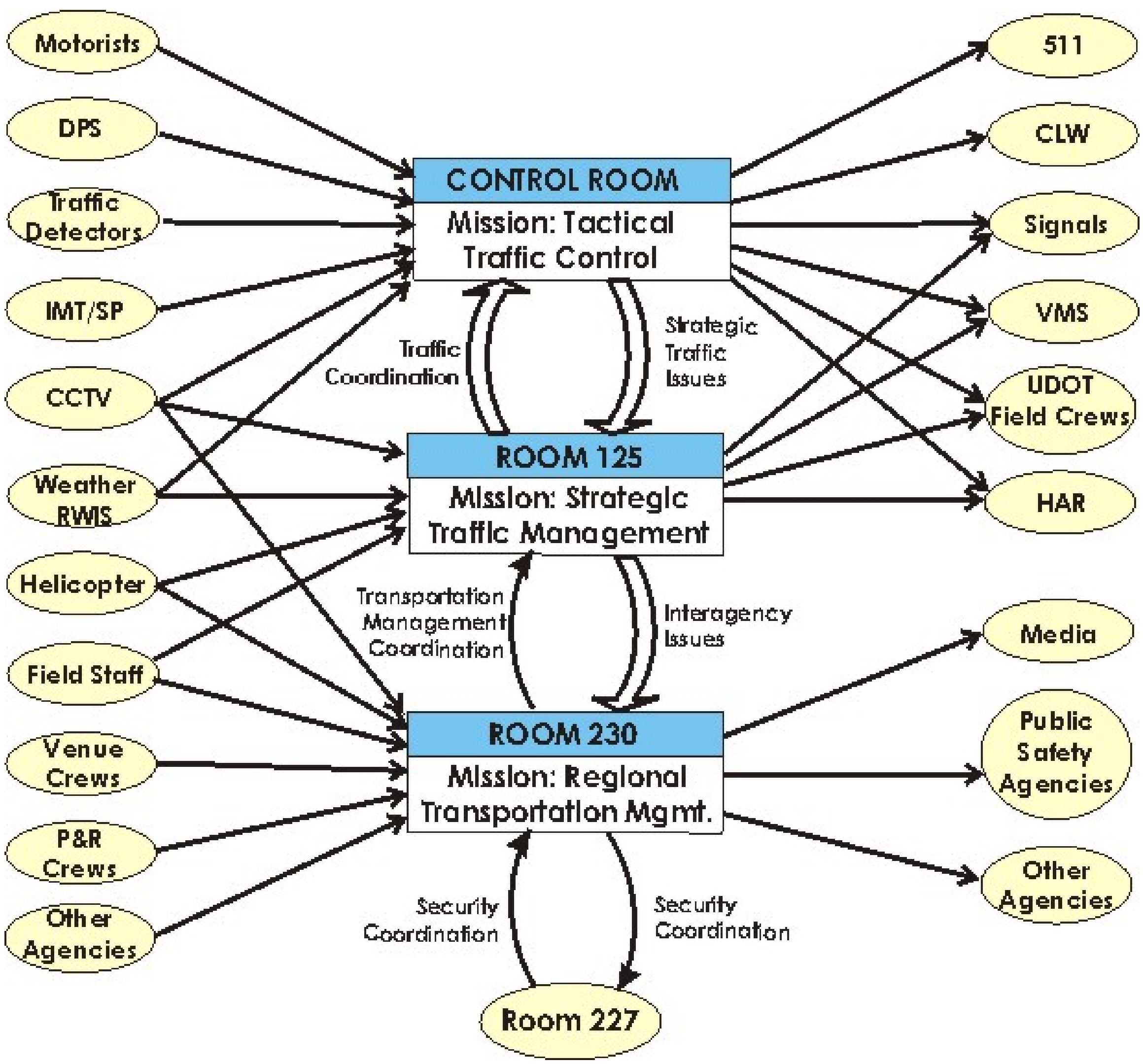

Figure 1.1 Information Flow for Decision-making in the TOC
(Heavy arrows indicate heavy information flow)

Transportation management actions included three major categories of activity:

- incident management,
- routine (non-incident) traffic management, and
- multi-modal management.

Incident management was quite broad, because the term "incident" took on many new meanings resulting from the heightened security for the Games. The primary activities included surveillance (information-gathering), decision-making, and response execution.

1. **Surveillance** activities relied upon information from the UHP, other public-safety agencies, cell-phone calls from motorists, UDOT field staff, service patrols, traffic observers, maintenance crews and monitoring of CCTV displays in the TOC, to identify incidents. Most of the incidents were traffic-related, and they were generally first detected and verified by the Control Room operators. Their most important tool for doing this was CCTV.

2. **Decision-Making** in response to traffic incidents was generally guided by pre-defined "Response Plans" on freeways and "Action Sets" on surface streets. Although these Response Plans were stored in the ATMS computer, the experienced operators generally did not need to look them up. Decision-making for traffic incidents was handled by the Control Room Operators when it was a minor incident, or Room 125 if it was a major incident. For non-traffic incidents that might have traffic impacts (e.g. a political demonstration), decision-making was generally done by Room 230, and was guided by the extensive planning and "desktop exercises" that was conducted prior to the Games.

3. **Response** to traffic incidents was usually similar to those of non-Games incidents. This included: dispatching the responders, distributing traveler information, and monitoring the situation until it has cleared. Response to non-traffic incidents (usually security-related) generally involved only dispatching and monitoring. Security incidents were generally managed jointly by Room 230 and Room 227. Two frequent types of security-related incidents were abandoned vehicles and suspicious (abandoned) packages.

Although most incidents were not foreseen, there were a number of "planned" incidents. One example is the Presidential motorcade from the airport to the Stadium for Opening Ceremonies on day 1. Whether planned or unplanned, security considerations always were an important part of managing incidents. Further, in almost all incidents, CCTV played a central role in surveillance and decision-making, as well as monitoring the progress of the response units. (See section 3.3.1 for further information on incident management.)

Routine Traffic Management was, as the name suggests, more routine than incident management. It might be better described as "congestion management, because mostly it consisted of managing traffic related to the "loading" and "unloading" of the parking lots at events. Routine traffic management also consisted of the same three primary activities: surveillance, decision-making, and response.

1. **Surveillance** relied mostly on CCTV, radio messages from UDOT field units, and weather information.

2. **Decision-making** relied heavily on the numerous "Event Plans" that were developed to cover each event at each venue on every day of the Games. It also relied on good judgment for other types of non-incident congestion – the prime example being "Saturday Night Downtown."

3. **Response** often included both proactive and reactive elements. Execution of the appropriate Event Plan was a common proactive step. But things did not always go as planned, and good judgment was often required.

As was the case with incident management, the most valuable tool in the ATMS toolkit for routine traffic management was CCTV. (See section 3.3.5 for further details on routine traffic management.)

Multi-modal management was one of the few ITS "surprises" during the Games – and it turned out to be a pleasant one. It arose on day 1, because several of the 22 Park-and-Ride lots were filling early in the day. Many motorists had to be turned away, causing traffic jams and ill feelings. Room 230 learned of the problem from observers at the park-and-ride lots.

A small, multi-agency team was delegated the responsibility to develop a response to this situation. They met immediately in a corner of Room 230. Within 10-15 minutes, they decided to set up a tracking system to monitor when lots were nearing capacity, and then to use the "upstream" VMS displays to advise approaching motorists to use a specific alternative lot. Working with the traffic engineers in Room 125 and the Control Room Operators, this plan was put into effect immediately without the need to gain approvals from any parties outside the TOC. The UTA representative also coordinated with the shuttle-bus managers (elsewhere) to ensure that the buses could be redirected to the alternative lots if needed. The public-relations representatives informed the media of the new plan.

This proactive step undoubtedly avoided a great deal of negative publicity. For example, a comparable situation developed on February 10 when a Mountain Green Parking lot near the Snowbasin events filled much earlier than expected, and approaching traffic was not promptly notified. That was the only case of significant negative transportation publicity during the Games.

This situation was a dramatic example of the value of both ***technical*** and ***institutional*** integration. Because all of the VMS displayed could be changed immediately from the TOC, and because all of the involved agencies were present in Room 230 and were authorized to make the necessary decisions, it was possible to take immediate action to avoid a potentially serious situation. (See section 3.3.6 for further details on multi-modal management.)

The **<u>TOC Computer System</u>** performed all of the traffic-management functions, plus most of the traveler-information functions described later. It consists of a complex, distributed network of 45 computer servers, plus extensive communications equipment. The TOC computer system was operating in a "worst-case" scenario. It was being heavily used for all of the standard traffic management functions, plus it was being queried by several dozen "new" users in the TOC and by untold numbers of people elsewhere seeking traveler information via the Website and 511 services. As a result, some computer problems were encountered. Fortunately, none of these problems prevented any of the mission-critical functions from being performed when needed. These problems were:

- Data from some traffic detector sites was missing
- Some of the traffic volume and speed data was not archived
- Some system functions were occasionally impaired

The first two problems were relatively benign, but the third problem was potentially serious if it had occurred during a major incident. Most of the causes of these problems were identified during the Games; a few immediate remedies were implemented and some were deferred until after the Games. (See section 3.3.7 for further details.)

1.3 ATIS Findings

The advanced traveler information system (ATIS) consisted of four primary channels for distributing transportation information to travelers:

- CommuterLink Website (CLW)
- 5-1-1 Telephone Service (511)
- Variable Message Signs (VMS)
- Highway Advisory Radio (HAR)

The following sections summarize key findings regarding the CLW and 511 services. Performance of the VMS and HAR systems was discussed above.

The **<u>CommuterLink Website</u>** was operated by UDOT, using computers in the TOC. Outside private server resources were used to augment the TOC computers in providing Olympic information. The CLW delivered these four categories of information during the Games:

1. Traffic Conditions (speeds, incidents)
2. Roadway Conditions (closures and construction)
3. Weather (including pavement surface conditions)
4. Olympics information

<u>CLW Usage</u> – The CLW was heavily used during the Games, experiencing 52 million "hits" during the 17 days. This compared to 8 million hits during a comparable period in

July. The usage was much heavier during the early days of the Games than in the later days. However, it was difficult to translate this into the ***number of people*** that used the CLW. Our best estimate is that something in the ballpark of 80,000 unique people used the CLW during the Games.

CLW Performance was evaluated based upon 5-8 hours of CLW monitoring each day. During the Games, there was only one occasion when the CLW was "down" (i.e. was not available for use). The accuracy of incident information appeared to be generally good compared to radio reports and the "5-1-1" service, but there was no absolute benchmark to compare it against. The same can be said about the timeliness of reporting incidents.

Perceptions of the CLW were positive, based upon surveys of visitors and residents.
Visitor surveys found that 41% of visitors said they heard of the CLW. Of those who heard of the CLW, 34% had used it and 98% of those who used it said it worked well for them. Almost two-thirds of users reported using the CLW to obtain traffic information.
Resident surveys found that 70% of residents said they heard of the CLW. Of those, 21% had used it and 97% said it worked well for them. All users reported using the CLW for traffic information, and some also obtained other information.
(See section 4.1 for further details on CLW.)

The **511 Telephone Service** was operated by UDOT and Tellme, Inc., using a combination of TOC computers plus Tellme computers in the San Francisco Bay area. The 511 service delivered these four categories of information during the Games:

1. Traffic Incidents
2. Roadway Conditions
3. Public Transit Information
4. Olympics information

511 Usage – 511 was heavily used early during the Games, receiving 4000 calls on each of the first two days. Usage then declined gradually for the remainder of the Games. This compared to 290 calls during a typical day in May 2002. (See section 4.2.2)

511 Performance was evaluated based upon 5-8 hours of 511 monitoring each day. During the Games, there was only one occasion when the 511 service was "down" (i.e. was not available for use). The accuracy of incident information appeared to be generally good compared to radio reports and the CLW, but approximately 15% of the incidents that were not reported on 511 did appear on CLW. Over 90% of the incidents that appeared on 511 did so within five minutes after appearing on CLW.

Perceptions of 511 were positive, based upon surveys of visitors and residents.
Visitor surveys found that only 25% of visitors said they heard of 511. Of those who heard of the 511 service, 17% had used it, and 75% of those who used it said it worked well for them. Almost two-thirds reported using 511 to obtain traffic information, and more than one-third sought Olympics and transit information.
Resident surveys found that 44% of SLC residents said they heard of the 511 service. Of those, only 4% (4 respondents) had used it and all of those four residents said it worked

well for them. Three of them reported using it for traffic information, and one sought other information. (Caution is necessary in using data based upon only four responses.) (See section 4.2 for further details on the 511 service.)

1.4 TDM Findings

Because more than a half-million visitors were expected for the Games, a great deal of traffic congestion was predicted without an aggressive effort to manage that demand. Consequently, a Travel Demand Management (TDM) Plan was developed by a coalition of local agencies and a public-relations consulting firm. The TDM Plan defined a program of activities that sought to involve over a dozen transportation stakeholders in the Salt Lake City area. This included residents, major employers, commercial/retail businesses, schools, and other local interests, plus long-distance truckers who pass through the area. The Goal of the TDM Program was to reduce the "background" traffic by at least 20% for specific major routes impacted by Olympic traffic. The strategies used included increased transit use, carpools, shifting work hours earlier, shifting travel routes and times (especially for trucks), and other TDM approaches to reduce traffic.

In parallel, SLOC, UTA, UDOT and other agencies addressed the ***spectator*** population by developing the Olympic Games Transportation System, which was designed to meet the transportation needs of spectators in two major categories – venues in the Salt Lake Valley and venues outside the Salt Lake Valley.

For all venues ***outside*** of the Salt Lake Valley, spectators were expected to use personal vehicles to travel to the park and ride or park and walk lots serving each venue. From these lots, spectators were shuttled aboard transit buses to the venue (each of which were located within five miles of the lots). Limited long-haul bus service was also provided for spectators not using their personal vehicles.

For all venues ***within*** the Salt Lake Valley spectators had three options. For certain venues, spectators were allowed to drive their personal vehicles to lots located near the venues. Most spectators utilized the extensive transit services provided by UTA, which included regular bus service (fixed-route and demand-responsive), the TRAX light rail system, and the downtown-based Olympic Shuttle System. The Olympic Shuttle system consisted of 1,000 loaned transit buses plus the existing UTA transit fleet, which carried spectators from park-and-ride lots to downtown and to the venues.

Reductions in background traffic were estimated by using data from UDOT's Automated Traffic Recorder (ATR) system, which has 24-hour traffic-counting sites on freeways and major surface streets. Data from six sites – three urban and three rural – were analyzed.

Downtown traffic – The urban ATR data documented a 15-20% reduction in **total** traffic (including visitors and residents) moving to and from **downtown** Salt Lake City. Because it was not possible to separate visitor from resident traffic, the reduction in

visitor traffic depends upon the visitor/resident traffic mix. If one were to make a seemingly conservative assumption that one-third of the observed traffic was visitors, the reduction in background traffic to/from downtown would exceed 40%.

Rural traffic – The ATR data from three sites on rural highways was inconclusive. Overall traffic counts increased substantially at all three sites, which were on roads that served major venues. However, the visitor/resident mix was unknown. If the visitor proportion was over 50%, then background traffic was reduced. Otherwise, not.

In summary, ATR data indicate that ***background traffic was reduced by more than 20%*** in the downtown area, but reductions in outlying areas are not clear. As stated previously, the TDM plan did not target a 20% reduction in background traffic in outlying areas therefore the interest and importance of reduction in these areas was not as vital to the Event Study.

Reductions in interstate truck traffic were estimated using ATR data from one site, on I-80 east of Salt Lake City ("Parley's Canyon"). The ATR stations also estimate vehicle lengths, and data for vehicles over 50 feet long was analyzed. This (very limited) data suggests that there was a substantial reduction of truck traffic in Parley's Canyon during the Games in the daytime hours, but no reductions at night. That would mean there was no time-shifting of truck trips, rather, the daytime truck trips were either diverted to another route or foregone during the Games. Once again, the data analyzed was very limited, so additional data should be analyzed before these conclusions can be validated.

UDOT also collected truck counts at the truck Ports of Entry (POEs) operated by UDOT. A UDOT Press Release on March 11 summarized reductions in total truck traffic at the POEs. They ranged from 1800 to 3700 trucks at two East/West POEs, and 7000 trucks at one North/South POE, during the 17 days of the Games. (Percentages were not given.) It also said that truck counts from one POE showed some shifting from daytime to night.

Public transit ridership generally met expectations during the Games. Over 2.5 million passenger-trips ("boardings") were recorded, for an average of almost 150,000 per day. TRAX carried two-thirds of these trips, and park-and-ride shuttle buses carried one-third. The peak transit ridership day was Saturday, February 16, with total ridership of 221,000.

Travel patterns of residents were examined using a telephone survey. About one-fifth said they changed their travel patterns during the Games. The predominant changes was in their work schedule, with a much smaller fraction reporting changes in modes or travel routes. A similar fraction, about one-fifth, reported that their employers changed their normal work schedules during the Games, mostly to earlier work hours but some to flexible schedules.

1.5 Transferable Findings

CCTV has emerged from this study as the "most valuable player" in the traffic-management toolbox. It was used extensively by all levels within the TOC, for surveillance, decision-making, and response execution. In a new security-conscious era, it also serves as a preventative public-safety tool for transportation-related situations. The traffic-management story during the 2002 Olympics would have been dramatically different without the extensive CCTV coverage that was available on highways and streets. The transferable finding is:
CCTV deployment is expensive, but once a "critical mass" of coverage is reached, it delivers unequalled benefits for traffic management and public-safety.
It must also be added that many other technical and organizational elements contributed great value also. One notable "organizational" example would be the TDM program, which helped avoid traffic problems by reducing travel demand.

The TOC computer system was "pushed to the max" throughout most of the Games – far beyond any previous experience. All of the normal, day-to-day functions were operating, at full capacity, and there were many new demands resulting from the Games. System enhancements were made during the week before the Games, and these resulted in some malfunctions that were visible internally but not to the public. The transferable finding is:
Make no changes – even seemingly small ones -- to the computer systems for at least one month before the Games, to ensure adequate time for testing.

The CommuterLink Website was heavily used during the Games for traveler information, by visitors and residents. Both the website and 511 telephone service were highly-rated by residents and visitors, although the 511 service was not as heavily used as the website. Both worked synergistically with the printed material and media coverage also used for distributing traveler information during the Games. The transferable finding is:
Technology can play an important role in efficiently delivering traveler information, but it must be implemented compatibly with the traditional distribution channels.

The extensive and detailed planning and preparations paid off. There were no major transportation surprises for which preparations had not been made. There was one minor situation observed that was not fully anticipated, but it was handled expeditiously by the existing structure. Transferable finding:
Detailed contingency planning and preparations are time consuming and resource draining, but they are absolutely essential and should be viewed as "event insurance."

The division of decision-making into three-plus levels of responsibilities within the TOC proved to be effective and efficient, because each level had a wide range of authority and clear definition of when to escalate a problem to higher levels. Similarly, the Area Traffic Engineers and other field crews were empowered to act autonomously to handle most of the problems they saw. Transferable finding:
Divide decision-making into appropriate levels, and empower people at each level.

Interagency cooperation during the Games was remarkable. The seamless decision-making of the multi-agency staff in Room 230 enabled rapid response to virtually all problems that developed, and true multi-modal coordination in all actions they took. ***Strong interagency cooperation is essential for effective transportation management, and proper structures must be created to engender it.***

In summary, ***the people and equipment that make up the ATMS and ATIS effectively performed all of the mission-critical functions required for safe and efficient travel during the Games***. Although problems were encountered, they were minor and visible mostly to project evaluators and ITS staff rather than to the public. Transportation is, after all, a ***means*** to an end rather than an end in itself. So perhaps the greatest achievement is to deliver transportation services so well that hardly anybody notices.

2 Introduction

2.1 Background

2.1.1 Study Purpose and Report Structure

The purpose of the study is to ***document and assess the performance of the UDOT advanced traffic management system (ATMS) and advanced traveler information system (ATIS) during the Olympic Games.*** An additional purpose is to ***document and assess the results of the Travel Demand Management (TDM) program*** created and implemented for the Games. This study did not examine the advanced public transportation systems (APTS) operating during the Games, except where they interfaced with the ATMS. A related study (see Ref. 1) examines those APTS elements and should also be read by those wishing a complete picture of all the major ITS components (ATMS, ATIS, and APTS) operating during the Games. This study also did ***not*** include the 2002 Paralympic Games.

There were many other interesting aspects of transportation during the Olympic Games, which are beyond the focused ATMS/ATIS/TDM scope of this study. Other reports are available for those topics.

This assessment study is written for two audiences:

- Local readers – This includes UDOT staff and other Salt Lake City transportation professionals, who were present during the Games and are familiar with the region and the ITS elements.

- National and world readers – This includes others other cities hosting future Olympics or other major events that generate large transportation requirements, as well as other ITS professionals who are planning or operating similar traffic-management or traveler-information systems.

This "Event Study" report focuses upon the period of time ***during*** the Games. A companion study, the "Case Study" examines the ATMS/ATIS deployment activities by UDOT ***before*** the Games.

This report begins with brief introductory and background material (Section 2), which will be of interest to the national/world audience. Readers who were in Salt Lake City during the Games may wish to skip this material. Section 2.3 describes the Study Methodology and activities in more detail, which may not be of interest to all readers. Sections 3 through 6, which constitute the bulk of the report, present all of the study findings. It consists of four parts: ATMS findings, ATIS findings, TDM findings, and Transferable Findings. The first three sections are written to stand alone, for those readers with specific interests. The Transferable Findings draw upon the previous three sections.

2.1.2 Overview of Event Study Methodology

The methodology used for the Event Study was originally based on the methodology used by Booz-Allen Hamilton in their Final Report "1996 Atlanta Centennial Olympic Games and Paralympic Games-Event Study." However, as the data-collection activities were developed and priorities were clarified, a decision was made to restructure the study methodology around four themes that better reflected UDOT's study goals. These areas were:

1. ATMS effectiveness
2. ATIS effectiveness
3. TDM effectiveness, and
4. Transferable Findings.

Based around these themes, the methodology was then divided into four stages:

1. Defining assessment areas.
2. Defining objectives and sub-objectives.
3. Preparing a data management plan.
4. Collecting, processing, and analyzing data.

The study methodology encompassed both subjective and objective assessment techniques. The wide array of data-collection activities, included the following:

Data for ***objective*** assessments included:

- Collection of a variety of traffic data, primarily using UDOT monitoring systems
- Structured observation and testing of the CommuterLink Website and "511" service
- Surveys of SLC residents (by telephone) and visitors (interviews at venues)
- Monitoring of news coverage regarding the ATMS and ATIS elements

Data for ***subjective*** assessments included:

- Observations in the TOC by the Study Team for 5-8 hours each day of the Games
- Follow-up interviews with UDOT and other agency staff

2.1.3 The Transportation Context – the Salt Lake City Region

The area included in this study includes a three county area known as the Wasatch Front region of Utah, which includes the developed regions of Salt Lake, Davis and Weber Counties plus the relatively undeveloped Morgan and Tooele Counties (see Figure 2.1). This fast growing region's borders include the Great Salt Lake and the Oquirrh Mountains to the west, and the Wasatch Mountains to the east. The Utah County line forms the region's southern border. The line between Weber and Box Elder Counties forms the northern border.

Figure 2.1 Regional Map

According to the 2000 Census, Utah's population has reached 2.23 million. Of that total, approximately 76% live in the Wasatch Front Region. With the nation's highest birth rate, lowest death rate and youngest median age (26.7), Utah expects to exceed 3 million residents by the year 2030 with a projected 2.1 million in the Wasatch Front Region. Counties in the Wasatch Front are all projected to undergo rapid population growth in the coming years. According to the State of Utah's Long Term Economic and Demographic Projections, 1.4 million people were employed in the state in 2000, of that total, 895,000 were employed in the Wasatch Front Region.[1]

The region's unique geographic features have shaped a region that runs approximately 60 miles from north to south while only 15 miles wide at its widest point. This dictated the creation of a transportation system that heavily favored north-south routes dominated by Interstate 15. (See Figure 2.2.)

The area's current roadway network includes several major interstate freeway systems including, I-215, I-80 and I-84 which provide east-west travel. I-80 extends east-west across the southern portion of Salt Lake City and the Wasatch Mountains to the Park City area. I-215 serves as a beltway around Salt Lake City and I-84 serves as a second east-west connection in the northern part of the region connecting Ogden and Echo Junction. The area is also served by several principal arterials, which provide connections to the downtown areas of regional cities as well as the University of Utah, the Salt Lake City International Airport and major recreation areas.[2] (See Figure 2.3.)

[1] US Bureau of the Census, Utah Population Estimates, Committee; Governors Office of Planning & Budget, 2000 Baseline, UPED Model System. http://governors.utah.gov/projections/

[2] *Wasatch Front Urban Area Long Range Transportation Plan: 2002-2030,* Wasatch Front Regional Council, 2001

Figure 2.2 Regional Freeway Systems

Figure 2.3 Downtown SLC Arterials

2.1.4 Overview of ITS Deployments – ATMS, ATIS, and Related Elements

The Salt Lake City ITS deployment is among the most comprehensive in the nation. During the Games, it included the following ITS elements:

- 120 miles of instrumented freeways continuously monitoring traffic flow
- 218 closed-circuit television cameras (CCTV) on freeways and surface streets
- 63 variable message signs (VMS) spread across the region
- 12 highway advisory radio (HAR) transmitters
- 30 roadway-weather information system (RWIS) data-collection stations
- a centralized control system encompassing 608 traffic signals, with over a thousand special signal-timing plans for regular traffic plus Olympic venues and events
- freeway on-ramp metering at 23 locations
- 350 miles of fiber-optics cable, plus extensive telephone and wireless links
- the CommuterLink Web site delivering traffic, Olympics, and other information
- an innovative "5-1-1" telephone service delivering traffic and other information
- a new light-rail system (TRAX) with traffic-signal preemption and other ITS features
- a Traffic Operations Center (TOC) serving as the nerve center for all the above, linked to satellite Traffic Control Centers serving other transportation agencies.

2.1.5 Travel Demand Management (TDM)

Because the Games were expected to significantly increase the number of person-trips being made in the Salt Lake City area, a coalition of SLOC, UTA, UDOT, and other government agencies led an effort to reduce traffic problems by ***managing the demand*** for travel by private autos. This Travel Demand Management (TDM) Program included ***two overarching strategies*** for two primary groups:

1. Spectators – For visitors (and for residents attending events) provide convenient alternatives to driving an automobile to the events. This included TRAX light-rail service, park-and-ride lots with shuttle buses to venues downtown and nearby, and shuttle services to outlying venues in the mountains.

2. Residents – For residents of Salt Lake City traveling to sites other than the Games, provide encouragement to alter their travel patterns to avoid driving during the times when Games events were underway. This includes personal and business travel, as well as truck traffic within and through the Salt Lake City area.

"Residents" were addressed by the TDM **Plan**, which defined a program of activities that sought to involve over a dozen transportation stakeholders in the Salt Lake City area. This included residents, major employers, commercial/retail businesses, schools, and other local interests, plus local and long-distance truckers who pass through the area. The Goal of the TDM Plan was to reduce the "background" traffic by at least 20%. The strategies used included increased transit use, carpools, shifting work hours earlier, shifting travel routes and times (especially for trucks), and other TDM approaches to reduce traffic.

In parallel, SLOC, UTA, UDOT and other agencies addressed the ***spectator*** population by developing the Olympic Spectator Transportation System (OSTS), which included:

- 19 park-and-ride lots with shuttle buses to downtown,
- the TRAX light rail system, with new overflow parking lots for TRAX riders
- publicly-subsidized contracted shuttle services to the mountain venues.

Over one-third of tickets to Olympics events were sold in Utah, so it must be recognized that many of the “spectators” were also Utah residents – in addition to the many “visitors” from outside Utah.

2.2 The Olympic Games

This section describes dimensions of the Games, the Olympic Spectator Transportation System and services provided, organizational structures, agency transportation roles, and the communications and transportation plans that were established to meet transportation needs during the Games.

2.2.1 Dimensions of the Games

The 2002 Winter Olympic Games in Salt Lake City were like no other Winter Games ever held, on several levels. The Games included the largest sport program in history with 78 events in 15 disciplines and seven sports – this included 10 more events than the 1998 Games in Nagano, Japan. With nearly 2,400 athletes, more than 30,000 volunteers and 11,000 media representatives and 10,000 security personnel, this was by far, the largest Winter Games ever.

An average of 70,000-80,000 visitors arrived in Salt Lake City every day for 17 days. 65,000 visitors were welcomed to downtown Salt Lake every night. As a comparison, the Delta Center, which is located just west of downtown Salt Lake City and serves as home to the NBA's Utah Jazz, draws a maximum of 17,000. It is located two blocks from the Salt Palace Convention Center, which can host up to 12,000.

By contrast, the last Winter Olympics in America took place in the small town of Lake Placid, New York – population 2,700 (1980). Salt Lake City is a bustling city of 800,000, and the Games took place over 900 square miles in wide-spread host cites that surrounded Salt Lake.

Beyond the sheer size of the Games, the issue of security and fears of terrorism following the attacks in New York City and Washington, D.C. on September 11, 2001 colored these Games like no other Olympics before. Extraordinary security measures were added, including a no-fly zone over the opening and closing ceremonies, security sweeps at all venues and measures similar to those used in the athletes' village after the terrorist attacks at the 1972 Summer Olympics. For the first time in a Winter Olympics, all visitors at all venues were subject to scans by metal detectors (nearly 1,000 of them). More than $300 million in combined federal, state and local funds were allocated for security for the Winter Olympics compared to $98 million spent at the 1996 Summer Olympics in Atlanta[3].

A comparison of recent major sports events is given in the table below. The record number of athletes, visitors, volunteers, plus the unprecedented number of events combined with extraordinary security measures, served to shape the 2002 Olympic Games transportation experience like no other in Winter Olympic Games history.

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[3] "Preparing for the World: Homeland Security and Winter Olympics", www.whitehouse.gov; Jan. 10, 2002

Table 1. Comparative Dimensions of Recent Olympic Games and Sports Events

Event	# of Athletes	# of Media	Ticket sales	# of Events
SLC Winter Olympics	2,399	11,408	1,525,118	78
Nagano Winter Olympics	2,302	8,730	1,275,500	68
Lillehammer Winter Olympics	1,821	7,888	1,230,000	61
1998 NBA Finals	24		20,000	3
1997 NBA Finals	24		20,000	3
1993 NBA All-Star Game	24		20,000	1

From: Final Report on the XXVIIth Olympiad 1992-2000, IOC

2.2.2 Olympic Games Transportation System

The transportation system created to meet the needs of all participants, visitors and local residents of the Salt Lake City area was a multi-modal system that encompassed highway, bus and rail services. In order to accommodate access to all Olympic venues for athletes, officials and spectators while still meeting the needs of local residents, the system had to be flexible. For venues outside of Salt Lake City, spectators used personal vehicles to get to park and ride lots and were then shuttled to the venues. There were also publicly subsidized contracted shuttle services to the mountain venues. For venues within Salt Lake City, park and ride lots in several areas near downtown and an accompanying shuttle service were also utilized. Enhanced light rail service was also used to serve the downtown venues.

The record number of participants and spectators, coupled with the fact that the venues were spread out over 900 square miles, created a unique challenge to the Salt Lake Organizing Committee (SLOC). SLOC was responsible for providing transportation for all ***athletes*** and ***officials*** in the Olympic Village. The transportation of ***spectators*** was a joint responsibility shared by SLOC, UTA and UDOT. The transportation system in the Salt Lake City area needed to account for the transportation needs of six groups:

- Athletes
- Media
- Olympic Family
- Spectators
- Sponsors
- Non-ticketed Visitors

Athletes
The Athlete Transportation System was created to service the nearly 3,300 athletes and officials that were housed in the Olympic Village, which was located in Salt Lake City on the University of Utah campus. (About 800 more athletes and officials were housed at

the Soldier Hollow Alternate Housing facilities located in nearby Wasatch County.) The Athlete Transportation System consisted of 500 12-passanger vans, 50 cargo vans and 44 recliner-seat, coach buses to transport the athletes between the two housing sites and the 13 venues. The system operated 24 hours a day between January 28, 2002 and February 27, 2002. All vehicles in the system were directed to use alternate routes between venues when possible in order to minimize the congestion cause by spectator traffic.

Media

A shuttle service was created to serve the 11,408 members of the mass media that were in Salt Lake to cover the Games. The system consisted of 300 recliner-seat, coach buses. The service was designed to operate on fixed routes up to 24 hours a day on three levels:

- between the media housing sites and the Main Media Center (MMC),
- between the MMC and the venues, and
- between select media housing sites and the venues.

The media shuttles used alternate routes where possible. Like the Athlete Transportation System, the media shuttle system operated between January 28, 2002 and February 27, 2002. In order to augment this service, and because the shuttle service was not available on an on-call basis, members of the media were provided free access to UTA TRAX light rail service and the local bus system.

Olympic Family

A Motorpool System was created to serve the needs of members of the Olympic Family. The Motorpool consisted of over 300 automobiles, vans, sport utility vehicles and 50 coach buses. Motorpools were established at the Olympic Village, the Olympic Venues, the Olympic Family Hotel, the Olympics Medals Plaza, and Salt Lake City International Airport.

Spectators

The Olympic Games Transportation System was designed to meet the transportation needs of spectators in two major categories – venues in the Salt Lake Valley and venues outside the Salt Lake Valley.

For all venues ***outside*** of the Salt Lake Valley, spectators were expected to use personal vehicles to travel to the park and ride or park and walk lots serving each venue. From these lots, spectators were shuttled aboard transit buses to the venue (each of which were located within five miles of the lots). Limited long-haul bus service was also provided for spectators not using their personal vehicles.

For all venues ***within*** the Salt Lake Valley spectators had three options. For certain venues, spectators were allowed to drive their personal vehicles to lots located near the venues. Most spectators utilized the extensive transit services provided by UTA, which included regular bus service (fixed-route and demand-responsive), the TRAX light rail system, and the downtown-based Olympic Shuttle System. The Olympic Shuttle system consisted of 1,000 loaned transit buses plus the existing UTA transit fleet, which carried spectators from park-and-ride lots to downtown and to the venues.

Sponsors
Sponsors were responsible for hiring their own buses (this fleet eventually numbered around 300 coach buses). SLOC did allow these buses access to the Olympic Venues by designating special sponsor load/unload zones at each site. The only stipulation was that the Sponsor buses not conflict with operations of the Olympic Spectator Transportation System. To that end, sponsor buses used different routes and arrival/departure times at each site.

Non-ticketed Visitors
Non-ticketed visitors in the Salt Lake area had full access to all regular UTA services (local and express bus services as well as TRAX) in order to access the Olympic Medals Plaza (downtown Salt Lake) and other non-ticketed areas. Residents and/or visitors had access to the downtown shuttle lots for free without event tickets. The Venue Shuttles were restricted to ticketed passengers. The SR 40 Venue parking lot was provided for non-ticketed tourists to Park City.

2.2.2.1 Olympics Transportation Services

The success of the Olympic Games Transportation System relied on the expanded and efficient implementation and use of new and existing transportation services in order to meet transportation objectives. Plans included a number of measures including:

- Expanding the regions roadways and utilizing ITS technologies along those roadways
- Establishing an extensive park-and-ride system
- Operating a free Olympic Shuttle Bus system
- Defining traffic hubs in downtown Salt Lake City
- Contracting long-haul charter services (Mountain Venue Express)
- Borrowing transit buses and light rail vehicles to augment existing services
- Maximizing TRAX capacity on both Salt Lake City/Sandy and University Lines

Roadways
The network of interstate highways in the Salt Lake region served as the principal transportation routes between the Olympic venues. These included:

- I-15, which serves as the primary north-south connector between Salt Lake City and Ogden City to the north and with Provo City to the south
- I-80, the primary east-west connector to Park City
- I-84, which serves the Ogden region to the north and connects with I-80 east of the Salt Lake City area
- I-215, the beltway in the southeast and southwest, and northwest quadrants of Salt Lake City.

Many of these roadways were expanded or improved in the years prior to the Olympics.

The north-south backbone of the Salt lake regional roadway network, 17 miles of I-15, underwent massive reconstruction from Sandy City (in the south), up to north of downtown Salt Lake City. The project included the addition of general purpose lanes, high occupancy vehicle lanes and construction of over 130 structures, which added over

30 percent capacity. Additionally, ITS systems were added including pavement temperature sensors, closed circuit television camera (CCTV), traffic monitoring loops, fiber optic cabling, and variable message signs. The systems were connected through the UDOT Traffic Operations Center.

A portion of I-80 through Parleys Canyon, between Salt Lake City and Park City to the east, was also reconstructed. The roadway was re-paved and median barriers were installed. Vehicle counting and speed-detection capability was also added along with pavement temperature sensors, closed circuit television cameras, and fiber-optic communication cables. These systems were then connected to the ITS system that was installed as part of the I-15 reconstruction project.

Parking Facilities

Olympic venue park-and-ride lots were integral to the success of the Olympic Transportation System. These lots served to minimize the use of personal vehicles as a mode of travel to both downtown venues and those venues outside of Salt Lake City. Spectators driving to the events were directed to one of 22 lots designed and strategically placed to intercept arriving traffic as it approached the venues (See Figure 2.4). Spectators then boarded buses and were shuttled to the venue. The free Olympic shuttle service operated on February 7th and 9th through 23rd.

Figure 2.4 Parking Facilities Near Downtown SLC

Olympic Shuttle System

The Olympic Shuttle System provided transportation from 30,000 spaces in park-and-ride lots to the Olympic venues. The shuttle system worked in concert with the park and ride lots to provide transportation for over 350,000 spectators who visited downtown Salt Lake City and more than 850,000 Olympic ticket holders and 100,000 people participating in non-Olympic festivities who traveled to mountain venues or towns.

About 1200 loaned transit buses were added to existing UTA and Park City buses to meet this need. This influx of buses required the establishment of additional service centers to store, clean, fuel and maintain the buses during the games. In Ogden and Salt Lake City, these facilities were located adjacent to the existing Mt. Ogden and Meadowbrook Maintenance Facilities.

Downtown Hubs

The shuttle services were designed to intercept spectator and visitor traffic as it approached the venues and funnel it to the park and ride lots. From these lots, the shuttles then traveled to the venues. Each park and ride lot serving the downtown area led to one of four bus hubs. The buses assigned to each park and ride lot operated in a fixed loop route with a designated hub, with buses dispatched at regular intervals.

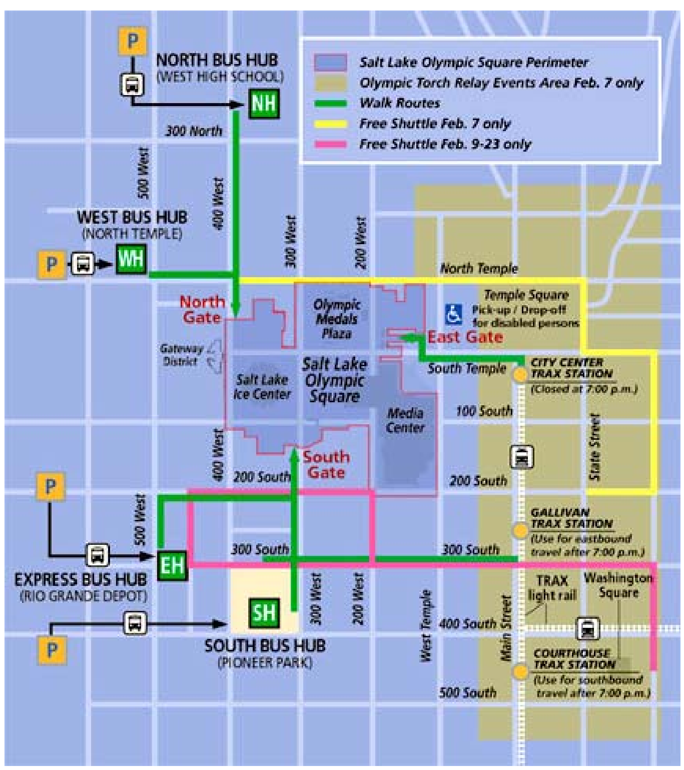


Figure 2.5 Downtown Hubs

Mountain Venue Express
The Mountain Venue Express (MVE) was an advanced-reservation-only, express bus service for ticket holders who chose not to use, or did not have access to, personal vehicles to reach the park-and-ride lots or who did not want to drive to the mountain venues. The service originated from three hubs:

1. Salt Lake City,
2. Provo (to Soldier Hollow only), and
3. Ogden (to Snowbasin only).

From these hubs, it ran to Olympic venue park and ride lots. Following the event, riders returned via shuttle bus to the appropriate venue park-and-ride lot, then returned to the appropriate hub once aboard the MVE.

The MVE was a success after overcoming some initial problems. The original charge for the roundtrip service was $20 per person. Due to lower-than-expected demand, this price was reduced to $5 in early January 2002. After the reduction, reservations on the system increased dramatically to the point that a fourth hub was added a few days after the start of Olympics at the Utah State Fair Park on North Temple and 1000 West.

Public Transit - Bus Service
The UTA fixed-route bus system continued its regular schedule of services throughout the Games with a few adjustments. Hours of operation were expanded, as was the frequency of the regularly scheduled Express Bus Service to Salt Lake City from Provo and Ogden. Minor changes were also necessary to some downtown routes in areas where traffic was restricted.

Park City Transit also offered expanded bus service similar to UTA, including additional routes, increased frequency, and longer hours of operation throughout the Games.

Public Transit - TRAX Light Rail
UTA operated the TRAX light rail system, consisting of a 15-mile transit line extending from Sandy north to downtown Salt Lake City, plus a 2.5-mile line extending from downtown SLC east to the University of Utah. During the Games, TRAX operated at a higher frequency and with longer trains (made possible by the addition of 29 borrowed

cars from the Dallas Area Rapid Transit). TRAX expansions increased the frequency of train arrivals to every eight minutes during peak hours.

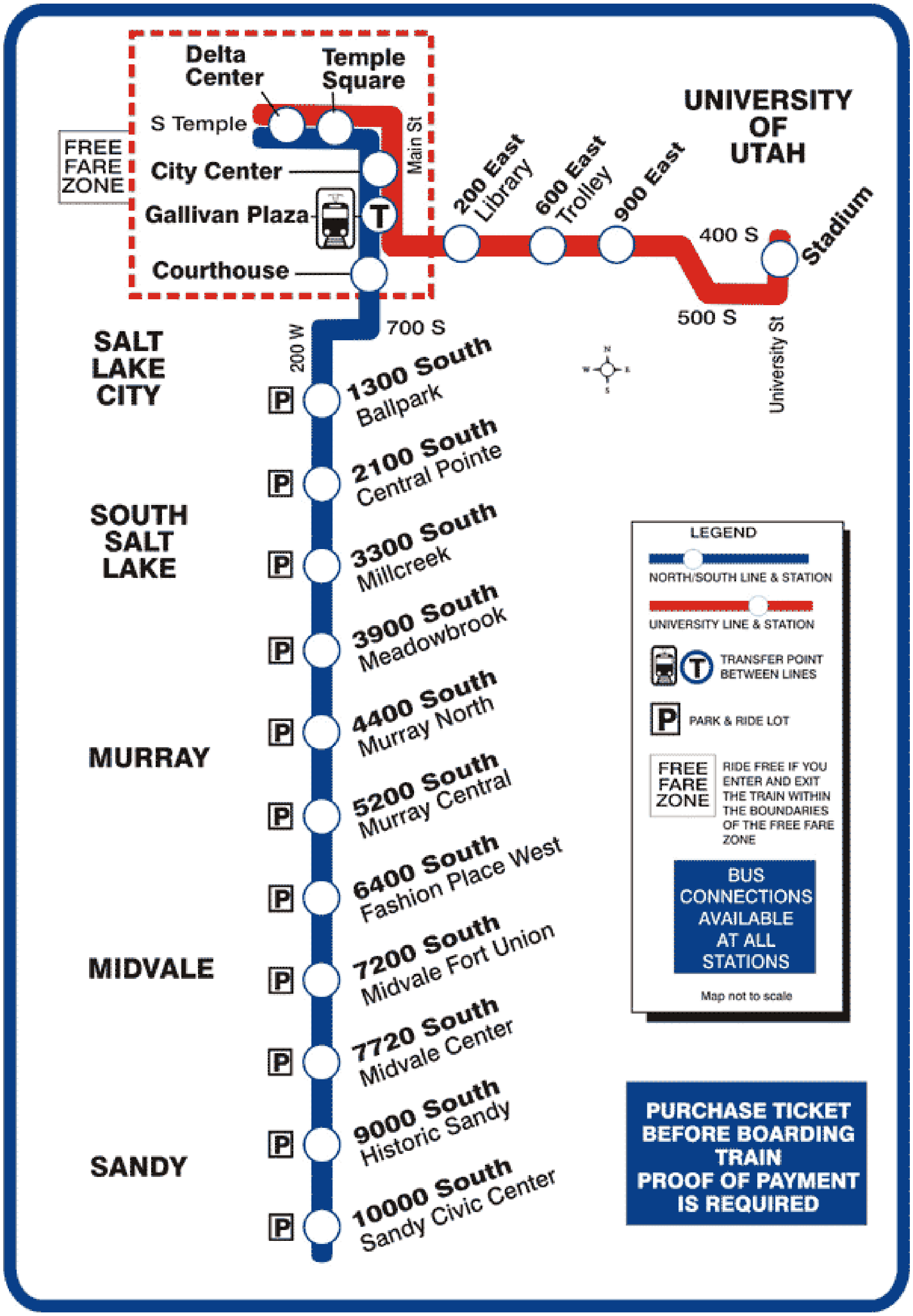


Figure 2.6 TRAX Service Map

2.2.2.2 Organization and Agency Transportation Roles

The three major private organizations and government agencies involved in providing transportation for the Games are listed in Table 2 below, along with a summary of their role(s).

Table 2 Key Transportation Organizational Roles

Organization	Role During Games	
UDOT	Utah Department of Transportation is a division of state government, with responsibility for all state highways and roads within Utah. UDOT provided staffing, facilities, funding, and infrastructure to help develop and execute many of the Olympic transportation plans. During the Games, one of UDOT's most notable contributions was the TOC, which served as both the control center for operation of all streets and highways in the Salt Lake City area, and as the Command Center where all transportation-related agencies coordinated their joint actions during the Games.	
UTA	Utah Transit Authority is the public-transportation operator for most of the area covered by Olympic Games. The UTA service area covers over 1400 square miles, serving 78 cities and towns in the counties of Salt Lake, Toole, Davis, Box Elder, Weber, and Utah. UTA operates fixed-route, local and express bus services, demand-responsive bus service, and the TRAX light-rail services. UTA also maintains park-and-ride lots at TRAX stations and elsewhere. During the Games, UTA also operated the Olympic Spectator Transportation Service (OSTS), which is described in sections 3.2 and 5.3.4 of this report.	
SLOC	The Salt Lake Organizing Committee for the Olympic Winter Games of 2002 was a private, non-profit organization, with responsibility for planning, promoting, and conducting the 2002 Winter Olympic and Paralympic Games. SLOC was managed by a President and a Board of Trustees, which oversees all SLOC undertakings. There is also a Board of Ethics that ensures adherence to ethical standards of the Olympic Movement. A 20-member subset of the Board of Trustees serves as the Management Committee, which is responsible for planning and executing all SLOC activities. Within the Management Committee, two members serve as Director of Transportation and Director of Operations Planning. They had primary responsibility for planning and executing the Olympic Transportation Plans. SLOC had a staff of over 20,000 people, most of whom were volunteers.	

2.3 Study Methodology

This section describes the methodology used in the Event Study. It lists the "assessment areas" and their corresponding objectives. Work tasks and sub-tasks that were performed before, during and after the Games are also summarized, as well as the data collection and data management plans.

2.3.1 Study Objectives

The goal of the Event Study is to evaluate the performance of UDOT's ATMS and ATIS during the Olympic Games. Drawing from the methodology in Booz-Allen & Hamilton's "1996 Atlanta Centennial Olympic Games and Paralympic Games Events Study," an initial decision was made to focus on the same four areas as the Atlanta study; transportation system impacts, Institutional Impacts, Agency and User Perspectives and Transferability. As the study methodology was further developed and priorities were clarified, a decision was made to restructure the study objectives around four themes that better reflected UDOT's study goals. These areas were:

- ATMS effectiveness
- ATIS effectiveness
- TDM effectiveness
- Transferable Findings

Once the assessment areas were clarified to meet UDOT's goals, the study objectives also had to be adjusted. The study objectives, which had reflected the assessment areas found in the Atlanta Olympics Event Study, **were all retained** but were reorganized according to the structure shown below.

Table 3 Assessment Areas and Objectives

Assessment Area	Objectives
ATMS Effectiveness	• Assess the effectiveness of the TOC for incident management and routine traffic management • Assess the effectiveness of the TOC Incident Management System software • Assess the effectiveness of the TOC traffic surveillance components • Assess the integration of the TRAX/Light Rail system with the ATMS • Document interagency operational coordination during the Games • Document perceptions of system performance by TOC operators and supervisors • Document perceptions of ATMS performance from the agencies involved

	• Document perceptions of the traveling public regarding their transportation experiences during the Olympic Games • Document perceptions of the ATMS performance as reported in the media
ATIS Effectiveness	• Assess the utility of the ATIS components • Document interagency operational coordination during the Games • Document perceptions of ATIS performance from the agencies involved • Document perceptions of the traveling public regarding their transportation experiences during the Olympic Games • Document perceptions of the ATIS performance as reported in the media
TDM Effectiveness	• Assess the effectiveness of the TDM Plan • Document interagency operational coordination during the Games • Document perceptions of the effectiveness of the Olympic Travel Demand Management Plan and other public relations efforts related to ATMS/ATIS operations.
Transferable Findings	• Document the extent of unplanned modifications to the Transportation Management Plans during the Olympic Games • Assess the transferability of key lessons learned to other locations/major events.

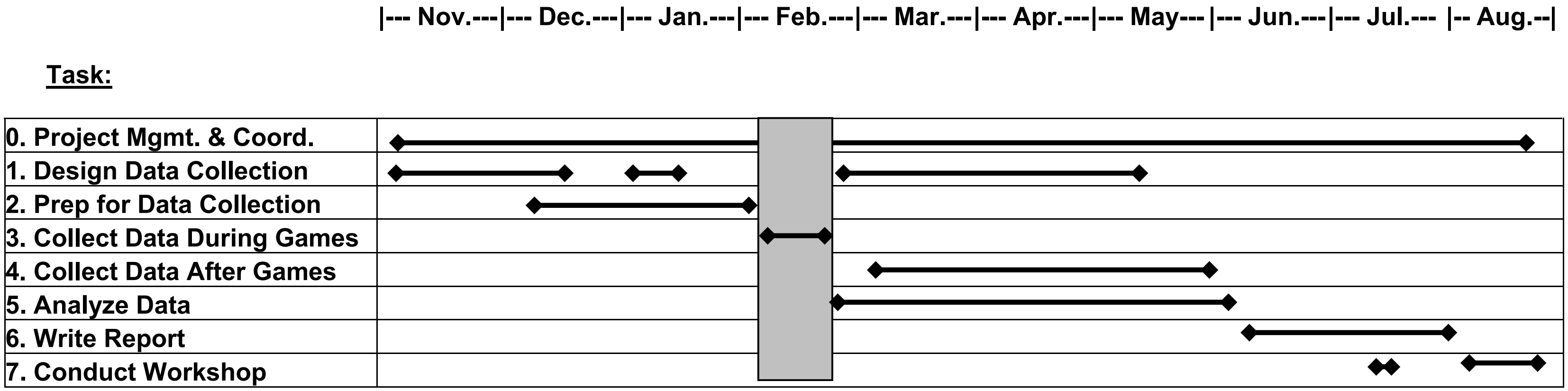
2.3.2 Work Tasks and Schedule

This section summarizes the Event Study work tasks and sub-tasks performed before, during and after the Games. Staff included a Study Manager, a Field Supervisor, and other staff assigned to specific responsibilities as described below and in the following section. After the study objectives and methodology were fully defined, the remaining work effort was organized around seven tasks:

(1) Designing Data Collection,
(2) Preparing for Data Collection,
(3) Collecting Data During Games,
(4) Collecting Data After Games,
(5) Analyzing Data,
(6) Writing the Report, and
(7) Conducting Transferability Workshop.

The original work schedule for the Event Study is shown on the next page. There were some deviations from this schedule.

Schedule of Tasks - UDOT Task 2 - SLC Olympics Event Study



2.3.3 Data Collection and Management Plan

The Event Study included empirical data collection (both automated and manual), and use of numerical Measures of Effectiveness (MOEs) in many instances to enable ***quantitative*** analysis to be performed. It also included collection of anecdotal data consisting of perceptions, recollections, and opinions about the ATMS/ATIS during the Games, to enable ***qualitative*** analysis to be performed.

Once the assessment areas, objectives and sub-objectives that reflected UDOT's study goals were finalized, a detailed Event Study Data Management Plan was created based on the identification of 29 potential data sources. These sources would provide information needed to conduct the quantitative and qualitative analysis on which the Final Report would be based. Each objective and sub-objective was addressed by one or more of the activities. Each data source was assigned an activity number and the following were specified for each activity:

- Data Source: Defined what source would provide the data items needed for collection.
- Assessment Area(s): Defined the assessment area(s) to be addressed by each activity.
- Purpose: Defined the method of data collection and the reason for collecting particular data.
- Background Information: Outlined any information that might help in the data collection process. This item was optional.
- Location of Collection: Locations where data was to be obtained or observed.
- Data Items to be Collected: Defined the items to be measured.
- Days and Times of Collection: Defined times of observation and/or data collection.
- Follow-up Processing Needed: Outlined how and when the collected data would be processed.
- Responsibilities, Roles and Level of Effort for Each: Identified the agencies and individuals involved in data collection, and specified the responsibilities of each.
- How Results will be Used in Final Report: Assessment of how the analysis of data would be used in the Final Report.

An example of a data management plan for one activity appears on the next page.

Salt Lake City Olympics Event Study
Data Management Plan

Activity No.:	**14**
Data Source:	**ATIS Form 1**
Assessment Area(s):	**I.E.1 and I.E.2. Utility of ATIS for Traffic Management – 511 Telephone Service and CommuterLink Website.**
Purpose:	Test the performance of the "511" telephone service and the CommuterLink Website ("CLW") from the ***user's*** point of view.
Background Info:	To supplement "internal" records kept by the 511 and CLW systems, this activity provides an "external" test of system performance.
Location of Collection:	UUTOC. Both 511 and CLW will be accessed remotely, using phone lines and the internet, respectively.
Data Items to be Collected:	A set of inquiry "scenarios" will be defined for each service, to test all of the options available to users. Some scenarios will test static information, others will test dynamic (incident-related or event-related) responses.
Days & Times of Collection:	Continuing, periodic tests each day during Games, with 2-3 inquiries per test of each system (511 and CLW).
Follow-up Processing Needed:	Key-enter test data into master database. Generate report with tabulations of test results. Write narrative describing perceptions of system performance and documenting any problems encountered.
Responsibilities, Roles & Level of Effort for Each:	Generating Scenarios – UUF & UUS. LOE= 4 hrs total. Executing Scenarios – UUS. LOE= 6 hrs/day. Data Entry – UUS. LOE= 1 hr/day Report Generation – RC. LOE= 6 hrs total
How Results will be Used in Final Report	These results will supplement the reports from Activities 12 and 13, describing system availability, ease of use, and accuracy of information provided by the systems.
Other Comments:	The Atlanta report did not assess the ***utility*** of ATIS services. It was covered only under Agency and User Perspectives (via interviews).
Prepared by:	Robert Jesse
Last Revised:	Jan 3 Jan. 8
Status:	Final.
	End of this activity.

3 Advanced Traffic Management Systems (ATMS) Findings

This section examines the Advanced Traffic Management System in Salt Lake City during the Games. The discussion is structured around the following topics:

- ATMS Elements – what the system included and how the various parts performed
- Organization for Traffic Management – how participating agencies were organized
- Transportation Management Actions – what was done and how the ATMS assisted
- Interagency Coordination – examples of collaboration and what role ATMS played.
- Perceptions of ATMS Performance – by UDOT staff and other agencies.

3.1 ATMS Elements

During more than five years before the Games, UDOT and other transportation agencies collaborated to deploy a comprehensive advanced traffic management system (ATMS), including the following major elements:

- A new Traffic Operations Center, plus several satellite Traffic Control Centers
- Traffic detection stations on all freeways and some arterial roadways
- Interconnected traffic signals on many arterials, plus some ramp metering
- Closed Circuit Television on all freeways and some arterials
- Variable Message Signs on all freeways and a few arterials
- Highway Advisory Radio stations at almost a dozen locations
- Roadway-Weather Information System stations at a number of locations
- Traffic Signal Integration with TRAX to provide signal preemption
- Other supportive "non-technical" elements (e.g., Incident Management Teams)

Each of these elements will be discussed individually in turn, beginning with a description of that element and followed by an assessment of how that element performed during the Games. A more holistic assessment of the performance of the entire ATMS appears in Section 3.3, following a discussion of how the ATMS was used for typical traffic-management actions.

3.1.1 Traffic Operations Center

The centerpiece of the Salt Lake City ATMS is the UDOT Traffic Operations Center (TOC), which houses UDOT traffic-management staff, UHP dispatchers, media reporters, and other support staff (see Figure 3.1). The TOC also houses a network of approximately 45 computer servers, which provided almost all of the ATMS and ATIS functionality. This included arterial-management software (ICONS) to manage the traffic signals, plus a freeway-management software package (a modified version of Georgia Navigator) to manage the freeway surveillance and control elements. The ATMS was also connected to a number of remote workstations at other agencies, plus an extensive array of field devices, including traffic signals, detectors, closed-circuit television cameras (CCTV), variable message signs (VMS), Highway Advisory Radio

(HAR), Road-Weather Information Systems (RWIS), and other elements. A high-level view of the system architecture is shown in Figure 3.2. Each of the field devices is described and assessed next.

Figure 3.1 Traffic Operations Center

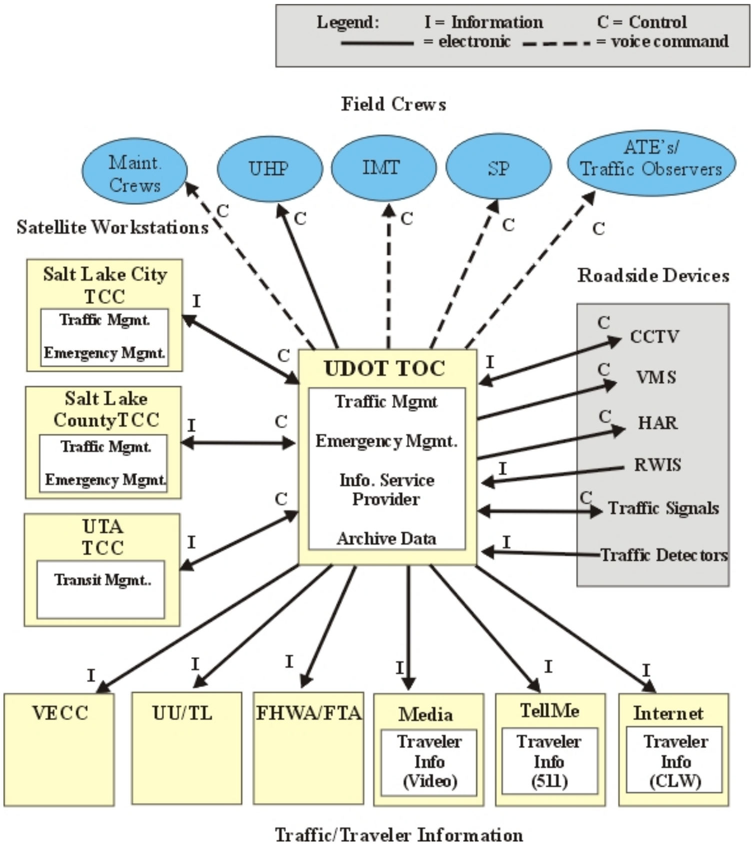


Figure 3.2 Subsystem-Level Architecture Diagram

3.1.2 Remote Workstations

The ATMS in the TOC was connected via high-speed communications to remote workstations at the offices of Salt Lake City, Salt Lake County, Utah Transit Authority, University of Utah Traffic Lab, and FHWA local offices. The interconnections for these control centers is depicted in Figure 3.2, and a photograph of the display wall for the remote workstation at the University of Utah Traffic Lab is shown in Figure 3.3. These remote workstations were capable of performing all the same functions as the TOC workstations – or limited functions – depending upon the login/password used to access the system. This included remote access and control of all CCTV cameras, allowing viewing of any camera from any remote ATMS workstation. All of these remote workstations remained operational after the Games.

Figure 3.3 Univ. of Utah Traffic Lab

Assessment of Remote Workstations:

Although the scope of this study did not include an assessment of each of the remote workstations, many of the data-collection tasks were preformed at the University of Utah Traffic Lab (UUTL), utilizing the remote workstation there. That workstation included several computers, plus one large display screen surrounded by four smaller screens, plus some auxiliary equipment (e.g., videotape recorders, etc.). This equipment, plus the fiber-optics communications link to the TOC, allowed the simultaneous display of up to four different CCTV images with full-motion video.

This functionality proved highly valuable during the data-collection effort. For example, one of the data items included manual counts of large trucks at a few freeway locations, to measure the reduction in interstate truck traffic resulting from the TDM campaign prior to and during the Games. Rather than stationing several observers on freeway overpasses in sub-freezing weather as well as causing security concerns, two of the

UUTL displays were used to perform the truck counts. This was done by selecting the proper CCTV sites and having the observers view the screens to count the large trucks. The displays were also videotaped in many cases, allowing re-counts when an unusual situation required a more careful examination (e.g. to differentiate "large" trucks from "small" trucks). This flexible surveillance capability proved extremely valuable to the study, as it likely would to the other agencies with remote workstation.

One key limitation (by design) at the UUTL site was the inability to directly control camera movements. This required telephone communications with the TOC Control Room operators whenever a camera needed to be moved – as was occasionally done if there was an incident that required the TOC operator to preempt one of the cameras that was dedicated to the truck counts. This limitation on camera control was not the case at all remote workstations, because the authorization to control cameras is determined by login code used, not strictly by location. Some of the remote workstations were able to control cameras, subject to a user hierarchy that allows the TOC staff to re-assume control of any camera if required.

3.1.3 Traffic Signals

There were 608 traffic signals controllable from the TOC during the Games, of which 34 used type 2070 controllers (exclusively at light rail traffic signals). The remainder used NEMA TS 2 controllers, either type 1 or type 2. Almost all of these were on surface streets, but there were also 23 ramp meter signals.

Over 1200 signal-timing plans were developed for three general purposes. These consisted of:

- 368 time-of-day plans
- 418 incident-response plans
- 478 Olympic plans

Monitoring of the traffic signal system takes place through the ***icons*** software. During the Games, operators monitored the system to ensure that:

1.) Signals remained "on-line" through the communication system (signals that dropped off-line for whatever reason were quickly identified and restored), and
2.) Timing plans that were scheduled to go into effect by clock-calendar were the correct plans and turned on and turned off at the appropriate times.

During the Games, traffic signal operation was monitored continuously from 5:00 AM to 11:00 PM, seven days a week. The traffic signal operators also monitored traffic conditions and would delay or extend pre-scheduled time-of-day timing plans if warranted, and manually initiate "Action Sets" in response to unexpected conditions. Thus, there were fairly extensive real-time adjustments to traffic signal timing patterns.

<u>Assessment of Traffic Signals</u>

In terms of their role as part of the ATMS, the key issue regarding the traffic signals is the interconnections to the TOC via communications lines to allow monitoring and control of the signal timing and phasing. There were no problems noted by Study

Observers with the monitoring of individual signal status, which was used infrequently by TOC staff for unusual situations. The ATMS computer also monitors the signal status ("faults") for internal purposes, and there were no reports of significant problems with that monitoring process. As would be expected with over 600 signals, there were maintenance/repair activities required, but they were reported to be comparable to non-Games levels.

For control purposes, most of these 608 signals were connected via fiber-optics lines, which enabled downloading of large signal-timing patterns from the TOC to the 2070 and NEMA controllers. This process appeared to work reliably and was generally not needed in "real-time" situations. There was only one instance noted by Study Observers when a slow communications link to a signal in the downtown area required a field visit to immediately download new signal-phasing commands to handle a reconfiguration of the roadway. Overall, both the monitoring and control of traffic signals appeared to operate very reliably.

3.1.4 Traffic Detectors

There were 656 traffic monitoring stations (TMS), of which 365 are mainline locations and 171 are connected to the CommuterLink/Operator map at the TOC via communications links. Almost all were on the freeway system, at approximately half-mile spacing. Each TMS generally consisted of a detector in each mainline lane, plus detectors on the on-ramps, if nearby. In almost all cases, each mainline lane detector consisted of two in-pavement loops, to allow it to measure volume and speeds. The detectors at the 23 metered on-ramps generally included several loops in each lane to detect calls, clearance, and queue backup. Detectors at non-metered on-ramps included fewer loops.

Assessment of Traffic Detectors

From the perspective of this study, the key question is whether the traffic detectors provided sufficient information to allow the ATMS to perform all necessary functions. From the perspective of the public, there were never any traffic-detector problems that compromised the essential traffic-management functions performed by the system. From the perspective of the TOC staff, there were two traffic-detector problems that had a minor impact on their functions.

1. Speed detection errors – Early during the Games, observers noted that several of the detector stations were producing speed measurements that were noticeably inaccurate. UDOT staff and contractors performed diagnostic tests and believed that this was a result of a bug in the "firmware" code of some of the signal controllers. There were three versions of this firmware installed in the controllers, and the problem was isolated to one of those versions. Because the re-installation of this firmware was very time-consuming, TOC staff decided that the situation did not require an immediate remedy and the updates were scheduled for after the Games.

2. Data gaps – In addition to reporting speed, the detector stations also reported traffic volumes in each lane, plus some data about vehicle lengths (e.g. to classify and count cars versus trucks). This data was not available from some of the detector stations because a limitation in the ATMS software (discussed in Section 3.3.4) required that their interconnect cables be used for another purpose.

In summary, there were some problems with a number of the traffic detectors that were noticeable to a "critical observer," but they did not seriously affect any mission-critical functions of the ATMS during the Games.

3.1.5 Closed Circuit Television Cameras (CCTV)

There were 218 Closed Circuit Television Cameras located across the SLC area during the Games. Most were on freeways, at approximately six-tenths mile spacing. See Figure 3.4 for a picture of a typical CCTV camera, and Figure 3.5 for a map of locations. A small number of these locations were temporary installations, for the Games only. Almost all CCTVs were connected via high-speed, fiber-optic communications lines, allowing full-motion displays and full control (pan/tilt/zoom). However, a few cameras at remote locations were connected via telephone lines (dedicated and dial-up), allowing only "slow-scan" images to be transmitted.

Figure 3.4 CCTV Camera

Figure 3.5 Map of CCTV Locations

Assessment:

Overall, the CCTV system was the most valuable surveillance element of the ATMS, and it performed its expected functions reliably. It was used for extensively for both traffic control and security functions related to the transportation system.

To minimize disruptions, access to the Control Room was tightly restricted during the Games. Therefore, most of the observations of CCTV usage made by the Study Team were done from adjacent Rooms 125 and 230, by looking through the glass walls into the Control Room to view the large video screens on the walls. These observations, supplemented by interviews with UDOT staff, revealed that:

1. Coverage – The 218 cameras in the CCTV system afforded very broad coverage plus extensive camera control, so the observers did not note any incident along the freeway that was not clearly visible to the operators via one of the surveillance cameras. Even on surface streets where there were comparatively few CCTV units, they were strategically located because most surface-street incidents could be seen through one or more of the ATMS surveillance cameras. Some dial-up cameras were added to the operator maps after the games began and some operators as well as the Room 230 personnel were unaware of their availability. The breadth of CCTV coverage was excellent.

2. Control – The control of the camera movements (pan/tilt/zoom), and the automatic rotation of images on the control room wall displays, appeared to be highly reliable with one exception resulting from an ATMS software anomaly (this will be fully discussed in Section 3.3.4).

3. Image Quality – In part because of additional field crews that were assigned to cleaning the camera lenses, there were very few situations in which a CCTV image was degraded by dust or water. Also, the Study Observers noted three instances when high-wind conditions at mountain locations degraded visibility for a time because of excessive camera oscillations. The slow-scan cameras were mentioned by UDOT staff as being harder to use because it was more difficult to interpret speeds for fast-moving vehicles. With these rare exceptions, the camera image quality was always clear and reliable and there were no consistent problems.

4. Location Labels – Most of the camera images carried a small, text label at the top that identified the location, but a few did not. This was of little consequence to experienced operators and others who are familiar with the area, because they either had memorized the location of each camera or recognized landmarks in the camera images. However, it likely increased the response time for those without that high level of familiarity of the Salt Lake City area (e.g., the security personnel and others who came to Salt Lake City to support the Games).

5. Direction Labels – A significant hindrance for those not familiar with the area is the absence of azimuth labels on the displays, to indicate the direction in which

the camera is pointing. For all users, including the experienced ones, this appeared to be a consistent hindrance at night when the landmarks were usually not visible and all that could be seen was headlights. Although it could not be measured, this likely increased the response time of those using the CCTV system at night. For others not familiar with each CCTV location (e.g. federal public-safety staff), it would likely also increase their response time during the day.

In summary, it must be said that the problems noted above were few and minor. The CCTV system proved to be an extremely valuable surveillance tool – probably the ***most*** valuable surveillance tool – throughout the Games, for both traffic management and security purposes. The CCTV system operated reliably with the only consistent problem being the absence of azimuth indication on the displays.

3.1.6 Variable Message Signs (VMS)

There were 63 permanent Variable Message Signs installed across the Salt Lake City area, primarily on freeways, plus several portable VMS units that were used during the Games. (See Figure 3.6 for a picture of a VMS display; see Figure 3.7 for map of VMS locations.) All VMS devices were connected via communications lines to the TOC and were controlled by the ATMS software, allowing messages to be posted or removed from any ATMS workstation – but only if the user entered a proper "login" code.

Figure 3.6 Variable Message Sign Display

Figure 3.7 Map of VMS Locations

The VMS equipment was used for both traffic-management and traveler-information purposes during the Games. Use of VMS for traveler-information is discussed in Section 4.3, and the application of VMS for traffic management is discussed next.

For traffic-management purposes, freeway VMS ***generally*** used a common message format, consisting of three lines.

1. The first line *identifies the problem*.
2. The second line generally *identifies the location*.
3. The third line generally *recommends action*.

This format is illustrated in the sample message below:

RT LANE CLOSED
1 MILE AHEAD
MERGE LEFT

There were also some instances where one or more of the lines on the sign would alternate or "toggle" between two different lines of text. This was one technique used to display more information than would otherwise be possible given the size of the VMS display.

Assessment of VMS for Traffic-Management

Most of the use of VMS for traffic management purposes was done by the TOC control room operators. As previously noted, operational precautions precluded the Study Observers from being in the control room to "look over the shoulder" of these operators as they posted VMS messages, so the following comments are based primarily upon follow-up interviews with UDOT staff and review of UDOT documents.

VMS usage ***for traffic management purposes*** during the Games was not significantly different from normal periods. Message content was generally selected to notify drivers of incidents ahead, and standard messages were generally used. No significant problems were noted by the Study Observers during the Games or identified by UDOT staff during the follow-up interviews. (There was one limitation of the VMS discovered when they were used ***for traveler information*** – the inability to post a "global" message. This is discussed fully under the ATIS assessment in Section 4.3.3.) Overall, the VMS subsystem appeared to perform fully all of its intended functions for traffic-management situations.

3.1.7 Highway Advisory Radio (HAR)

There were 12 Highway Advisory Radio installations across the region during the Games. Figure 3.8 presents a list of locations at the beginning of the Games (a few units were moved during the Games). As is true of all HAR systems, the geographic coverage area of each HAR unit's transmission signal was limited. When any HAR unit was transmitting a message, roadside signs within the radio coverage area would flash, indicating that motorists should tune their radio to a specific frequency for important traffic information.

Figure 3.8 Location of Highway Advisory Radio Units

Unit #	Location
1	I-15 – University Avenue, Provo
2	I-15 – Point of the Mountain
3	I-215 – East Knudsen Corner
4	I-80 – Kimball Junction
5	I-84/US-89 – Ogden
6	I-84/I-80 – Echo Junction
7	I-80 – Lakepoint (near Toole)
8	I-15 – Salt Lake City Downtown
9	I-15 – Centerville
10	I-84 – Mountain Green
11	I-80 – Wendover Port of Entry
12	I-15 – Perry Port of Entry (Idaho Stateline)

All of the HAR units were controlled via a wireless telephone. Hence, changes to HAR messages could be made from any location, but this task was performed mainly from the TOC Control Room and Room 125 during the Games. However, the system for monitoring and updating HAR messages was "stand-alone," that is, entirely separate from the ATMS and other computer systems in the TOC.

As discussed in section 4.4.2, the HAR units were also used during the Games for traveler information. Although the Study Team did not analyze the data that was collected by UDOT regarding HAR messages that were broadcast during the Games, it was clear that the HAR were used ***far*** more heavily for traveler information than for traffic management.

Prior to the Games, a number of HAR messages were recorded and stored in each HAR unit, to be used at pre-specified times during specific days of the Games, primarily to direct motorists to parking at nearby venues. There were also a number of real-time changes to these messages, in response to unexpected events, such as the loading/filling patterns of the venue parking lots.

Assessment of HAR for Traffic Management

For the most part, the HAR units performed their mission effectively and were considered an important tool by UDOT staff, although they encountered several problems because of the unique demands of the Games. These included:

Message Updating – A significant upgrade to HAR system was installed shortly before Games began, including new signs plus new software for updating messages. Some difficulties were encountered in learning to use the new system to change the message content because the operator interface was cumbersome and unforgiving. On several occasions this caused partial or incorrect messages to be transmitted for a period of time.

Wireless-Phone Batteries – Some HAR units were accessed via wireless phones, and the phone at those HAR units was powered by a battery that was recharged by solar panels. There were some instances when the batteries discharged and the HAR unit could not be accessed for a time. UDOT staff offered two explanations for this: (1) The HAR messages were changed much more frequently during the Games than normally, and because difficulty in changing messages resulted in increased air time on the wireless phones. (2) The HAR units were transmitting 24 hours per day, and when the batteries discharged, pre-programmed messages were lost.

Wireless-Phone Traffic – There were a few situations during the Games when the heavier-than-normal cell-phone traffic in the area of a HAR unit prevented it from being updated promptly.

Overlapping Broadcast Areas – Because the permanent and portable HAR units were deployed more densely and used much more intensely during the Games, UDOT staff noted a few situations when broadcast messages from two HAR units overlapped and made it difficult to understand either one.

The only recorded instance when a HAR unit encountered problems that ***may*** have generated public notice was at Snowbasin on February 10 when the batteries on a HAR unit discharged and the HAR unit could not be accessed for a time. The HAR unit on the highway approaching the venue was transmitting a message instructing motorists to continue to the parking lot at the venue, and that lot was full. TOC staff learned from venue observers at the lot that it was full. They then attempted to change the HAR message to instruct motorists to use a nearby park-and-ride lot and take the shuttle bus to the venue. However, they were not able to establish a wireless telephone connection with the HAR unit. Hence, the old message continued and motorists continued driving to the venue, contributing to the traffic jam that caught the attention of the media and SLOC management. It must be noted, however, that there were also non-technical circumstances that contributed strongly to this traffic jam). In subsequent days, UDOT assigned specific personnel to stand by at critical HAR units. If a cell-phone connection could not be made, they would manually change the message. Thus, this incident involved use of the HAR for both traveler information and traffic management.

3.1.8 Roadway Weather Information Systems (RWIS)

There were 30 roadway-weather information stations connected to the TOC. Some of these were connected via dial-up telephone "land-lines" and some were accessed via wireless dial-up phone lines.

Assessment of RWIS

The only problem noted with RWIS during the Games was a situation when the heavier-than-normal cell-phone traffic in the vicinity of a RWIS unit in the very remote Trapper's Loop area prevented it from transmitting its data via wireless telephone to the TOC. The problem was diagnosed and solved by TOC staff as resulting from the fact that the RWIS unit contained an ***analog*** modem, which required much greater bandwidth than a digital modem. The wireless cell tower service to this RWIS station was able to handle either one analog call or eight digital calls at a time. If one or more digital calls were in progress, then an analog call could not be completed. During the Games, the much-greater digital cell-phone traffic effectively blocked the RWIS unit from transmitting its data to the TOC. UDOT staff solved the problem by replacing the analog modem in that RWIS unit with a digital (CDPD) modem. Other than this one instance, which was very unique to the Games period, the RWIS system performed reliably.

3.1.9 Traffic Signal Integration with TRAX

A new light-rail system recently became a part of the transportation system in Salt Lake City. It consists of two lines. The 15-mile, north/south "Sandy/Salt Lake Line" became operational in December 1999 and the 2.5-mile, east/west "University Line" began operating in January 2002. These lines are shown in Figure 3.9, and a TRAX vehicle is shown in Figure 3.10. During the Games, there were several changes to the normal configuration.

(1) The Sandy Line was terminated at the northern end at Courthouse station.
(2) UTA vehicles were supplemented by LRT vehicles on loan from Dallas Area Rapid Transit.

The TRAX vehicles operate in a separate right-of-way (except for cross streets) on the Sandy route south of 700 South. Elsewhere, the trains operate within the roadway. Much of this is in a barrier-separated configuration in the median of the roadway, but some portions of these segments share the roadway with automobile traffic. This often occurs at left-turn pockets.

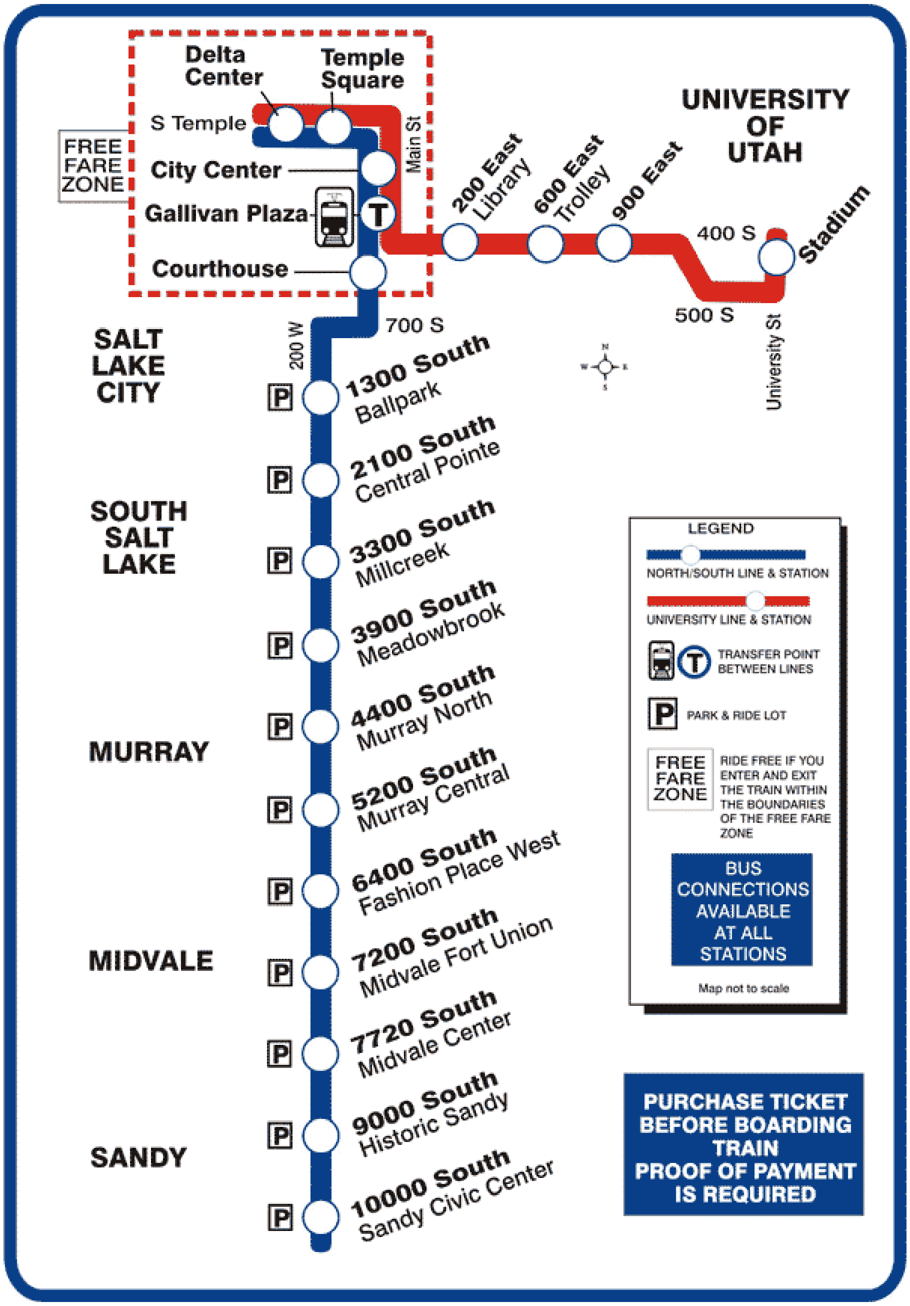


Figure 3.9 TRAX Route Map

Figure 3.10 Picture of TRAX Vehicle

Interconnection of the TRAX system to the traffic signal control system was an important element of the LRT design and installation. The interconnection was designed to provide preferential treatment to TRAX vehicles in two ways:
(1) Signal ***preemption*** at a few locations, where it was essential that TRAX receive preferential treatment for safety reasons.
(2) Signal ***priority request*** at all other locations where TRAX operates within the street right-of-way – where traffic and transit demands must be balanced.

Signal ***preemption*** occurred, for example, at the intersection of Main and 700 South, where the TRAX line makes a 90-degree turn. In this case, ***all*** signal indications at that intersection are turned red until the train clears the intersection. Also, in the southern portion of the Sandy Line where TRAX operates on separate right-of-way, signal preemption also occurred whenever the TRAX line crossed streets at grade.

Signal ***priority requests*** occurred, in contrast, along much of the University Line, which operates in the median of a busy roadway with a number of high-volume cross-streets. The design of this interconnection can be described as a "tiered/decentralized" operation. When the TRAX train is in a separate right-of-way, sensors under the pavement detect the LRT vehicle as it passes over them. In the few instances when automobiles share the right-of-way with the TRAX train, the sensor also utilizes an automatic vehicle identification (AVI) system to separate TRAX vehicles from autos. As the train moves down the street, it is sensed at each detector station. That detector station then sends this information to the TOC, which acts strictly as a clearinghouse and forwards this information to the traffic-signal controllers at several downstream intersections. The controller at the nearest intersection then responds by aggressively changing the prevailing timing pattern to clear the cross-traffic as soon as possible (considering the cross-traffic demands), attempting to turn the signal green for the TRAX train (and the parallel mainline traffic) at its expected arrival time. The controller at the second intersection downstream responds similarly, but less aggressively, to prepare the intersection for the oncoming train. Depending upon distance, intersections further downstream may also begin to prepare for the train arrival, but much less aggressively because of the longer lead times. Note again that the TOC did not perform any ***control*** functions in this operation; its function was strictly as a ***communications hub*** – to pass information between the detectors and the downstream signal controllers.

Assessment of Traffic Signal Integration with TRAX:
Because of the complexity of assessing signal-control operations, there was no structured data collection to assess this interconnection. The findings below are based primarily upon interviews with UTA staff and consultants, supplemented by a few field observations.

The UTA staff and consultants reported that the TRAX/traffic-signal integration worked well overall. There were no reported problems with the equipment or communications lines. One small and unavoidable problem was described by UTA staff. During the entire Games, a portion of the downtown area was defined as a secure area with a perimeter fence. Consequently, TRAX trains could not operate north of the Courthouse station, except for approximately 1000 feet of track that was used as a turnaround and layover point for train sets. This required that some trains cross over to the opposite track for a short distance at the end of their northbound run. When doing so, they triggered the detector station for the traffic signal at 400 South, which assumed that the train was ***approaching*** the intersection – when it was in fact moving away from the intersection. This was not a practical problem, however, because that traffic signal was heavily saturated with automobile and pedestrian demand on all approaches, so the signal priority-control logic had little effect upon the actual timing patterns used. Nonetheless, it did illustrate a lesson for similar situations in the future. The special operating configuration required for the Games had unintended consequences for the traffic signal priority-control system.

The Study Team did perform some “anecdotal” observations at several intersections, and observed one additional situation that was worth noting. Along the Sandy Line south of 700 South, the train operates on an entirely separate right of way that crosses streets at grade. In this segment, the train detectors were connected to the traffic signals so as to ***preempt*** the normal displays and display a red signal to all cross traffic. This is necessary, of course, for safety reasons. There were a number of TRAX stations that were located close to the cross street (e.g. at 9000 South), and the Study Team observed that the train detectors would trigger the signal preemption logic while the train was stopped in the station for loading and unloading. This would normally have limited impact upon cross traffic, because the dwell time in the station was relatively short – on the order of a minute or so, even with heavy passenger loads.

However, there was one instance during the Games when a train was stalled in such a station for an extended period because of a power-supply problem. This caused the nearby downstream traffic signal to be preempted for an extended period of time, which caused very extensive queuing on that cross street. In followup interviews with UDOT and UTA staff, there were different opinions expressed about how the signal-preemption logic was supposed to handle this type of situation, and they indicated that question will be examined further.

Once again, these two situations were highly unusual and ***not*** typical. For the overwhelming majority of time during the Games, the TRAX system operated reliably and the signal-preemption and priority-control system appeared to operate flawlessly.

Shortly before the Games, the UTA also began operating a new and innovative ITS service, called "Connection Protection," which assures timed-transfers from TRAX to 17 long-headway, local bus routes. The initial deployment covered 17 bus routes. This new Advanced Public Transit System (APTS) service was not examined in this ATMS/ATIS study because it was outside of the scope of investigation, but it is examined in detail in the Olympics APTS evaluation study conducted for UTA (Ref. 1). Readers desiring a complete picture of all ITS elements used during the Games (ATMS, ATIS and APTS) are encouraged to peruse that study of advanced public transit systems operating during the Games.

3.1.10 Other ATMS Elements

There were other elements that were not a part of the ATMS in an ITS Architectural sense, but played very important roles in traffic management during the Games. These traffic-management elements included:

- Incident Management Teams – UDOT's incident management team normally provides two services: 1) patrolling the freeway to assist motorists, and 2) managing traffic incidents. During the Games, the IMT staff was assigned to manage traffic incidents only. Motorist assists were handled by a specially created "Service Patrol." In the fall of 2001, UDOT's IMT staff was increased from four to eleven. The eleven UDOT IMT staff members were supplemented by four Incident Management Specialists from Tennessee DOT, and four from Washington State DOT. These nineteen specialists were assigned to work in two shifts, covering the period from 5:00 AM to 11:00 PM, seven days a week. Approximately eight to ten personnel were on duty at any one time; they were assigned to specific zones, based on the event schedule for the day. In addition, Illinois DOT provided one heavy-duty tow truck with two operators, a mechanic and a supervisor. This crew was assigned to stand by at UDOT's Station 235 near the Utah Olympic Park, and was available to be called out to assist with clearing incidents. The out-of-state incident management personnel worked under the direction of the Supervisor of UDOT's Incident Management Team, and were dispatched by the Department of Public Safety Communication Bureau, using the customary Utah Highway Patrol frequency for each area.

- Freeway Service Patrol – In order to permit the Incident Management Team to concentrate on traffic incidents, UDOT created a "Service Patrol" to assume the normal duties of motorist assists ***during the Games***. The Service Patrol staff was drawn from UDOT office personnel who volunteered for this duty. A total of 34 separate zones were created; each zone consisted of a section of freeway or highway approximately ten miles in length, creating a twenty-mile "tour." The Service Patrol was assigned to work in two shifts. Thus there were two, and in many cases, three, people assigned to each route in order to provide coverage for seven days a week, 18 hours a day. Approximately 80 different UDOT staff served a Service Patrollers. The Service Patrol was dispatched from Console G of the TOC using special radio frequencies established for this purpose. The Service Patrol's primary duties were to provide motorist assists, although on some occasions, they were requested to assist IMT with incidents. As discussed later in this report, IMT and FSP also served an important ***surveillance*** function. See Figure 5.11 for a picture of an IMT unit assisting a motorist.

- Other UDOT Field Crews – In UDOT Regions One and Region Three, the existing Region Traffic Engineers were designated as the "Area Traffic Engineer." In Region Two, which is normally divided in to two areas (East and West) for traffic engineering administration, the location of the Olympic venues led UDOT to break the Region into three "areas" – Park City, downtown Salt Lake City, and west Salt Lake County). Thus, there were a total of five "Area Traffic Engineers". Each was assigned a deputy or assistant in order to cover two shifts, and each was assigned a crew of approximately ten "Traffic Observers." They spent most of their time in the field, identifying and resolving numerous localized traffic problems.

- Helicopter Observers – UDOT rented helicopter flight time (10 hours per day), which was used for traffic observations by a UDOT traffic engineer onboard. This observer reported via 2-way radio to the TOC, which directed this helicopter operation.

- 2-Way Radio System – An 800MHz radio system that featured theatre-wide coverage including hand held units was used, with 280 radios being leased. This included multiple channels of voice communications, which were used to communicate between the TOC and field personnel (on the ground and in a helicopter), as well as to monitor UHP radio communications.

Although these elements played an important and highly valuable role during the Games, no direct assessment of them is included in this study because they were not "ITS" elements within the ATMS deployment. However, the important roles they played in incident management and routine traffic management are described in subsequent sections.

Figure 3.11 IMT Unit

3.2 Organization for Traffic Management

Even in “normal” times, regional traffic control and transportation management requires a wide range of activities – generally including surveillance, decision-making, and response. During the Games, there were two additional major “layers” of activity required: management of traffic specifically related to the Olympics, and management of security related to the entire transportation system. To respond to these added requirements during the Games, staff and facilities within the TOC were organized in ways that are different compared to non-Games circumstances.

For transportation management during the Games, efforts were organized in three levels of decision-making, reflecting increasing levels of complexity and inter-agency coordination requirements. Each level of decision-making was focused upon one room in the TOC. Figure 3.12 shows the three rooms primarily involved, plus the general flow of information between them.

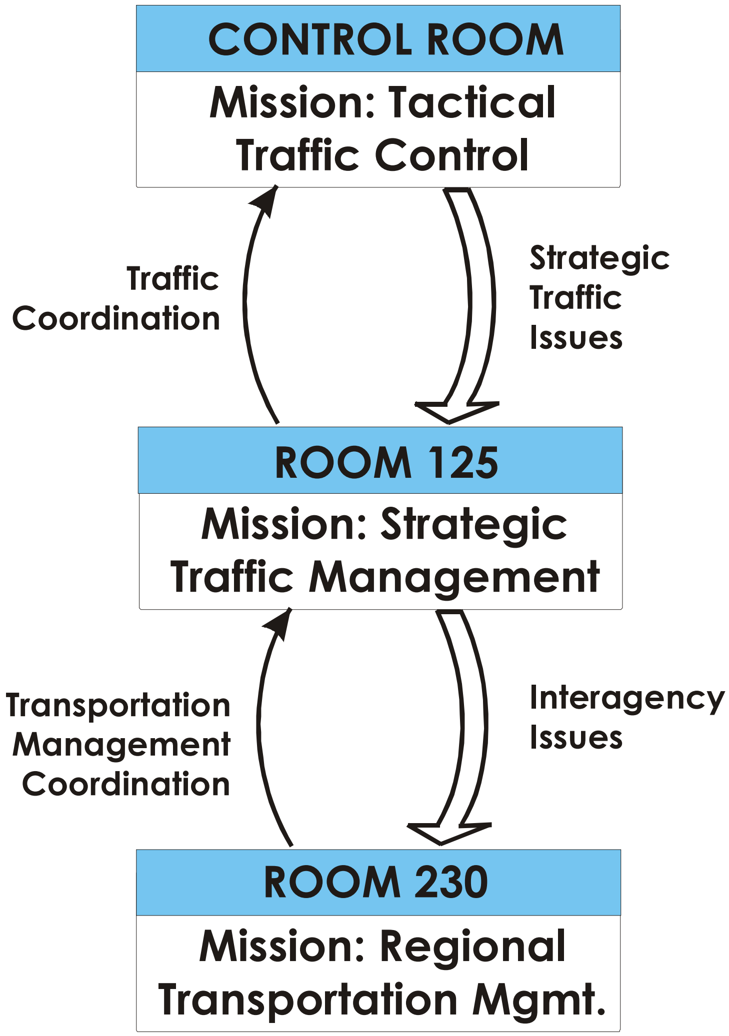


Figure 3.12 3-level Decision-Making Process in TOC

(Heavy arrows indicate heavy information flow)

In general terms, the division of responsibilities was ***generally*** as follows:

- The **Control Room** was responsible for ***tactical*** traffic control (e.g. responding to "minor" incidents)

- **Room 125** was responsible for ***strategic*** traffic management (e.g. preparing for motorcades)

- **Room 230** was responsible for ***regional*** transportation management (e.g. coordinating multi-modal and multi-agency actions)

This 3-level management process is explained with more detail in the next three sections, one level at a time.

3.2.1 Control Room

The control room included six “primary” workstations located on the first floor of the TOC, plus an array of three large wall-screens, capable of being subdivided so as to simultaneously project up to 24 different images. See Figure 3.13 for a picture of the wall screens and Figure 3.14 for a diagram identifying the purposes of the six workstations.

The control room operators were the “front-line troops” for traffic management, receiving surveillance information via a number of methods, including:

- Monitoring the CCTV images as they rotated through pre-established cycles, or viewing specific camera(s) as selected by an operator.
- Calls from travelers (usually via mobile phones), using the 887-3700 phone line.
- Messages from the UHP dispatcher, via the UHP CAD system screen at each workstation. (The UHP CAD system was not connected to the ATMS at the time of the Games.)
- Radio messages from the IMT and Service Patrols on the roadways, plus the UDOT observer in a helicopter.
- Radio and telephone messages from other UDOT staff in the field.
- Weather information and roadway conditions from several sources.

Figure 3.13 CCTV Display Wall in TOC

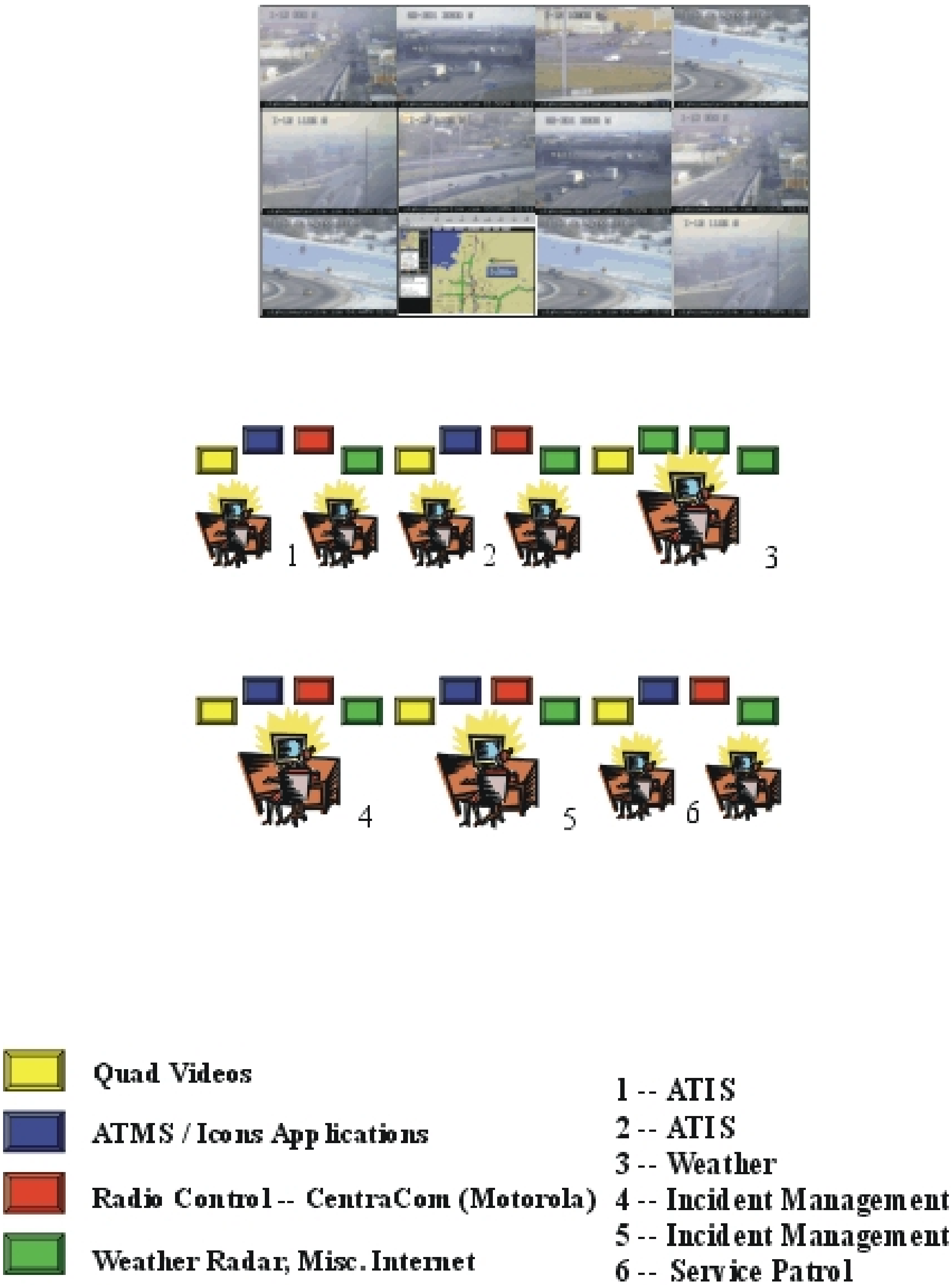


Figure 3.14 Functions of TOC Control Room Workstations

In general, the control room operators were responsible for handling minor incidents as well as minor, (non-incident) congestion (that is, traffic situations that did not require major traffic-management decisions or substantial interagency coordination). Most of the incidents that occurred during the Games fit into this category, and were handled entirely by the control room operators through a combination of:

- Dispatching of Service Patrol and coordination with those crews at the incident (dispatching of IMT and other UDOT maintenance personnel was done by the DPS Communications Bureau on the second floor of the TOC).
- Use of VMS, HAR, and CommuterLink Alert messages.
- Posting of incident information on the CommuterLink Website and 511 Telephone Service.
- Changes to traffic-signal timing.
- Creation of routine incident messages that were sent to the media.

Information Flow for the Control Room is characterized in Figure 3.15, which shows the ***primary*** information sources, plus the ***primary*** recipients of information resulting from the actions executed by the Control Room operators and computer systems. It must be stressed that this diagram does not show all of the many information flows that took place during the Games – only those that occurred with high frequency, based upon the Study Team observations and followup interviews with UDOT staff.

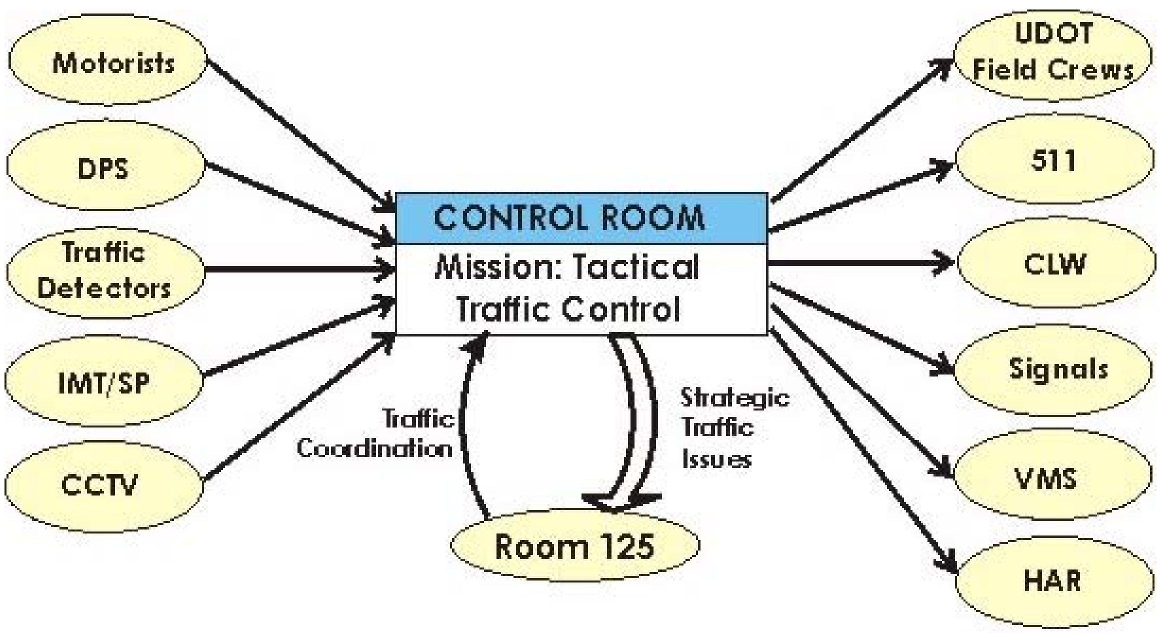


Figure 3.15 Information Flow Diagram for Control Room

(Heavy arrows indicate heavy information flow)

For situations (either incidents or non-incident congestion) that ***did*** require strategic traffic-management decisions or substantial inter-agency coordination (including all public-safety issues), the control-room operators also notified Room 125 immediately upon recognizing that it was not a "minor" problem.

3.2.2 Room 125

Room 125 was immediately adjacent to the Control Room. Although some "communications" with the control room operators took place by electronic means or by walking through a door, the primary means was the telephone, in order to maintain an orderly working environment. The room was equipped with a number of computers, three multi-line phones, a "Smart Board" and a multi-channel, 2-way radio. Room 125 also had a full-featured ATMS console, enabling staff to control CCTV, VMS, and traffic signals. (See Figure 3.16 for a picture of the main console in Room 125.)

Figure 3.16 Workstation in Room 125

The staff in room 125 consisted primarily of traffic engineers, whose responsibility was strategic in nature. They monitored ongoing operations and responded to incidents or other situations that required significant traffic-management decisions or substantial interagency coordination. These individuals had access to all of the information sources available to the control room operators, although they did not monitor these sources on a continuous basis except when needed. A few examples of their (many) activities were:

- Preparing for and monitoring VIP motorcades, generally between the airport and the Stadium area. These took place when the President attended opening ceremonies and when the Vice-President attended the closing ceremonies, and were closely coordinated with the Secret Service. (These types of activities are discussed further in Section 3.2.1, Incident Management.)

- Defining messages for the appropriate VMS and HAR locations, to direct motorists to park-and-ride lots and venues. There was an extensive set of predetermined VMS and HAR messages that were posted in planned patterns or "Event Plans", in conjunction with each event. However, real-time modifications were frequently needed whenever the park-and-ride lot loading patterns deviated significantly from expectations or when other unforeseen situations arose. The posting of these messages would generally be done by Control Room Operators. (This situation is discussed in detail in section 3.3.3 - Multi-Modal Management.)

- Coordinating closely with the Area Traffic Engineers (ATE's), who were generally on-site at key locations in their area of responsibility. Although the ATE's were authorized to make tactical decisions in response to traffic problems, they sometimes sought additional information that was available at the TOC (e.g. traffic information from CCTVs). Room 125 also collaborated with the ATE's on responses to more complex or strategic problems that required broader awareness of the situation. (This is discussed more fully in Section 3.3.2, Traffic Management.)

Information Flow for Room 125 is characterized in Figure 3.17, which shows the ***primary*** information sources, plus the ***primary*** recipients of information resulting from actions taken by the UDOT Traffic Engineers in Room 125.

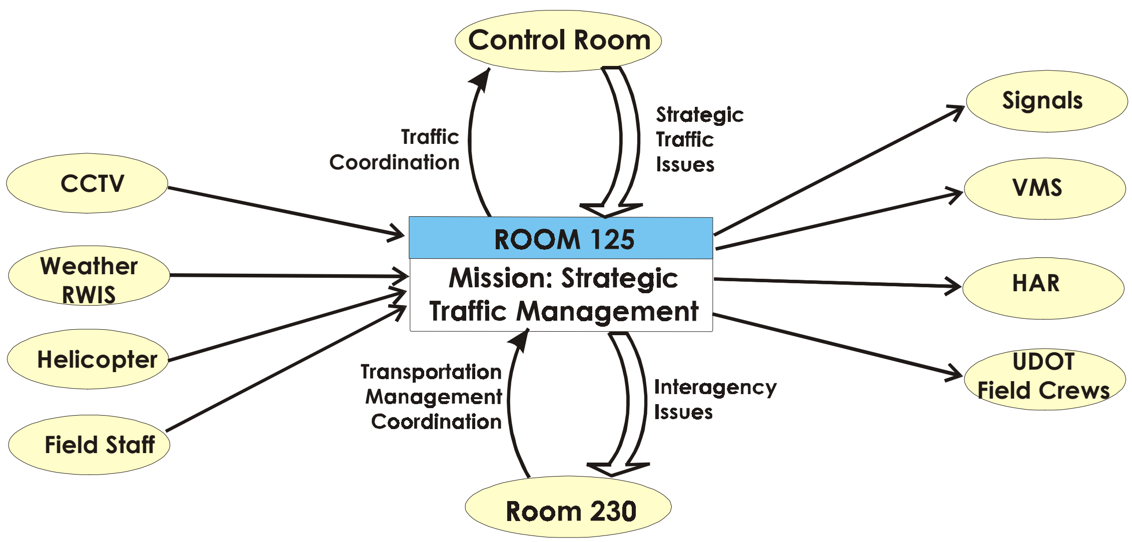


Figure 3.17 Information Flow Diagram for Room 125
(Heavy arrows indicate heavy information flow)

In addition, Room 125 staff coordinated with Room 230 on matters that required significant coordination with other agencies. This communication was initiated by Room 125 if a "routine" traffic situation escalated to one that required interagency coordination, or the communication was initiated by room 230 if they learned first of a situation that would require significant traffic-management intervention.

3.2.3 Room 230

Room 230 is on the second floor of the TOC, and one wall of this room was glass to allow viewing of the large display screens in the Control Room. Room 230 was generally staffed 14-16 hours each day with representatives of the following external agencies and internal divisions of UDOT:

- UDOT Management
- UDOT Region-2 Roadway Maintenance
- UDOT Community Affairs
- Utah Transit Authority (UTA)
- UDOT ITS Director
- UDOT Region 1 Liaison
- UDOT Region 3 Liaison
- FHWA
- SLOC
- Support staff (to maintain databases, obtain supplies, deliver packages, etc.)

These personnel generally worked in two shifts each day. At any given time there were typically 12-16 of the above representatives in the room, plus a few outside observers. These representatives were arranged around one large rectangular table (see Figure 3.18 for a picture).

Figure 3.18 Room 230 in Action

Each person had a multi-line telephone plus a laptop computer networked to allow access to the media version of the CommuterLink website plus the Internet. In addition to a number of maps posted on the walls, there was also a 3'x4' moveable computer-display screen ("Smart Board") that was used for a variety of purposes (discussed later). See Figure 3.19 for a picture of moveable display board. There were also two conventional television sets for monitoring commercial broadcast channels.

Figure 3.19 Display Board in Room 230

The normal activities in Room 230 centered around managing and tracking of "issues" as they arose. These issues varied widely in importance, but most of them had the *potential* to become significant. Some examples of these issues were:

- A major freeway incident that affected traffic near a venue
- A collision between a private auto and a TRAX train
- A suspicious package at a signalized intersection
- An abandoned car under a bridge on the freeway right-of-way
- Deteriorating pavement in a temporary park-and-ride lot, reducing its capacity
- Power outages affecting traffic signals or systems
- The President's motorcade
- A protest activity that was obstructing traffic

Information Flow for Room 230 is characterized in Figure 3.20, which shows the ***primary*** information sources, plus the ***primary*** recipients of information resulting from actions taken by the multi-agency staff in Room 230.

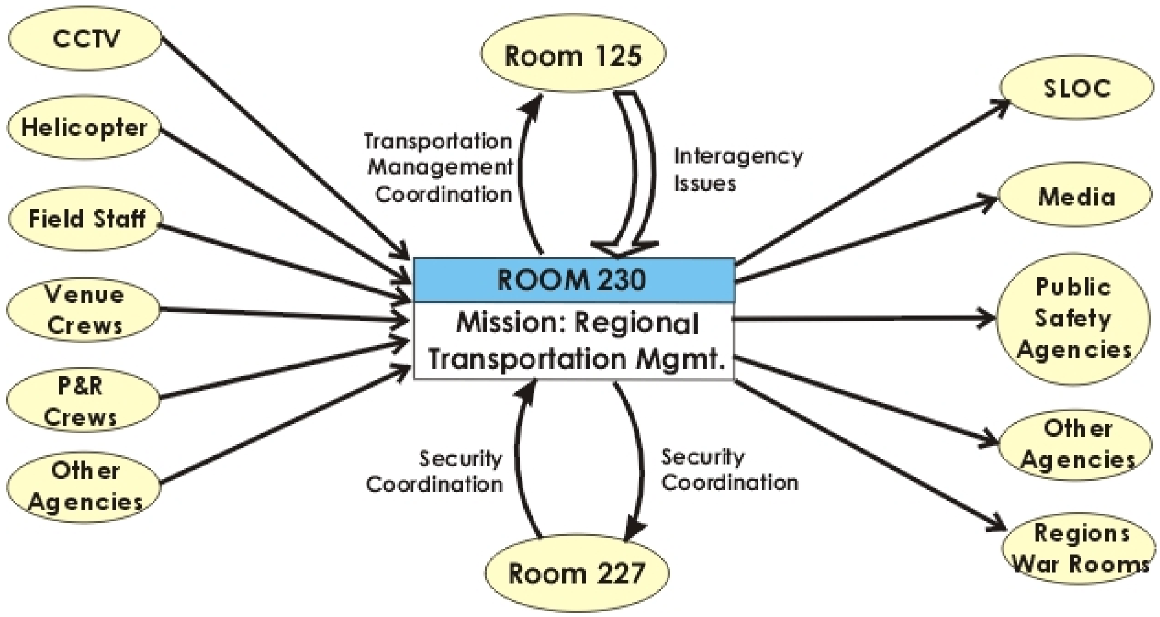


Figure 3.20 Information Flow Diagram for Room 230
(Heavy arrows indicate heavy information flow)

The general procedure utilized in Room 230 typically included most or all of the following steps:

1. Information identifying the situation was received from the TOC Control Room, or Room 125, or from any of a variety of external sources.

2. A brief description was entered into an "Issues" database, which was a Microsoft Access database, shared and displayed on the Smart Board in Room 230 and also in Room 125.

3. If the issue required interagency coordination (most did), a discussion took place among some or all of the people around the table. During these deliberations, the Room 230 staff often obtained further information from any of a variety of additional sources, for example:
   - by looking through the glass wall to view the display screens on the Control Room wall
   - by looking at video on the Smartboard inside the room
   - via their laptop computers that were networked to the ATMS and CommuterLink Website
   - from hard-copy reference materials and documents, and/or
   - by contacting somebody outside the TOC via phone or 2-way radio.

4. A response strategy was then developed by consensus of the participating group.

5. The relevant individuals then took the necessary actions, which often included contacting another party in their agency or another agency, either in the TOC or

elsewhere, to either obtain further information, or to initiate remedial or preventative action, or to have them stand ready to take action.

6. As the situation unfolded, any significant changes in status were recorded in the Issues database and, if needed, additional decisions were made and actions undertaken.

7. When the issue was resolved, it was declared closed and an entry was made in the database noting when and how it was resolved.

This general process was used for multiple purposes. Three common purposes were: (1) incident management, (2) routine traffic management, and (3) multi-modal management. These are discussed further in Section 3.3 below.

3.2.4 Other Traffic-Management Activities in the TOC

Public safety and security was a major concern during the Games, and there were several command centers around the Salt Lake City metro area that monitored and managed issues related to public safety. The most notable activity was tracking athlete vehicles using an AVL locating system. For Public Safety issues involving transportation in some way, there was a command center located in Room 227 – immediately adjacent to Room 230 – that was staffed with public-safety specialists. This room also had a direct view of the large wall displays in the Control Room, plus equipment similar to that in Room 230. One key difference is that Room 227 contained an ATMS workstation that enabled direct control of any CCTV camera connected to the ATMS. For issues that involved public safety or security, the staff in Room 230 communicated directly with Room 227, usually by walking next door.

3.2.5 Summary of Organization for Traffic Management

In summary, the basic decision-making structure in the TOC included three hierarchical levels:

1. Tactical or routine traffic management (Control Room)
2. Strategic transportation management (Room 125)
3. Multi-modal management and interagency coordination (Room 230)

plus occasional contact with the law-enforcement officials in Room 227. In subsequent discussions, we will refer to this as the “3+ Decision-Making Paradigm” or the “3+ Structure” for short. It was the fundamental organizational structure for transportation management actions during the Games. This overall management structure is shown in Figure 3. 21.

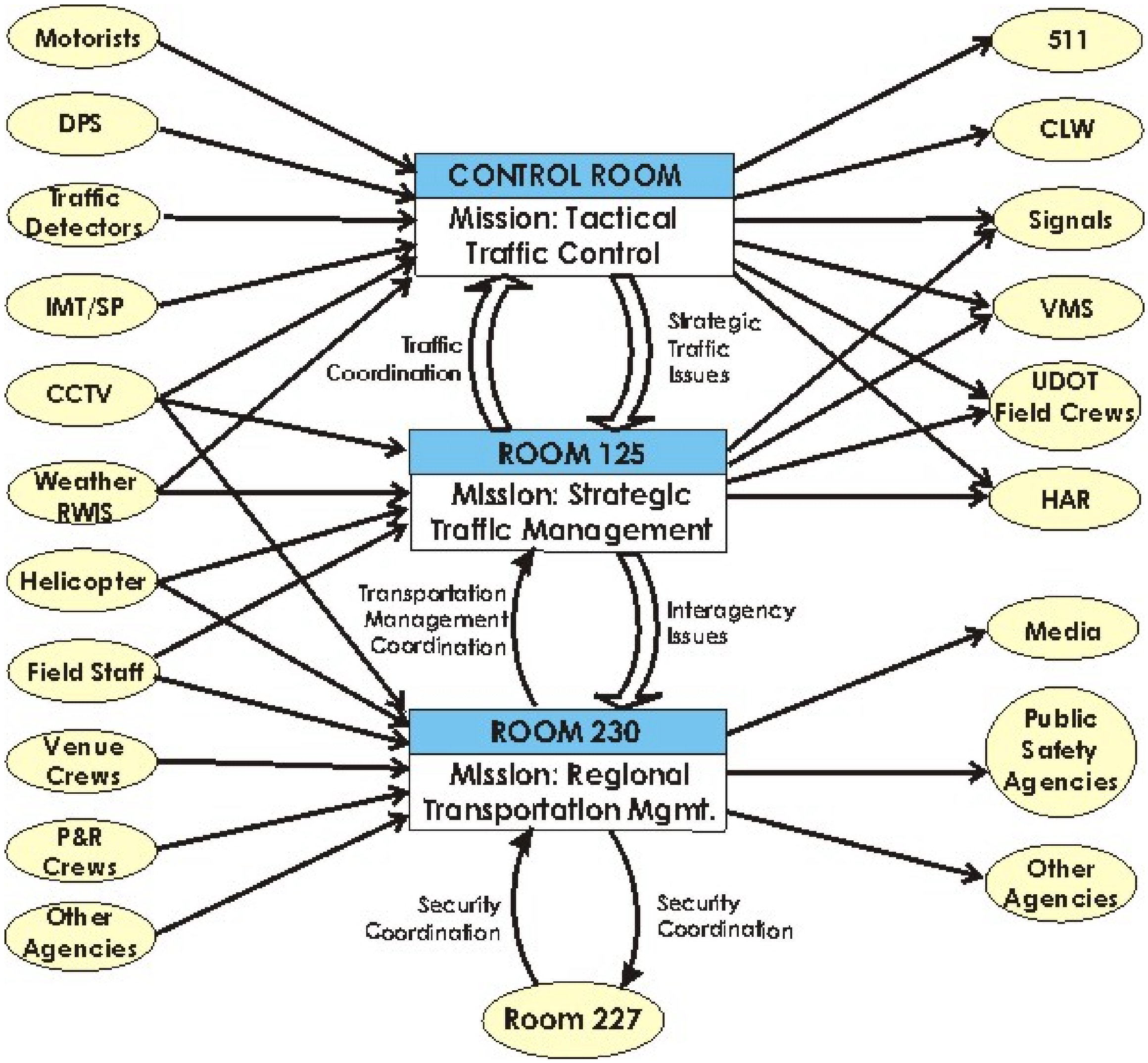


Figure 3. 21 Information Flow Diagram for Three Levels
(Heavy arrows indicate heavy information flow)

The next section describes how the "3+ Structure" actually operated when executing three frequently-recurring types of transportation management actions.

3.3 Transportation Management Actions

Having described (above) the "3+" organizational structure for transportation management, the next questions to examine are:

- **How was this organizational arrangement used for transportation management?** and
- **How well did the ATMS support these activities?**

We will answer these questions by discussing the three most common types of transportation-management activities during the Games:

(1) incident management,
(2) routine (non-incident) traffic management, and
(3) multi-modal management.

Concluding this section, we will discuss some additional aspects of the performance of the ATMS during these actions.

3.3.1 Incident Management

During the Games, the term "incident" took on many new meanings in addition to the traditional ones. As related to traffic, for example, there were "planned" incidents, such as the motorcades for the President and Vice-President, and there were "unplanned" incidents, such as vehicle collisions on the freeways. Aside from traffic-related incidents, there were also safety-related incidents, such as abandoned vehicles on the freeway and suspicious packages on/near major roadways. Although these situations would be of little or no consequence in prior times, they were treated as potential threats to safety during the Games. Our discussion of "Incident Management" encompasses all of these situations during the Games.

In general, incident management actions included three steps: surveillance, decision-making, and response execution. These three steps are discussed next.

3.3.1.1 Surveillance for Incident Management

In this context, "surveillance" is defined broadly to include all forms of information gathering. As mentioned above, the Control Room Operators were the "front-line troops" for incident management and were usually the first of the three levels to become aware of an incident. They received surveillance information about incidents via a number of methods, including:

- <u>Monitoring CCTV images</u> – Most of the wall screens were programmed to automatically rotate through a pre-established pattern of camera locations, generally moving sequentially along a freeway and holding each image for several seconds. Operators could also select one camera for continuous viewing, either on one wall screen or on their workstation monitor. Some incidents were detected initially by the operator seeing the problem on the screen, usually as a result of noting heavy queuing on the freeway when/where it does not occur normally.

- <u>Calls from the public</u> – As mobile phones become more ubiquitous, motorists have played an increasing role in traffic surveillance. When a motorist dialed the *11 or 887-3700 number, the phone would usually be answered by one of the Control Room Operators. In most cases, the operator would then select and move one of the CCTV cameras to *verify* the incident.

- Messages from the UHP dispatcher – The UHP dispatchers (Department of Public Safety Communications Bureau) are located in a room on the second floor of the TOC, overlooking the Control Room. There are six dispatcher positions, plus a training console that was used during the Games. The DPS Communication Bureau is a secondary 911 Pubic Safety Answering Point (911 calls are first received by the primary PSAP and forwarded to DPS if necessary). UHP dispatchers received 911 and *11 calls from motorists or other travelers. As part of the UHP dispatching process, they would enter descriptive data into their Computer-Aided Dispatch (CAD) system. At the time of the Games, the UHP CAD system was not connected electronically to the ATMS. However, at each Control Room Operator's workstation, one of the several monitors was connected to the CAD system and was able to display the incident information immediately after the UHP CAD operator entered it. The Operators also had access to information from other emergency-services agencies in the region, by monitoring their 2-way radio transmissions.

- Radio messages from UDOT field units – The Incident Management Team and the Service Patrols spent the bulk of their time on the freeways. When they encountered an incident, they would communicate the information using the 800 Mhz radios or cell phones to the Control Room Operator or the "War Rooms" located in the offices of Regions 1 and 3 (which are not in the TOC). There were many other UDOT staff deployed on the roadways for other purposes, especially during the Games, and they also served a surveillance function.

- Weather and roadway conditions – Bad weather can itself be an incident – especially when it causes slippery pavement conditions – so the Control Room Operators monitored the weather via a screen on their workstation (or on the display wall) that displayed a variety of weather maps and other weather-related information.

- Other sources – Another ***potential*** means of identifying the presence of an incident is the incident-detection algorithms that are part of the Navigator software. However, UDOT staff reported that the time required to process the detector data and identify an incident reliably was substantially longer than the average time to identify an incident using other means (especially cell-phone calls from motorists).

Via these information sources, the control-room operators were usually the first (among the three levels) to detect and verify an incident. Please note that, with only a few exceptions, these surveillance methods were essentially the same during the Games as in normal operations. One of those exceptions was the surveillance information from the helicopter that UDOT rented during the Games for 10 hours per day.

<u>Assessment of Surveillance for Incidents:</u>
The surveillance function was delegated primarily to the Control Room Operators. Although empirical data was not collected, TOC observations by the Study Team suggested that a very small percentage of incidents were first detected by Room 125 or 230. This generally occurred when a report was received from staff in the field (e.g. on the roadways, at venues, at park-and-ride lots, or in the helicopter). Thus, most incidents were detected and verified by the Control Room Operators.

Undoubtedly, the most important surveillance element for incident management was CCTV. This included the 218 cameras located strategically across the Salt Lake City area, plus the multi-screen display wall in the TOC that was visible to all staff in the Control Room, plus rooms 125, 230, and 227. CCTV images could also be viewed at any workstations in the TOC, at the TCCs, and at other sites. These images could also be viewed – with full-motion video – by several local media outlets via a high-speed communications link to their studios. (There were some situations where the images to the media were blocked.) Static snapshots of the CCTV images could also be viewed worldwide through the CommuterLink Website by anybody with access to the Internet. The coverage of the CCTV cameras was so broad that almost all incidents could be viewed using one or more cameras. Thus, it can be said that what the incident-managers (and the world) saw about traffic during the Games was largely through the "eyes" of the CCTV system.

As discussed in Section 3.1.5, the CCTV system performed all of its intended functions reliably, with only a few exceptions. Thus, it was clearly the *primary* surveillance tool for incident management. Upon learning of an incident, the first step for staff for *all staff* in the TOC was to look for a CCTV image of that incident. They would find this image using any of the following means:

- the large display wall in the control room,
- workstation displays in any of the TOC rooms,
- display boards in each room,
- their own computer screens (via the CommuterLink Website media channel).

Thus, it can safely be said that the CCTV system was clearly the dominant surveillance tool and the foundation for incident management. Information was also sought and received from the other sources – motorist calls, UHP CAD messages, UDOT field units, weather services, etc. However, the old adage proved to remain true in the current ITS age: "One picture is worth a thousand words."

3.3.1.2 Decision-Making for Incident Management

In general, the control room operators were responsible for handling minor traffic incidents and minor non-incident congestion, that is, traffic situations that did not require strategic traffic-management decisions or substantial interagency coordination. Most of the incidents that occurred during the Games fit into this category, and were handled entirely by the control room operators. They did so by assessing the situation and deciding upon a "response plan." The ATMS software contained several-hundred of these response plans, which were pre-defined by UDOT staff prior to the Olympics based upon the type, severity, and location of the potential incident. The ATMS computer did not automatically display the response plan for the current incident; the operator had to request the computer to do so. In most cases, the operators were sufficiently experienced that they identified the appropriate response plan immediately, without requesting it.

Assessment of Decision-Making for Incident Management:
The decision-making methods used for incident management during the Games were similar to those in normal times – except for a "security overlay" that required attention always being paid to potential safety/security concerns. Although it was almost invisible during the Games, the security overlay included extensive and comprehensive planning for a wide range of hypothetical "incident" situations that went far beyond normal traffic collisions, plus "desktop exercises" to test those plans and rehearse their use. Fortunately, these plans and preparations were not put to the test.

Observations by the Study Team in the TOC indicated that this 3+ strategy for decision-making appeared to be an effective means of organizing for incident management during the Games. During the first few days, there were a number of incidents where the responsibility for leadership in decision-making was not entirely clear, and two of the three "levels" initially assumed the lead role. However, after the third or fourth day, these "gray areas" were clarified and there was very little overlap observed for the remainder of the Games.

3.3.1.4 Response for Incident Management

As said above, the response to each incident was executed by one or more of the three levels in the TOC. In general, the response by the TOC Operators included the following actions:

- Notify the "responders" – This included any of the field units (UHP, IMT, paramedics, etc.).
- Distribute information – Likely including "broadcast" messages (e.g. CLW Alerts), or "targeted" techniques (e.g. VMS and HAR messages).
- Monitor the situation – Track progress until it is cleared, often using CCTV plus 2-way radio to communicate with IMT and UHP units on the scene.

Once again, response by Control Room Operators to incidents were generally similar during the games versus normal operations, except for a few additional concerns:

1. Security issues – two common situations were suspicious packages and abandoned vehicles.
2. Special routes – situations affecting routes used by athlete's vans were handled differently.
3. Complex situations – this would include notifying Room 125 and/or 230, as discussed next.

If strategic traffic-management decisions appeared to be needed, the control room operator would notify Room 125 before selecting or executing a response. Similarly, if the participation of other agencies were required (e.g., SLOC, UTA, UOPSC, etc.), the operator would notify either Room 125 or Room 230 directly. Often the multi-agency responses also required strategic traffic management actions. In that case, both rooms would be notified.

In the initial few days of the Games, many more incidents were escalated to Room 125 and/or 230, where they were entered into the Issues database and followed carefully by the staff in the room(s). During these initial days – especially if the incident had security implications or media attraction – the staff would proactively swing into action to gather related information, notify their agency colleagues, and discuss the situation with others in the room (especially in Room 230). Toward the end of the Games, the staff members in Room 230 were less animated because they had learned to discriminate between situations that required proactive response and those that could be handled with a normal response plus "watching and waiting." This is evidenced by the count of the number of items in the Issues database, which began at over 70 entries on the first day of the Games and declined to two on the next to last day.

To illustrate how the incident-management approach was used in the unique context of the Games, the following vignettes describe actual events.

- Freeway Crash, Day 1 – A moderate snowstorm passed through Salt Lake City on the morning of Day 1, making the roads slippery and resulting in a number of collisions on the freeway. One such crash occurred on the freeway adjacent to the E-Center, a major Games venue. One of the vehicles involved left the roadway and crashed through the chain-link fence surrounding the E-Center's large parking lot. There were injuries, but none looked to be serious. To all appearances, this was just another incident among many that day. The Control Room Operators followed standard response procedures, which included issuing an Alert. The message in the Alert described that the vehicle breached the fence, and also mentioned that the fence was the "security perimeter" for the venue. When reading the message, an anxious media immediately assumed the worst – the security perimeter of a venue has been breached – and they inundated the TOC with phone calls seeking further information. Room 230 sprang into action to issue clarifications, and the issue quickly subsided. There was a brief discussion about possibly discontinuing the Alerts, but UDOT management decided that their value for traveler information justified the extra effort required to avoid misperceptions by the media.

- Presidential Motorcade – The President attended the Opening Ceremonies, arriving at SLC Airport around Noon on the first day of the Games and traveling via motorcade to the University of Utah area, near where the Opening Ceremonies took place at Rice-Eccles Stadium. For security purposes the exact arrival time and travel route were not disclosed to TOC staff until roughly one hour before the motorcade began. Plans were previously made by TOC staff to accommodate the several likely routes. Thus, to some extent, this was a "planned" incident, for which the incident-management actions included:

- o Law-enforcement officers closed all cross streets and freeways along the route as the motorcade passed.
- o TOC Control Room operators set traffic signals along the route to green indications, whenever possible.
- o Room 125 staff posted VMS signs to warn motorists of road closures ahead.
- o TOC staff (at all three levels plus Room 227) tracked the motorcade using CCTV.
- o TOC staff blocking those specific camera images from the media.

Although there was a small "glitch" with the camera-control software earlier that morning, everything was in order at the time of the motorcade and it proceeded as planned. Similar actions were executed for the President's return to the airport, as well as for the Vice-President's trip from and back to the airport, when he attended the Closing Ceremonies. All went as planned.

- <u>Suspicious Truck Stopped on Freeway</u> – Early in the Games, a semi-trailer truck was stopped on I-15 freeway, just south of downtown Salt Lake City. Because the truck did not have the legally required markings and other reasons, the UHP considered the situation to be a potential safety threat. Additional law-enforcement resources were summoned to the scene. During this entire time, the staff in Room 230 monitored the situation closely, viewing it with a nearby CCTV camera as well as monitoring radio reports from the UHP officers at the scene. After almost an hour passed without a resolution, staff in Room 125 began preparing to invoke the contingency plan for closing the freeway in both directions. This Response Plan would have diverted all freeway traffic to parallel arterials, with the appropriate traffic-management actions (new signal timing on the surface streets, VMS messages on the freeway), plus traveler-information actions (issuing a CommuterLink Alert, media bulletin, etc.). Fortunately, it was soon determined that the cargo in the truck was benign and the "issue" was closed in Room 230.

<u>Assessment of Incident Management:</u>

The strategy and tactics for ***incident management*** during the Games were, for the most part, similar to those used in day-to-day traffic operations of the TOC. However, the key difference was the "security overlay" that often required that otherwise innocuous events be treated with a high degree of caution. Responses usually involved a great deal of extra effort by TOC staff at all of the 3+ levels, but few if any of these efforts were visible to the traveling public or the media.

Certainly, the most important ATMS tool for incident response was the CCTV system. This was noted by the Study Team observers in the TOC and corroborated by follow-up interviews with UDOT and UHP staff. The CCTV system was valuable for both traffic surveillance as well as security purposes, and the broad camera deployment was an important asset.

3.3.2 Traffic Management

Because several of the venues were quite large and had heavy attendance, there were high traffic volumes during the "loading" and "unloading" of these events. Most of the routine traffic management efforts were directed towards ensuring that traffic moving to and from these events was handled as efficiently as possible given the constraints of the existing roadway capacity.

Aside from the venue loading/unloading, there was much less traffic congestion than was expected. But there were a number of non-incident situations where traffic congestion occurred and the TOC staff took actions to reduce the impact of those situations. The TOC response to those situations and to event loading/unloading is described next. The discussion is structured in terms of the same three categories as before: surveillance, decision-making, and response. The discussion concludes with an assessment of traffic-management activities overall.

Surveillance for Routine Traffic Management:
Surveillance for routine traffic management involved some of the same activities and ATMS elements as for incident management. The key elements were:

- CCTV – As was the case with incident management, the dominant tool for routine traffic management was the CCTV system. As the wall screens automatically rotated through a pre-established pattern of camera locations, the Control Room Operators would look for queuing caused by incidents or non-incident congestion.

- Radio Messages from UDOT Field Units – Especially on streets in the downtown area and near the venues, the UDOT field staff were a frequent source of information about development of non-incident congestion. Traffic Observers reporting to the Area Traffic Engineers were assigned specific zones to monitor, and notebooks with color coded maps and written descriptions of expected traffic conditions. They were asked to routinely report conditions on every hour, as well as when they noted problems or exceptions. These hourly radio reports were compiled by the Area Traffic Engineers and reported to Room 230 and Room 125.

- Weather Information and Pavement Conditions – On (the few) days when bad weather was forecast, Room 125 staff was kept informed by the weather specialist at console 3 (farthermost right, front row) in the Control Room. Room 125 staff also carefully monitored several sources of weather and roadway information via the display screens in the control room, through their workstations, or via telephone conversations with external weather-service personnel under contract to UDOT.

Decision-Making for Routine Traffic Management:

"Event Plans" were developed prior to the Games to manage traffic to and from each event at each venue. These Event Plans consisted of a database containing over 1000 prescheduled actions to start or stop the following:

- VMS messages – typically including directions to venues and parking lots
- HAR messages – typically including directions to venues and parking lots
- Traffic signal action sets – including signal-timing patterns at specific times and intersections feeding each venue
- Traffic control set ups – including special signage, etc.

These Event Plans were executed primarily by Room 125 and the Control Room Operators, and did not require the participation of Room 230 under normal circumstances. Thus, most of the routine traffic management for events at venues consisted of executing predefined Event Plans.

It should not be a surprise that things did not always go exactly as planned, and there were often unforeseen situations that required modifications to the Event Plans. The causes were many; they included, for example: weather, schedule changes, stalled vehicles, unruly pedestrian movements, etc. Responses to these unforeseen situations involved use of the ATMS elements in conjunction with non-technical actions.

One of the fundamental decision-making principles for the Games was that the ATEs and other field staff were authorized to make decisions and take action unilaterally in response to a wide range of situations. Thus, there were some congestion problems that were resolved entirely in the field before they reached the TOC, by actions such as moving traffic cones or portable signs, for example. For more complex situations, the ATE or other field staff would contact Room 125 or 230, and a decision would be made jointly. For example, during the Opening Ceremonies some of the shuttle buses were parked in a location that would impact traffic movement during the unloading after the event. The ATE contacted Room 230 and requested that UTA staff arrange for several of the buses to be moved to a different location. More frequently, the field crews would contact Room 125 to discuss a situation and jointly decide upon a course of action. Thus, in addition to the 3+ levels of decision-making for routine traffic management, there was an additional level in the field that sometimes did not involve the ATMS at all.

Response for Routine Traffic Management:

The predominant response to routine traffic congestion was a ***proactive*** action – to execute the predetermined Event Plan for each event at each venue before congestion develops, and then to monitor the loading or unloading as it proceeds to watch for unforeseen occurrences. This addressed much of the routine traffic congestion that occurred during the Games. However, non-incident traffic congestion sometimes developed in circumstances not related to the loading or unloading of an Olympics event. In addition to the numerous actions taken unilaterally by the ATEs and field crews, responses to routine traffic congestion generally consisted of the TOC staff posting VMS messages in response to congestion on freeways, and adjusting signal timing for congestion on surface streets.

To illustrate the surveillance/decision-making/response activities involved in routine traffic-management during the Games, the following vignettes describe actual events.

- Saturday Night Downtown – The downtown area of Salt Lake City was the focus of a great deal of activity. In addition to several large Olympic event venues and the Medals Plaza (where Awards were bestowed nightly upon the winners of each event), there was also a large number of cultural and entertainment activities in downtown Salt Lake City. These numerous activities attracted both Olympics visitors and local residents – in numbers larger than have ever been seen before in Salt Lake City. Not surprisingly, this created traffic congestion on several of the major arterial access routes into downtown. The most dramatic example of this occurred on Saturday, February 23, the day before the Games ended. TOC staff in the Control Room and Room 125 monitored this congestion via CCTV cameras, and maintained frequent communication with the ATE for the downtown area and other field staff. Working together via 2-way radio, they took some actions in response to this situation. Their congestion-management actions included:
  - The ATE and field staff reported at a "micro" level what they were seeing on the street.
  - Room 125 staff reported what they saw via the several CCTV cameras in downtown.
  - Room 125 staff diverted the helicopter to circle the downtown area and report on queue lengths and speed (or lack thereof) of movement along these congested arterials.
  - TOC Control Room operators adjusted the timing of some of the traffic signals.
  - The ATE assumed manual control over one of the traffic signals for a period of time.
  - Room 125 staff posted VMS messages on nearby freeways to warn motorists of congestion downtown and advise them to use park-and-ride lots instead of driving.
  - Room 125 staff, along with the field staff, continued this process for several hours, until the crowds dissipated.

  Although these actions did not "eliminate" the congestion caused by an unprecedented number of cars attempting to drive into the downtown area, it likely mitigated the extensive delays that were experienced. It can also be speculated that the advanced warnings via the VMS messages caused the motorists in the queues to understand and be more tolerant of the situation, because the field crews commented that the traffic appeared to be moving very orderly.

- Closing Ceremonies Storm – The Closing Ceremonies took place during the evening of the last day of the Games. Although the weather was very good during the day, a snowstorm was approaching Salt Lake City and was expected to arrive sometime in the evening. Staff in Room 125 were very concerned because Rice-Eccles Stadium, where the Closing Ceremonies were being held, is located on a hill and most major egress routes for the unloading after the event were downhill. TOC staff were concerned that dangerous conditions could develop if the storm dropped snow or rain on the roadways as the pavement temperature fell from above freezing to below freezing. This would result in ice on the pavement of these downhill streets, which would have to carry heavy bus, auto, and pedestrian traffic after the event ended. During the Closing Ceremonies, Room 125 staff monitored their consoles displaying weather information often, and were also in frequent telephone contact with the UDOT weather service contractor to track the advance of the storm and predict the time at which the pavement would freeze over. Some contingency plans were made in case this should occur before or during the unload. Fortunately, the storm was a bit slow in arriving and had less precipitation than expected, so the icy road conditions did not develop until after the unload was finished. Once again, Mother Nature smiled upon the Salt Lake City Olympic Games, while the TOC staff was busy preparing for the worst-case weather scenario.

Assessment of Routine Traffic Management:

Although these extensive efforts were largely invisible to travelers and to the media, they are nonetheless a clear example of the combination of ***proactive*** and ***reactive*** traffic management strategies that made extensive use of the ATMS elements. Several further observations can be made.

- The predetermined Event Plans were very important to the effective management of traffic during the loading and unloading phases of each major event. The traffic-management resources (VMS, signal-control, CCTV, etc.) allowed these plans to be deployed smoothly – in conjunction with the many efforts of the field crews – and monitored at one central location.

- The decentralized decision-making authority, which empowered the ATE’s and field crews to unilaterally resolve many of the small-scale congestion problems on surface streets, was an effective element of the overall strategy. For larger problems, they worked effectively with TOC staff (primarily Room 125), to use the ATMS resources to resolve problems.

- Based upon follow-up interviews and observations in the TOC, the CCTV cameras were the dominant source of information about traffic congestion on the freeways as well as many of the surface streets. Once again, they were the most-used and most-valuable ATMS surveillance tool.

In summary, the ATMS resources were critical to the effective execution of traffic-management activities during the Games, but the less-visible role of the ATE’s and field crews “on the streets” was also critical.

3.3.3 Multi-Modal Management

Perhaps one of the greatest ITS surprises to the Study Team was the dramatic extent to which the traffic management system was used during the Games for "multi-modal" management – to manage and optimize the operations of the park-and-ride lots and their shuttle bus services. This activity proved to be the most dramatic example of ***integration*** – both technical and institutional – during the Games.

Because the TRAX system was expected to be fully utilized (and it was), the strategy for managing transportation during the Games also relied heavily upon the use of park-and-ride lots. Free shuttle buses were provided from each lot to the downtown area where several major venues were located, and also to Olympic Stadium for the Opening and Closing Ceremonies. Overall, these shuttle buses carried approximately 700,000 passenger trips during the Games. Thus, it was essential that these lots and buses operate efficiently and effectively.

There were 19 Park-and-Ride lots at locations across the Salt Lake City region. (See Figure 3.22 for a map of Park-and-Ride Lots.) Because of continuing negotiations, some of the lots were not confirmed until a few months before the Games, so time was limited for detailed planning of traffic management for these lots. Prediction of lot usage was difficult, because of the lack of precedents, but estimates of usage were made for each lot. Recognizing that predictions were difficult, field observers were stationed at each lot to report loading information (percent of capacity used) to Room 230 each hour.

Figure 3.22 Locations of Park-and-Ride Lots

During the first day of the Games, the reports from the observers at the lots indicated that the loading patterns were quite different from the predictions. Some of the lots were loading faster than expected, and several lots were unexpectedly exceeding their capacity. The latter resulted in traffic jams as spectators continued driving to those lots, only to be turned away and re-directed to another lot. Reports of these traffic problems, and motorist complaints to the lot attendants, soon reached Room 230.

The staff in Room 230 discussed this situation, and developed a strategy to actively manage the demand for each of the park-and-ride lots. (The details of how they developed this strategy are discussed in Section 3.4.2 – Interagency Coordination.) In general, the strategy involved providing real-time information to travelers to guide them to the appropriate lots. More specifically, the plan included the following steps.

1. The observers at each lot reported hourly to Room 230 on the percent of capacity in use.
2. The status of all lots was tracked by Room 230.
3. As any lot approached capacity, a backup lot was identified by Room 230.
4. For each lot and backup lot, the "upstream" VMS locations were identified (by Room 230 and 125).
5. Diversion messages were posted (by Room 125) at those VMS locations.
6. Approaching motorists saw the VMS instructions and diverted to the new lot.
7. If a "full" lot emptied substantially, the diversion actions were revised accordingly.

These steps constituted a process that was executed periodically – typically every hour, but sometimes more or less often depending upon the situation. This continued for the first several days of the Games, with the tracking initially being done on a paper map, then on a computer spreadsheet, and finally settling on a large flipchart.

During the first 4-5 days of the Games, the staff in Room 230 began to recognize the loading patterns of each of the park-and-ride lots. By the end of the first week, the loading patterns and the resulting traffic-management plans became more predictable. In response, staff in Room 230 and 125 jointly developed a "posting plan" that identified specific diversion messages to post on specific VMS units at specific times of the day. In addition, some of the shuttle buses serving the full lots were shifted to the lots that where traffic was being sent. After the first week, the lot-monitoring process continued routinely under the supervision of Room 125, and the only time decisions needed to be made was when the lot-loading patterns deviated sufficiently to require a change to the posting plan.

<u>Assessment of Multi-Modal Management</u>

As said above, one of biggest surprises – both for the Study Team and for UDOT – was the extent to which the traffic management system was used during the Games to manage and optimize the operations of the park-and-ride lots and associated shuttle bus services. This activity proved to be the most dramatic example of effective technical and institutional ***integration*** during the Games.

In contrast to the comprehensive and detailed planning that characterized other transportation aspects of the Games, it appeared that the need for tracking and managing the demand for specific park-and-ride lots was not fully anticipated. The primary reason for this is that the lot-tracking system was not established prior to the Games, and it evolved over the first few days as Room 230 experimented with several different means of tracking lot occupancies.

Perhaps because there were relatively few "major" problems involving interagency response, the staff in Room 230 was able to devote a substantial amount of time to multi-modal management. It is likely that this quick response avoided frequent traffic jams and spectator delays at full park-and-ride lots, which would certainly have resulted in adverse publicity. A similar situation occurred at Snowbasin on February 10, when the Mountain Green parking lot filled and the HAR diversion messages were not posted timely, thus adding to an existing traffic jam. That situation produced perhaps the most visible negative media coverage of traffic during the Games. In addition to avoiding traffic problems, these multi-modal management actions also avoided any negative press coverage about the park-and-ride services. If that had happened, it would likely have dissuaded some people from using the shuttle-bus system and created more automobile traffic.

Another ingredient that must be mentioned is the broad VMS coverage of the freeway system. This allowed diversion messages to be posted in appropriate "upstream" locations for each of the park-and-ride lots. If the VMS units were not so widespread, this strategy would have been much less effective. With no VMS, it would have been impossible.

Thus, this coordinated effort allowed the park-and-ride/shuttle-bus system to serve the maximum number of spectators, reducing the demand for automobile traffic, especially in the areas that were most likely to be congested. Clearly, this multi-modal management effort contributed in several ways to the overall positive image of transportation during the Games.

3.3.4 Assessment of ATMS Computer Performance

The previous sections of this report have described and assessed the many elements of the traffic-management system, and described and assessed how they were used during the Games to manage traffic as well as transportation demand (by optimizing the park-and-ride/shuttle-bus system). The CCTV coverage was almost ubiquitous and the system was the most-important surveillance tool. The traffic signal control system functioned reliably, as did the VMS system. The HAR system also was an effective traffic-management tool, notwithstanding a few isolated problems. There were a significant number of malfunctions with the traffic detectors (especially the speed sensors), but the highly effective CCTV system almost eliminated the need to use speed data for incident detection and traffic management. However, these are all field devices, so the remaining question is: "How did the computer hardware and software at the TOC perform?"

The TOC computer system performs a broad range of ATMS and ATIS functions, and it is very complex. It includes over 45 servers in a multi-platform network combining Unix and Windows NT operating systems, with several hundred high-speed communications lines connecting to other locations across the region. (For simplicity, we will often refer to this network as "the TOC computer.") The TOC computer included arterial-management software (ICONS) to manage the traffic signals on surface streets, plus a freeway-management software package (Navigator) to manage the freeway surveillance and control elements. The TOC computer was connected to a number of remote workstations at other agencies, plus an extensive array of field devices, including traffic signals, detectors, CCTV, VMS, HAR, RWIS, and other elements.

Moreover, the computer system had been evolving continuously for several years prior to the Games with significant new functionality "upgrades" being installed often. These were accompanied by the frequent software enhancements and "bug-fixes" that are a necessary part of any complex and evolving computer system. During the month prior to the Games, there were several such upgrades and enhancements, most notably the 511 telephone system integration.

The TOC computer system was also being used in highly unusual ways, because there were far more users connected simultaneously than ever before. Most of those users were very active, requesting information from the system frequently – especially during incidents when other demands upon the system were also high. Further, many of those users were not entirely familiar with the system, so they may have inadvertently used it in inappropriate ways.

Thus, the TOC computer system was truly operating in a "worst-case" scenario, so it would be unrealistic to expect that there would be no computer problems whatsoever. Fortunately, the problems that did occur never rose to the level where they prevented any essential functions from being performed in a timely fashion. From the perspective of the public, the system did everything they expected of it. From the perspective of the Study Team who was scrutinizing the system very closely, there were some flaws noted. These are described next.

1. Data from some TMS sites missing. The TOC system utilized two different software packages to manage traffic. The Navigator software, which was developed in Atlanta and transplanted to Salt Lake City, provided the functionality to manage the freeways. The ICONS software managed traffic signals on surface streets. The Navigator software did not provide the functionality needed to operate traffic signals at the 23 metered on-ramps, so the signals at these on-ramps were put under the control of the ICONS software. However, this required that the communications lines from the TOC to those signals be dedicated to performing the ICONS communications instead of carrying data from the nearby Traffic Monitoring System (TMS) sites back to the TOC. Thus, a number of TMS sites near to the metered on-ramps did not report volume or speed data back to the TOC. Fortunately, there were relatively few of these missing sites and enough functioning TMS sites nearby, so that the freeway management system was able to perform normally.

2. Gaps in TMS archived data. With the few exceptions described above, data from all TMS sites was flowing back to the TOC continuously, and was being stored in a "buffer" in the TOC computer every twenty seconds. This data was used by the TOC computer to perform the "real-time" traffic management and traveler information functions. Afterwards, the data was stored ("archived") in the computer for use at a later date. Although the data was available for all real-time functions, there were recurring problems with the archiving of this data for later use, with numerous periods of hours or days during which the data was not archived. At the time of the Games, UDOT had not yet begun to use the archived data, so this problem had not direct impact on traffic management or traveler information functions during the Games. However, it precluded

analysis by the Study Team of traffic speeds and delays during the Games, and it would prevent future performance monitoring and analysis by UDOT.

3. System functions occasionally impaired. There were several instances during which certain functions of the TOC computer were impaired or inoperative. One example was the loss of control of the CCTV cameras, during which the cameras continued to transmit full-motion video images but they could not be moved (pan/tilt/zoom) and the cameras selected for display on the wall screens in the Control Room could not be changed. This malfunction was repaired by the TOC computer staff, generally in about 20 minutes, by re-starting one of the key computers in the TOC computer network. This was a potentially serious situation, but fortunately it never occurred at a critical time when full functionality was required. In addition, the TOC computer support staff decided to re-start the system to clear out memory and restart the logs in order to stabilize the system. Near the end of the Games, TOC staff discovered that a software enhancement installed several days before the Games required a revised startup procedure, which was not communicated to the TOC staff. In follow-up interviews with the TOC staff, they recommended that future Olympics TOC staff should "freeze" the software configuration at least several weeks before the Games.

In summary, the TOC computer was operating in a "worst-case" scenario, and some problems were encountered. However, none of these problems prevented any essential functions from being performed in a timely fashion. From the perspective of the public, the system did everything they needed.

3.4 Interagency Coordination

It would be impossible to conduct an event the magnitude of the Olympic Games without extensive and effective coordination between all of the transportation agencies in the region. The positive image of transportation during the Games is evidence of strong interagency coordination in the Salt Lake City area before and during the Games.

In the context of transportation management and traveler information specifically, most of these efforts during the Games revolved around Room 230 in the TOC. As described fully in Section 3.2.3 above, Room 230 was staffed 14-16 hours each day with representatives from several division of UDOT, plus Utah Transit Authority, FHWA, SLOC, and other agencies. In the adjacent Room 227, representatives of the public-safety and law-enforcement agencies also used the ATMS facilities to monitor and respond to safety issues, and to coordinate with Room 230 by walking next door. From Room 230, communications equipment including telephones, mobile phones, 2-way radio, pagers, and email were available to coordinate with colleagues in the same organizations and with other agencies. A TOC operator was provided to Room 227 to assist them in using the ATMS facilities, primarily CCTV cameras for security surveillance purposes.

Previous sections have discussed the role that staff in Room 230 played in transportation management. This section expands upon those previous discussions by presenting the examples below that illustrate how those interagency collaborations actually took place in Room 230.

3.4.1 Interagency Coordination for Incident Response

In the middle of the day before the beginning of the Games, there was a collision between a TRAX train and a private auto that was making a left turn across the tracks on the University Line. There were serious injuries to the occupants of the auto. The field crews (SLC Police, paramedics, etc.) responded promptly, and shut down the intersection and the TRAX line for well over an hour while they tended to the injured, investigated the collision, and cleared the debris.

Because the field crews were on-site and handling the incident, the concern in Room 230 focused upon public perceptions and possible adverse publicity. Staff in Room 230 monitored the accident scene via a CCTV camera image on the large screen of the Control Room display wall, and also via reports from staff on the scene. After a brief group discussion, it was decided that there was no need for any traffic management actions beyond those already implemented by the field staff, but that traveler information was needed. A media bulletin was released describing the incident and advising motorists to avoid the area until the incident was cleared. Representatives of the various agencies in Room 230 contacted their colleagues elsewhere to gather background information that might be needed to answer media inquiries in a consistent fashion. In due course, the incident was cleared, an "all clear" bulletin was released, and this item on the Issues Database was closed.

Summary: In this situation the staff in Room 230 decided that their primary response was to provide consistent information to travelers and to the media.

3.4.2 Interagency Coordination for Multi-Modal Management

As described above in Section 3.3.3, reports from field crews on the first day of the Games indicated that some park-and-ride lots were unexpectedly exceeding their capacity and creating traffic jams as spectators had to be re-directed to another lot.

The staff in Room 230 discussed this situation and designated several people from UDOT and UTA to develop a solution. This sub-group conducted a "standup" meeting in one corner of Room 230. They examined the available information about loading patterns of the various lots, and the possible response options. They concluded that it was necessary to actively manage the demand for the park-and-ride lots by doing the following:
(1) Assign staff at each lot to report occupancy to Room 230 each hour.
(2) Systematically track the occupancy of each park-and-ride lot, and
(3) Whenever any lot approached capacity, identify the appropriate backup lot and immediately use the VMS displays to direct motorists to appropriate backup lots.

This group instructed one of the support staff to obtain a large map containing the locations of all park-and-ride lots, and arranged to receive and record the lot occupancy data each hour. The UDOT representative coordinated with Room 125 to arrange for posting VMS messages when needed. The system was placed into operation for the remainder of the Games, with changes to the tracking system over the next few days to experiment with a computer spreadsheet and then settle upon a flipchart on an easel.

After about a week, the pattern of lot filling was clear, and this ongoing tracking/posting task was transferred to Room 125.

Summary: In this situation the staff in Room 230 decided that their primary response was to implement an ongoing system that used the VMS (a traffic-management element) to provide real-time information to motorists using specific park-and-ride lots.

3.4.3 Public-Safety Issues

For routine public-safety issues involving the freeway system, the UHP was responsible during the Games, as was true at other times. The UHP dispatcher is located in the TOC, in a separate room overlooking the Control Room. Responses to routine public-safety issues would be treated as described above for incident management.

For public-safety issues related to the transportation system that rose above "routine" (e.g. security issues involving threats to lives), responses would be managed by the law-enforcement officers in Room 227. When necessary, they would coordinate with any appropriate staff in Room 230, which was immediately adjacent to Room 227. The officers in Room 227 had an ATMS workstation with full camera control, plus a TOC operator to manipulate the cameras. Observers were restricted from Room 227, so the Study Team did not record information about how security incidents were managed by that group, and discussions with Room 230 staff generally took place inside Room 227. Thus, the nature and extent of interagency coordination between Rooms 227 and 230 cannot be further described in this report.

3.4.4 Perceptions of System Performance

This section describes and (occasionally) assesses the opinions of the following:

- Utah DOT staff who worked in the TOC
- Other Agencies, who either worked in the TOC or communicated with the ATMS
- The Public (Residents and Visitors)
- Media Coverage (primarily news stories)

Data Collection – For the first three groups, data was collected via personal interviews – either in-person or via the telephone. For the fourth category, data was collected primarily from websites of major newspapers, plus a few Internet-only news publications.

Topics Covered – The subjects examined with UDOT and other agencies ranged widely, including the effectiveness of the TOC computer, surveillance systems, traffic management, incident management, traveler information, interagency coordination, TOC operations, security, etc. With the Public the principle subject addressed was perceptions about traffic conditions. For the Media, the key topic analyzed was coverage of ITS elements specifically (not general traffic conditions).

3.4.5 Perceptions of UDOT Staff

Twelve individuals were interviewed, including UDOT employees plus contractors and consultants to UDOT during the Games. Most worked in the TOC. The interviews were 1-2 hours long, so the Study Team has selected those comments that appeared to be the most important in terms of transferability to other major events, and also to future UDOT operations. The comments are arranged in terms of topics. You will note that, at times, there are differences of opinion expressed by the different interviewees.

<u>TOC Computer System</u>

- There were software changes made during the weeks before the Games in response to requests and to upgrade functionality. One of these changes introduced a new and quite significant problem that caused certain parts of the system to freeze on a few occasions. The system support personnel were able to work around the problem until they diagnosed and fixed it late in the Games.
- There were two other problems that required a lot of maintenance activity during the Games, and prevented the archiving of a considerable amount of traffic data after it was used for real-time functions.
- Recommendations: All needed software changes should be identified and implemented well in advance, so that no software changes are made for at least one month prior to the event. During that "stable" period, the system should be "stress-tested" to the maximum extent possible. During the event, specific diagnostic tests should be run regularly, in addition to careful monitoring of system performance.

<u>Interagency Cooperation</u>

- The missions and priorities of the participating parties differed – especially between government organizations and private organizations, but also between some government agencies (e.g. the Secret Service).
- The design of the TOC to serve as a control center, housing multiple transportation-related agencies, was an important asset. Co-locating the cooperating agencies in Room 230 was an important ***structural*** step that enabled and encouraged more effective cooperation. All respondents agreed that inter-agency cooperation during the Games was remarkable.
- The CommuterLink Website was perhaps the most important ***management*** tool and was used heavily by SLOC as well as the personnel in the TOC. Other technology tools were also very helpful (e.g. J-page system, etc.).

- CCTV control sharing requires strong interagency coordination. Sharing with law-enforcement agencies raised issues.
- A railroad operation was blocking traffic in north Salt Lake City. It required a call from the FHWA office to the Amtrack Communications Center to prevent future recurrences.

Incident Management

- The pre-Games "exercises" focused on extreme events, with no day-to-day scenarios. This may have encouraged a broader response than required.
- Rapid response and clearing of incidents reduced secondary incidents.
- When diverting traffic for an incident, it was necessary to avoid using the routes designated for the athlete vehicles. (Part of the "Olympics Overlay" to normal incident management.)

Media Relations

- The media was very receptive to transportation messages from Room 230 and other related sources, but the review of news releases was time-consuming.
- Media coverage was very positive.

Planning and Preparations

- 40% of Olympic tickets were sold in Utah.
- Planning began at least 4 years prior to Games.
- Various group leaders had different levels of knowledge about ITS tools, and the practice scenarios helped educate them. Some education happened during Games.
- The ATMS and ATIS were viewed as decision-support systems for traffic management and traveler information.
- The ATMS goal was to integrate traffic management across agencies and jurisdictions in the region.

Security

- Advanced preparations were valuable, to learn the capabilities of the systems.
- The three major security problems were: motorcades, athlete's vans straying off route, and the refinery explosion that shut down I-15.
- "Fortunately, we were not ***really*** tested."

Surveillance

- CCTV was mentioned by almost all those interviewed as a valuable asset. The cameras were used extensively and for a wide range of purposes including: incident response, traffic management, monitoring TRAX loading and other pedestrian movements, abandoned vehicles, suspicious packages, etc.
- One of the television stations had some issues with CCTV camera control and blocking.
- It would have been good to have more cameras at venues and park-and-ride lots.
- Helicopter was needed less often because the CCTV coverage was so broad. There were some restrictions on its flight path, and there was no video feed from

the UDOT helicopter. They were useful for monitoring park-and-ride lots, and it was useful to have as a contingency in case of a major incident.
- The UDOT field crews were valuable for traffic surveillance. They were given tips on what to look for to identify traffic problems.
- One weather surveillance station had persistent communication problems because of cell-phone traffic. It was resolved by switching from analog to digital modem.

TOC Operations
- The desire for frequent and detailed reporting sometimes led to micro-management.
- There were some differences in policies between day and night shift, and there opportunities for miscommunication between shifts.
- The Control Room was staffed with seven people, plus one administrative person to assist with radio and telephone communication. This is compared to two or three during normal business. The staffing was adequate to handle the workload routinely without overload.
- There was nearly 24-hour coverage in the Control Room by weather specialists, which was new for the Games. The full operations plan for weather support was never fully tasked since there were no major weather events.

Traffic Management
- CCTV displays in TOC were programmed to rotate through a series of locations, which were sites where the greatest traffic congestion was expected, based upon volume/capacity analysis.
- There was a plan for VMS messages for the Park-and-Ride lots, based upon estimated usage. But the usage deviated from expectations and contingency plans were developed during Games.
- Planned traffic-management actions were developed in advance for time lines down to 15-minute intervals, for each day of the Games. These included VMS, HAR, signal timing, physical control, etc.
- Sometimes there were too many people, and coordination became a problem. But sometimes they were all needed. Perhaps there should be leaner staffing, with a “reserve team” available for special situations.
- There was an Area Traffic Engineer (ATE) assigned to each venue. These field assignments were new, but proved valuable for coordinated response with Room 125 and 230.
- There was a multi-agency effort to develop common signal strategy (event plans) before the Games. Those used before Games were fine, others less so. Practice makes perfect. Modeling also helped. There were some questions about when to manually control signals. Field staff and CCTV also helped. Some local police departments had good previous experience, others not.
- HAR was very useful to solve a congestion problem at Kimball Junction, by telling motorists to use both available lanes.

<u>Traveler Information</u>

- The mission of the TDM Plan was to educate the public on traveler information tools, and encourage them to use them. CommuterLink Website was the main focus. SLOC website maintained (non-real time) information on spectator transportation; real-time traffic information was offered on the CommuterLink Website.
- VMS and HAR were extensively used to display TDM messages before the Games.
- VMS and HAR were also used as traveler information tools, but this was not foreseen until later in the planning process.
- There were reliability problems with HAR; it was a new system to UDOT.

3.4.6 Other Agency Perceptions

Five individuals from agencies other than UDOT were interviewed, including UHP, UTA, FHWA, and FTA. Most worked in the TOC.

Their perceptions mirrored those described above, but with the following exceptions and additions:

- Weather information on the CommuterLink Website was not reliable
- The Olympic radio station was underutilized
- The CCTV system was a very important surveillance tool, but the displays needed direction indications
- They used the J-page system as a major source of information, sometimes receiving information before it reached Room 230
- A full workstation was needed in Room 230
- The teamwork was exceptional

3.4.7 Public Perceptions

To measure perceptions of the performance of the traffic management system during the Games, the Visitor and Resident Surveys included one very general open-ended question: "Do you have any other comments about transportation during the Olympics?" Responses to this question were tabulated in terms of positive, negative, or neutral.

A majority of the Residents surveyed gave answers to this question. Of the 154 residents who did, **75% gave a positive response**, 7% gave a negative response, and 18% gave a neutral answer (e.g. "no comment").

A majority of the Visitors surveyed also responded to this question. Of the 385 visitors who gave answers, **68% gave a positive response**, 6% gave a negative response, and 26% gave a neutral answer.

Thus, these surveys indicate that a clear majority of both visitors and residents had a positive view of traffic during the Games. From another perspective, an extremely small fraction (about 7%) of the respondents had a negative view.

3.4.8 Media Perceptions

This section describes the coverage of local ATMS /ATIS elements during the games by the media and how the performance of those systems was perceived. The principle source of media comments for this assessment came from directed Internet searches. A study of newspaper and television coverage was conducted for UDOT by PPCH/ProClix, and is available from UDOT.

These Internet searches focused on items that referenced transportation during the games, with a special interest in items related to ATIS/ATMS. The Internet searches were conducted at approximately the same time each day for the duration of the Games. Using these parameters, over 300 items were located. Of these, the vast majority focused on broader transportation issues such as congestion, availability of transit options, parking, detours and road closures, and the overall effectiveness of the Transportation Plan. There were 46 articles that focused specifically on ATIS/ATMS.

- 43 articles detailed the debut of the 511 system
- 2 articles discussed the use of ITS systems and CommuterLink

The two articles on the use of ITS systems (one posted on January 2 and the second on February 8) were positive reports on the expected impact of technology on the local transportation system. Both outlined the use of cameras and sensors linked by fiber-optic networks to the TOC, which will allow for the adjustment of traffic signal timing in reaction to accidents, and the dispatch of real-time traffic reports to the public via the 511 phone service and the CommuterLink website. Because these stories were posted before the start of the games, they do not offer any perception on the effectiveness of the system during the Games.

The articles detailing the debut of the 511 system, posted mostly before the start of the Games, were also very positive. The focus of the articles was on how the service will allow callers to use voice access to get Olympic schedules, driving directions, event results, and advice on avoiding traffic congestion. One article, posted on February 16 on www.wired.com, reports that a local user found that dialing 511 for traffic updates was “much more efficient than the television and radio news reports.”

4 Advanced Traveler Information Systems (ATIS) Findings

The advanced traveler information system (ATIS) consisted of four primary channels for distributing transportation information to travelers:

- CommuterLink Website (CLW)
- 5-1-1 Telephone Services (511)
- Variable Message signs (VMS)
- Highway Advisory Radio (HAR)

In addition to these technology-oriented ATIS channels, heavy use was made of "traditional" (i.e. non-ITS) channels for distributing information to travelers (television, radio, newspapers, brochures and pamphlets at worksites, grocery stores, etc.). The next sections discuss the ATIS channels. Use of the traditional channels is discussed later in Section 5 – Travel Demand Management Findings. Note that VMS and HAR were also used for traffic-management purposes, as discussed in Section 3.

4.1 CommuterLink Website

The centerpiece of UDOT's ATIS is the CommuterLink Website (CLW), www.utahcommuterlink.com. It was the most heavily used ATIS element during the Olympic Games. This section first describes the website, then presents assessment findings in terms of usage rates, performance, and user perceptions. The SLOC transportation website, developed and maintained by PPCH was directly linked off of the CLW. This site provided helpful information for the day, such as congestion maps.

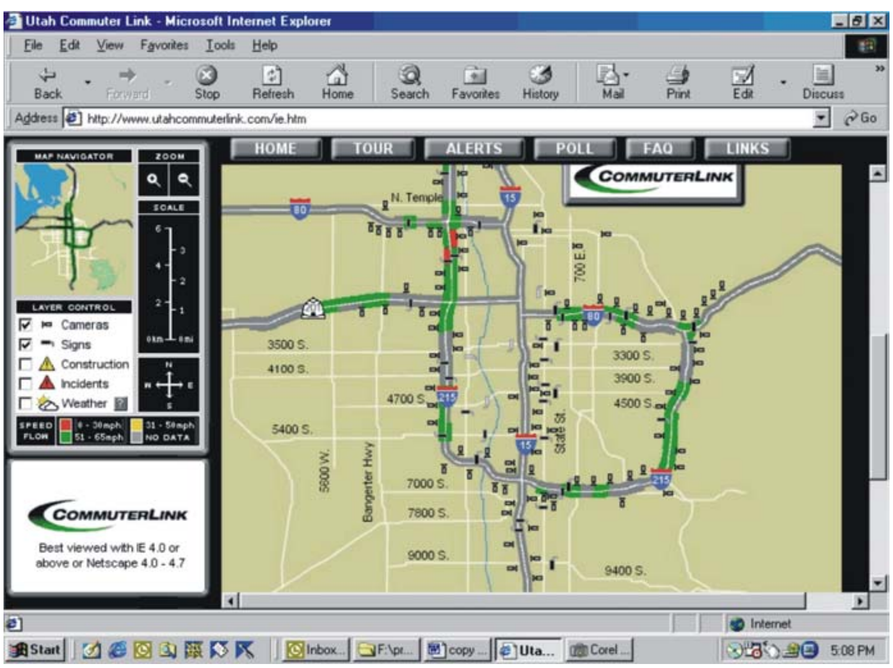


Figure 4.1 CLW Home Page

4.1.1 Description of CommuterLink Website

The CommuterLink Website (CLW) was operated by UDOT, on computer servers located at the TOC. As can be seen in Figure 4.1, the CLW is built around a map of the freeway system and the major surface streets, where most of the surveillance equipment is installed. During the Games, the CLW offered four primary types of information to the traveler:

1. Traffic conditions (speeds, incidents)
2. Roadway closures and construction
3. Weather (including pavement conditions)
4. Olympics information

Traffic information is presented in a number of ways. To display congestion conditions, the speed on each freeway segment (typically about one-half mile long) is shown as color-coded band (red = 0-30 mph, yellow = 31-50 mph, and green = 51 mph and above). Incidents are denoted with a red triangle; if the user clicks on that symbol, further information about that incident is displayed on a small portion of the screen, in the lower left corner.

Roadway construction and closures are displayed as a color-coded triangle, near the location involved. Yellow triangles denote current construction and/or closures; blue triangles identify future construction or closures. During the Games, there was no roadway construction except for emergency repairs. However, there were a substantial number of planned road closures, especially in the downtown area. Note that roadway construction/closure information is displayed for both freeways and major streets.

Weather conditions were displayed during the Games – primarily in terms of pavement conditions. (Note that this feature is operable only from November through April.)

Olympics Information was, of course, displayed only during the Games. This was implemented primarily via a link to the SLOC website.

Supplemental information of several types is also available on the CLW. The locations of most CCTV cameras are denoted with a small symbol. If the user clicks on one of these symbols, the camera image (a recent snapshot) is displayed on a small portion of the screen. Similarly, most VMS locations were shown with a symbol that, when clicked, displayed the text message currently appearing on that VMS. Additionally, it is possible to zoom out to display the entire state of Utah, or to zoom in to show a smaller portion of the SLC area including the major surface streets. The CLW also enables individual users to subscribe to an "Alert" system, which automatically sends an email message in the event of an incident that falls within user-specified parameters (time of day, day of week, severity of incident). Finally, the CLW offers links to the websites of other organizations, including the State of Utah, UDOT, UTA, the City of Salt Lake, the County of Salt Lake, UDOT IMT, and the National Weather Service.

4.1.2 Assessment of CLW Usage Patterns

Detailed usage statistics for the CommuterLink Website were maintained by the website host (UDOT), using the "Webtrends" tracking software package. All usage data reported in this section are based upon the information reported by that system.

During the 17-day period of the Games, the CLW experienced over 52 million "hits" compared to 8 million hits during a "normal" 17-day period in July. Thus, CLW usage increased dramatically during the Games. (No usage data was recorded on February 18, for reasons that remain unknown, so the actual total number of hits during the Games was approximately 55 million. Note that all CLW usage data presented herein do ***not*** include any corrections for that missing day.)

However, for the purposes of this study, it is necessary to ask "What does this remarkable increase in hit-rate reveal about the value of the CLW as a tool for distributing traveler information during the Games?" The answer to that question is more complex than a simple measurement of the increased hit rate – dramatic though it was. To better understand the usage of CLW, it is necessary to first discuss the several general ways of measuring usage of web-sites, including definitions of several key measures of effectiveness (MOEs). This discussion is structured around the following questions:

- How extensively was the CLW used during the Games?
- How many ***people*** used the CLW during the Games?
- How did the usage patterns vary during the Games?
- What types of information did they want?
- Who were these users and where were they located?

How extensively was the CLW used during the Games?

Hits – This MOE generally represents the number of times that certain files at the website is accessed successfully. (This usually includes files with file-name extensions .htm, .html, .asp, and a few others.) The precise definition depends upon how the Webtrends monitoring software is set up on the host computer, but it generally includes a large number of files that are not meaningful to the user. Further, when a user moves ("clicks") through the CLW, multiple hits are recorded as the user requests additional information. As said above, during the Games there were over 51 million hits to the CLW, or an average of more than 3 million hits per day. It is very difficult to identify a clear relationship between the number of CLW hits and the amount of traveler information delivered to SLC residents and visitors.

Page Views (Impressions) – This MOE represents more closely the number of different "web pages" requested by users, where a page may be loosely defined as a screen containing substantially different information than was contained on the previous screen. Once again, the precise definition depends upon how the Webtrends software is set up on the host computer, but this MOE is a much better approximation of the number of different items of information sought by users. It usually does include some intermediate screens displayed as the user moves through the menu structure, however, the CLW has a relatively “flat” menu structure that allows users to retrieve desired information with very few intermediate menus. During the 17 days of the Olympics, there were 3.2 million page views of the CLW, or an average of about 191,000 page views per day. This compares to an average of about 37,000 page views on a “normal” day in July 2002.

How many people used the CLW during the Games?

Visitor Sessions – This MOE can be loosely defined as the approximate number of times that the CLW was “entered” from somewhere outside the CLW. It does not distinguish the amount of time since the previous entry – it could be two minutes or two weeks. It also does not distinguish between first-time users versus previous visitors. Also, for those users who remained in the CLW for many hours per visit (e.g., the media, the evaluation team, the folks in room 230 of the TOC), multiple visitor sessions may have been recorded for each actual session. During the Games, there were almost 120,000 visitor sessions, or about 7,000 per day, with an average session length of 38 minutes.

Unique Visitors – This MOE is an attempt to measure the number different people who used the CLW, but it is inherently a rough measurement. Unique visitors are counted using the visitor’s IP address, domain name, or cookie, depending upon which is available from each user.

The most reliable identification of a unique visitor occurs when the user allows the CLW to record a small file of information (a “cookie”) on the user’s hard drive, which includes a unique identification number that allows the subsequent identification of that user as being a returning visitor. But even cookies are not perfect, because several people could use the same computer, and also because some people prohibit the storage of cookies on their hard drive. For those users who prohibit cookies, the identification is made based upon the “IP address” or the “domain name” of the user. The IP address is akin to the internet “street address” of the computer server that connects the user to the internet, and the domain name is generally the portion of the user’s address after the “@” sign (e.g., utah.gov, iteris.com, or earthlink.com). Typically, many people share one IP address and an even larger number of people share a domain name. Thus, “unique visitors” is likely to greatly ***under***estimate the true number of ***individual people*** who visited the CLW, because for people who prohibit cookies, it will lump together everyone who shares one server or even one domain name.

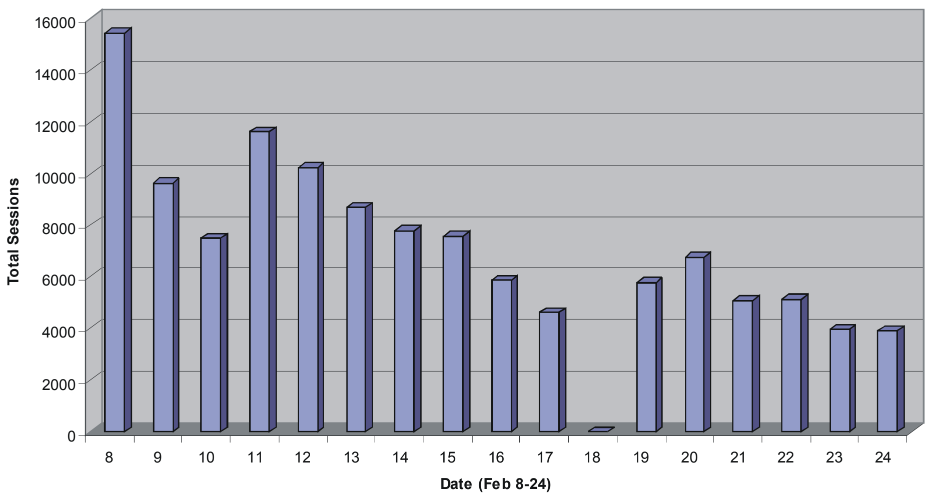
During the 17 days of the Olympics, the Webtrends software counted 41,088 unique visitors to the CLW. It identified 31,372 of them as visiting once and 9,716 of them as visiting more than once. For the reasons described above, both of these numbers are probably much lower than the “true” numbers.

Thus, the unfortunate conclusion of this analysis is that the number of ***individual people*** using the CLW during the Olympics is impossible to measure accurately. However, the true number is certainly more than the 41,000 ***unique visitors*** – probably much more –

but less than the 119,600 ***visitor sessions*** during the Games. Thus, for a "ballpark" answer to the first question ("How many people used the CLW during the Games?"), we will split the difference and say that ***roughly*** 80,000 different people used the CLW during the 17 days of the Games, for an average of ***roughly*** 4700 different people per day.

How did usage patterns vary during the Games?

The Webtrends monitoring package tracked ***visitor sessions*** on a daily basis. The results are shown in Figure 4.2, which reveals a pattern of heavier use at the start of the Games. Visitor sessions were highest on the first day of the Games (Friday, Feb. 8), at approx. 15,500 per day, dropped sharply to about 10,500 on day 2, and generally declined thereafter to around 4,000 per day at the end of the Games.



8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
15424	9612	7490	11606	10232	8676	7772	7565	5865	4609	0	5775	6751	5060	5139	3963	3902

Figure 4.2 Visitor Sessions

The Webtrends plot of visitor sessions by day of the week (see Figure 4.3) shows highest activity on Fridays, and lowest on Sundays.

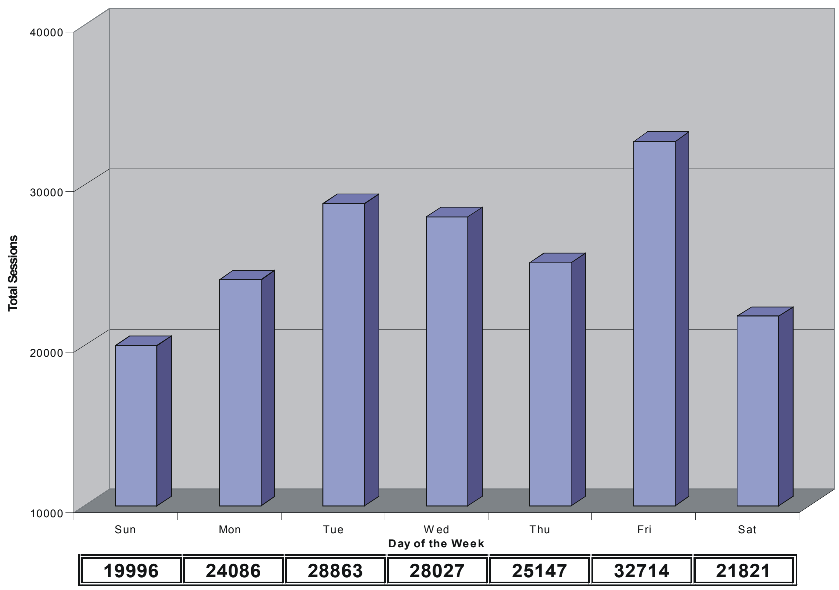


Figure 4.3 Activity Level by Day of the Week

Similarly, the plot of visitor sessions by time of day (see Figure 4.4) reveals highest activity levels from about 8am to 5pm – normal business hours! – with the peak single hour being 8:00-8:59am.

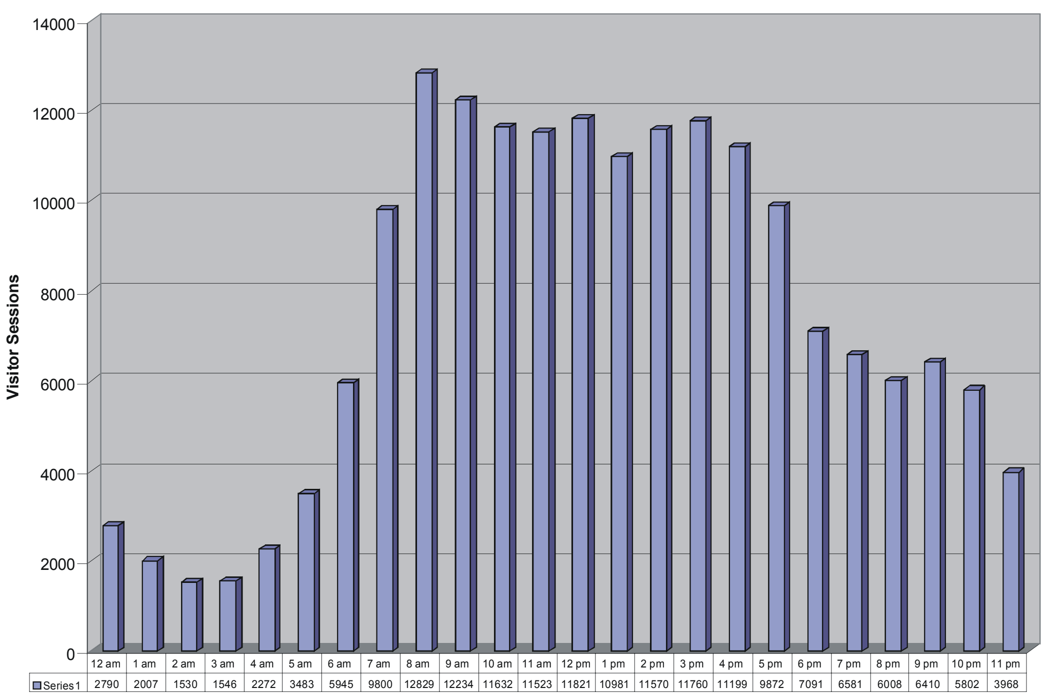


Figure 4.4 Activity Level by Hour of Day

Who were these users and where were they located?

To more fully understand the answer to either of these questions, they must be examined together. Webtrends reports included a tabulation of the "top 20" user's (by IP address or domain name), and the number of visitor sessions and hits for each. Surprisingly, there were no "dominant" users. For example, the top visitor, IP address 208.8.57.2, (which could not be identified further) accounted for only 329 visitor sessions out of the 119,682 total visitor sessions for the Games. In other words, the most-frequent visitor accounted for only one-quarter of one percent of all visitor sessions. Hence, the CLW users entered from a multitude of IP addresses.

Other Webtrends reports list Top Geographic Regions and Most Active Organizations. A bit less than 5% of the visitor sessions were from outside the United States. Among the Internet service providers (ISPs), the most active was AOL, with about 5% of the visitor sessions but only 1.5% of the hits. See Figure 4.5. Because AOL predominantly serves a nationwide clientele, it cannot be said how many of these were users in SLC. At positions 6 and 10 on this list of Top 20 ISPs are two local ISP's – "xmission.com" and "utah.edu" – who accounted for about 1% of the visitor sessions between them. Thus, this data does not answer the question "where are they located?" It is also curious that this tabulation does not include some major ISPs – Earthlink and MSN for example.

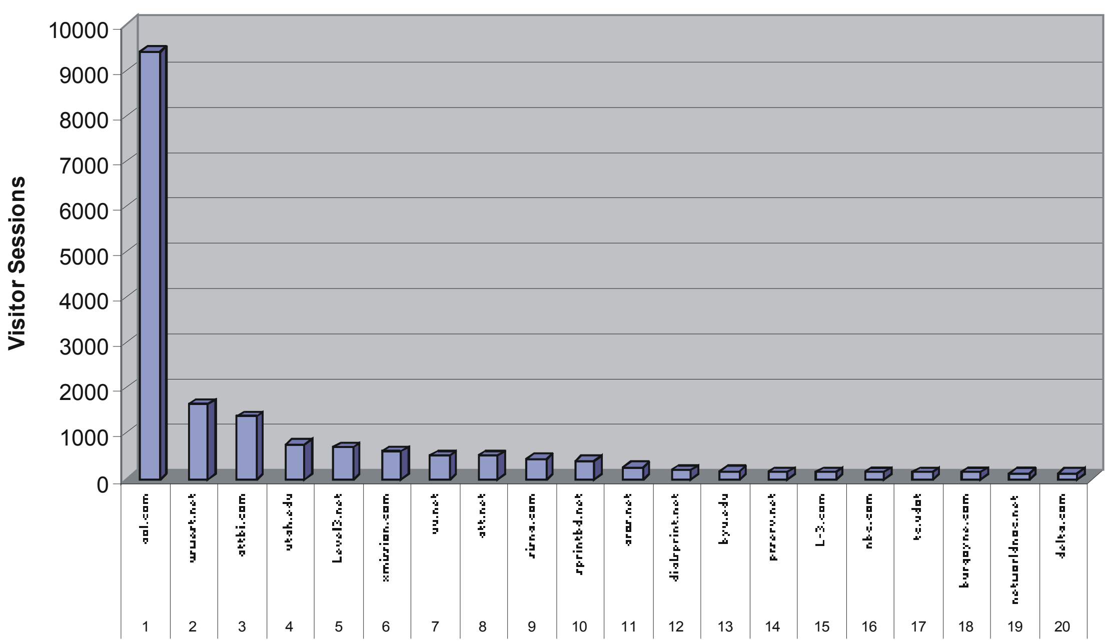


Figure 4.5 Most Active Organizations

Attempting to answer the "location" question, two additional Webtrends reports should be considered. The Organizational Breakdown (see Figure 4.6) is based upon the domain suffix (.com, .edu, and so forth.) This data says that Commercial or (.com) organizations accounted for almost two-thirds of the users, with Network (.net) being second with 30% market share. Because there is overlap between these two organization types (e.g., AOL.com and earthlink.net are both commercial ISPs), it is best to consider them as one category, which has 94% of the market share of CLW users. All other types (Education, Government, Military, Non-Profits, etc.) account for only 6% of all CLW users.

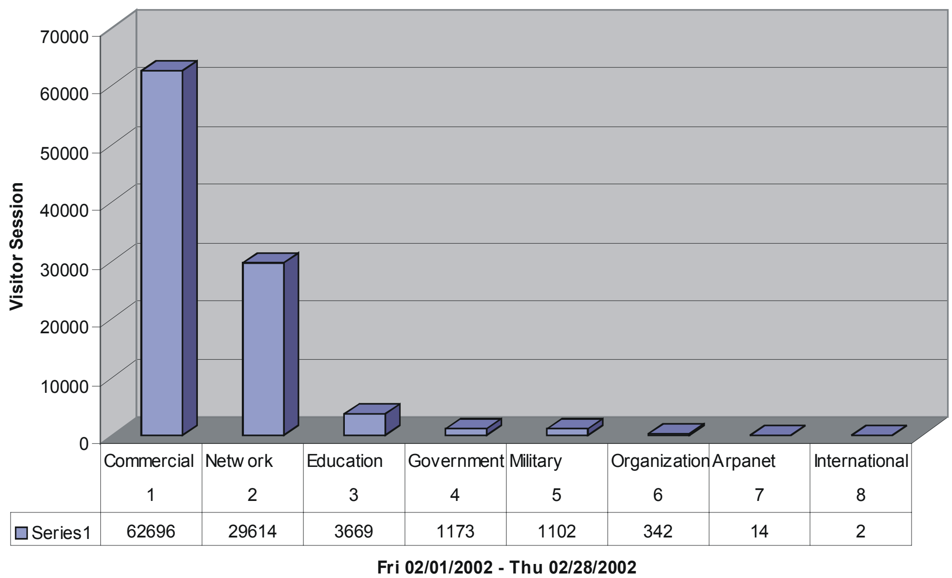


Figure 4.6 Organizational Breakdown

We shall make one final attempt to answer the question “Who are these users?” It is informative to examine the Webtrends report “Visitors by Number of Visits During the Games” (see Figure 4.7), which says that over 76% of all unique visitors only visited the CLW one time. Thus, the majority of visitors to the CLW were one-time users. The percentages decrease rapidly for two-time users, three-time users, and so forth. However, over 3% of unique visitors made 10 or more visits. Although no data was available, one can speculate that this category includes the media, the interagency staff in the TOC, the evaluation team, and perhaps others who were not visitors or residents directly.

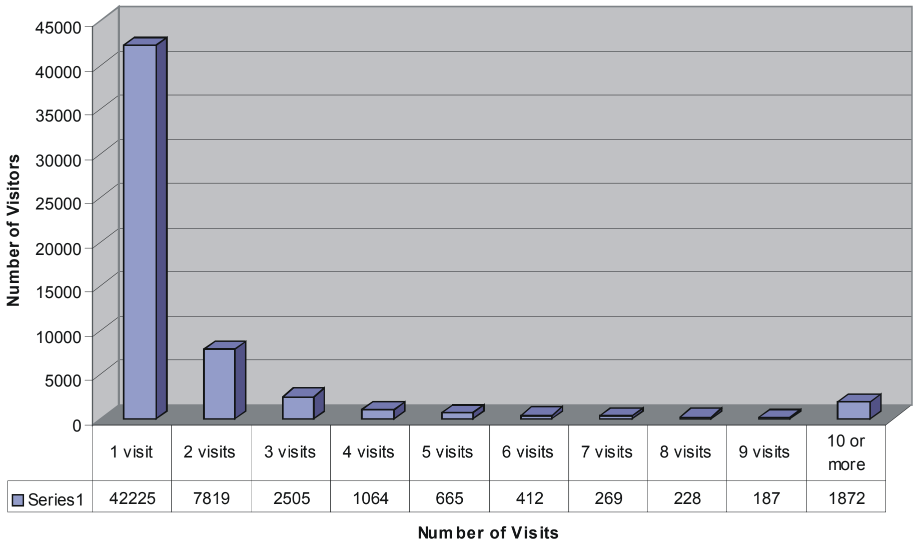


Figure 4.7 Visitors by Number of Visits

What types of information did the users want?

The last usage question to consider is what information these users sought. Once again, Webtrends offered two tabulations, "Most-Requested Pages" and "Most-Accessed Directories," that promised to answer this question. Unfortunately, these two tables consisted of names of pages and directories that were incomprehensible to the evaluation team. Thus, this question will remain unanswered.

In summary, during the Olympic Games:

- Over 3 million pages (impressions) of the CLW were viewed by roughly 80,000 different people,
- Most users were one-time visitors,
- Usage was highest at the beginning and declined by two-thirds thereafter,
- There were almost 120,000 visitor sessions with an average session length of roughly 38 minutes,
- The users were a diverse group from a wide variety of organizations, but
- Their specific interests and whereabouts were unclear.

4.1.3 Assessment of CLW Performance

As described in Section 4.1.1, the CLW provides a number of different items of traveler information. The most challenging of them is the delivery of real-time information about traffic incidents. Performance of the CommuterLink Website can be viewed in many ways, but in the context of using the CLW as a tool for distributing ***incident*** information, three parameters stand out as important. They are:

1. <u>Accuracy</u> – Is the information provided correct and complete?

2. Timeliness – Is the information provided quickly enough to be of benefit?
3. Availability – Is the information available whenever it is needed?

Timeliness is the most difficult parameter. In an ideal world, it would be possible to somehow know exactly when each incident occurred, and exactly what happened. In a real world, this is not possible except in the very rare instance when a control-room operator happens to see the incident occur on a CCTV camera. Thus, in essentially all incidents, some time elapses before the incident is detected and verified by the traffic-management system (whether by human or machine efforts). Although some research studies have attempted to measure this detection/verification period, there was no attempt in this study to do so. The initial study design envisioned obtaining internal data from the ATMS computers to determine, for each incident, when the system had detected and verified that incident. This data was not available for extended periods.

Hence, to measure CLW performance in terms of these three parameters, observers were assigned to monitor the CLW continuously for 6-8 hours per day, generally in the afternoon, for each day during the Games. They did so by watching the CLW display on their computer monitor, and recording the time and description of every incident that appeared on the screen. The observer also recorded any time periods during which the CLW display did not refresh at the standard 5-minute intervals. Concurrently, a second observer monitored a broadcast radio station that gave frequent traffic reports, and also regularly monitored the 511 telephone information system. These data provided a rough measure of timeliness, a fair measure of accuracy, and a good measure of system availability. On that basis, the following findings were drawn regarding CLW accuracy, timeliness, and availability.

Accuracy of the CLW, as described above, was judged primarily by comparing incident descriptions on CLW primarily to those on 511, and secondarily to any radio traffic announcements that were heard by the study team observers. It must be recognized that both CLW and 511 obtain their "raw data" from the ATMS computers at the TOC, so any judgments about accuracy of information are really assessing whether or not the CLW reported that raw data incorrectly while transforming it for web-based delivery. By that definition, the accuracy of the CLW was very high. Very few incident descriptions were observed to have noticeable errors or omissions. (See the "accuracy" discussion in section 4.2.3 for a tabulation of differences between CLW and 511 incident descriptions.)

Timeliness was difficult to measure with any real accuracy, because data was not available defining the "actual" time of occurrence of the incident or the time it was posted in the ATMS computer by the TOC Control Room operators. The only possible measure of timeliness was to compare CLW posting times with those of 511. This information is presented in Section 4.2.3 below.

Availability of the CLW was judged in terms of the number and amount of time that the system was not available for use. This could mean that a new user could not access the site, or a user that had the website already displayed on their computer screen would not see the display contents updated every five minutes. (The latter describes the procedure used by the Study Team CLW observers.) During over one hundred hours that were chosen for observation ("sampling"), there were no instances noted when the CLW was not available and updating the display every five minutes. However, the TOC observer did note one such occurrence, but it was outside of the "sampling" times for CLW so there was no accurate measure of the down time. Even considering that one instance, the CLW had a high availability (98% or better).

4.1.4 Assessment of User Perceptions of CLW

The CommuterLink Website was used by a number of parties, including residents, visitors, UDOT staff, and the interagency staff in Room 230 of the TOC. To determine the perceptions of residents and visitors, surveys were conducted of each group. Residents were surveyed via telephone, based upon random selection from the SLC phone book white pages. Visitors were queried via intercept surveys, conducted while they were waiting in line to enter the downtown venues. Both surveys were conducted during the last half of the Games, by the same survey crew, using a highly-similar set of questions. See Appendix A for copies of both questionnaires plus a detailed tabulation of all responses.

Both surveys addressed multiple topics, with the CLW being one. The objectives were to measure three parameters regarding the CLW: awareness, usage, and satisfaction.

Visitor Survey -- There were 448 visitor questionnaires with valid responses to this section, which yielded the following results:

Awareness – **41% of the visitors said they have heard of the CLW**.

Usage – Of the visitors who heard of CLW, **34% had used it**.

Satisfaction – Of the visitors who used CLW, **98% said it worked well for them**.

Of the 61 visitors who used CLW, the information they got was:
61% - traffic information
3% - road conditions
39% - Olympics information
0% - weather information
23% - other information.

Residents Survey -- There were 242 resident questionnaires with valid responses to this section, which yielded the following results:

Awareness – **70% of the residents said they have heard of the CLW**.

Usage – Of the residents who heard of CLW, **21% had used it**.

Satisfaction – Of the residents who used CLW, **97% said it worked well for them**.

Of the residents who used CLW, the information they got was:
100% - traffic information
24% - road conditions
12% - Olympics information
3% - weather
15% - other information.

Thus, the dominant purpose for both residents and visitors using CLW was to get traffic information. Olympics information came in second for visitors, while road conditions were second for SLC residents. Note of caution: it is possible that the Olympics category is overstated for both groups, because some respondents may have been confusing the SLOC Olympics Website with the UDOT CLW.

4.2 511 Telephone Service

The "511" telephone service was a recent addition to the traveler-information services for the Olympics, having begun operations less than two months before the Games began. This section first describes the 511 service, then presents assessment findings in terms of usage rates, performance, and user perceptions.

4.2.1 Description of 511 Telephone Service

The "511" telephone information service was operated by Tellme, Inc., under contract to UDOT. Tellme used computer servers located in the San Francisco area, connected via the Internet to the ATMS computers at the TOC that supplied the necessary data to Tellme. The Tellme service to users was entirely automated, using a computerized voice-recognition and voice-response system. Thus, the user would ***speak*** to request information, and the voice-recognition system would interpret verbal commands. Readers that wish to listen to the actual UDOT 511 service from locations within Utah may dial 511. To access the service from outside Utah should dial 866-511-UTAH(8824).

During the Olympics, the 511 service offered four general types of information:

- Traffic
- Public Transit
- Road Conditions
- Olympics

This structure changed after the Games to eliminate the "Olympics" option, then later replacing it with "Ferries" as the fourth main-menu option.

The "script" for a typical user session regarding traffic information is illustrated next. Recall that the system recognizes and responds to the user's voice instructions, and responds with a synthesized voice message using "concatenated speech" technology that creates normal sentences.

User: < Dials 511 on a mobile or landline telephone. >

Tellme: ***"Welcome to Utah's 511 travel information service.***
Main Menu.
Here are all your choices; when you hear the one you want, just say it:
Traffic; public transit; road conditions; or Olympics.
You can also say help, or press zero at any time."

User: "Traffic."

Tellme: ***"Traffic. When you're done here, say Main Menu. Say the name of a city in Utah, or the number a highway name, like I-15."***

User: "I-15"

Tellme: ***"OK. Interstate 15. Is that north of Salt Lake City, south of Salt Lake City, or in the city?***

User: "South of Salt Lake City."

Tellme: ***"Currently there is one incident reported. On Interstate 15 at State Route 154, there is a disabled car affecting southbound traffic."***
"Say the name of another city in Utah, or say the highway name, like I-15. When you are done here, say Main Menu."

User: "Main Menu."

Tellme: ***"Main Menu. Traffic, Public Transit; Road Conditions; or Olympics."***

User: < Terminates the call or requests another option. >

As is seen from the above example session, the information available via 511 during the Games related to traffic, public transit, road conditions and Olympics. A depiction of the menu structure for 511 service during the Games is shown in Figure 4.8.

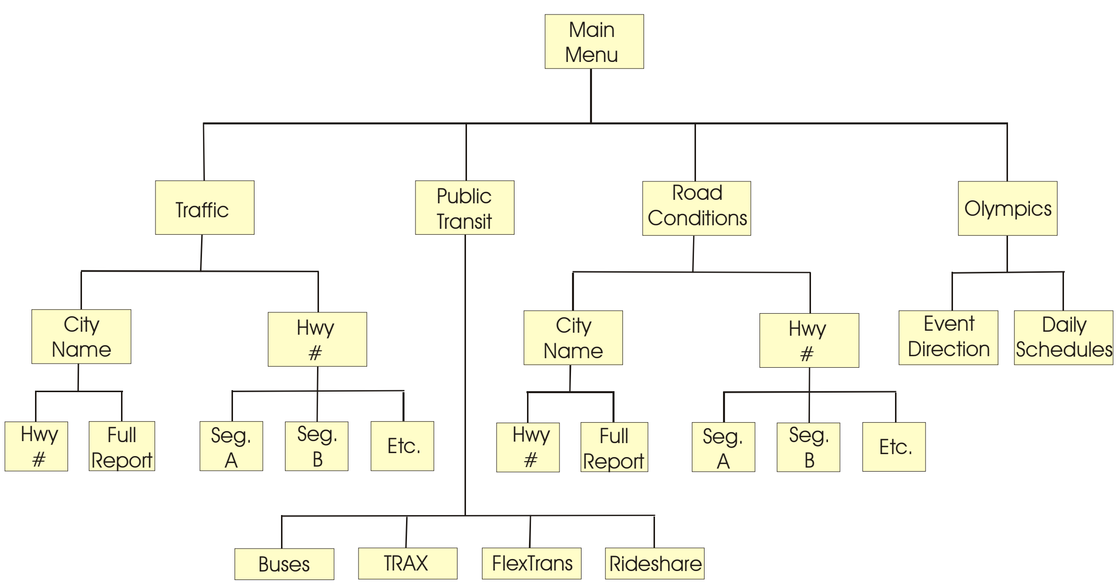


Figure 4.8 511 Menu Structure

Also note that this menu structure is ***not*** strictly hierarchical with only vertical movements permitted; there are some situations where the user may move laterally to jump directly between different "branches" in the "tree structure" of the menu system.

A detailed explanation of the operations of the 511 system appears in the next section. For readers not wishing to read this level of detail, please skip to section 4.2.2.

Traffic and Road Conditions
Traffic and Road Conditions are very similar in structure and type of information presented. The following applies to both menu options:

- the caller is given the choice of saying a city name or a highway number. If highway number is selected and if the highway is a lengthy (traversing several regions or the entire state) the highway is further segmented and the caller is asked to select a more specific area.
- "Behind the scenes" the state is divided into three urban regions (Salt Lake, Ogden, and Provo), plus 15 rural regions covering the rest of the state.
- When a caller selects a city in an urban region, the caller can then do either of the following.
  (1) select a highway number or a road name from a set list for that urban region; or
  (2) request the "Full Report" that gives Traffic and Road Conditions for all highways and roads from the set list.
- When a caller selects a city in a rural region, the caller only hears the "Full Report" for that region; there is no option to select a highway number or road name.

The information presented in these two menu options comes directly from the CommuterLink ATMS. During the Games, the system operated differently than afterwards. Under normal operation, each request from the caller causes the Tellme computers to send a query over the Internet to the ATMS computers, which send back the desired information. Because of the high call volumes expected during the Games, the Tellme system "cached" or obtained all traffic and road conditions data from the ATMS frequently and stored it on the Tellme computers. This allowed a more rapid response and greater reliability too. Note also that the information was obtained directly from the ATMS computers, not from the CommuterLink Website. Thus, the CLW and 511 services worked independently.

Public Transit
When callers select Public Transit, they are presented with 4 submenu options:

1. Buses
2. TRAX Light Rail
3. FlexTrans
4. Rideshare

During the Games, there was a fifth option, "Mountain Venue Express" which provided information about private shuttles to the remote venues. For all of these submenu options the information given is relatively static and of a general nature (i.e., not route-specific or time-specific). Each submenu option also includes a referral to UTA (via a phone number and/or the UTA website). At the end, there is also a call transfer option to a UTA operator.

Olympics
When callers selected Olympics, they were presented with two submenu options:
1. Event Directions
2. Daily Schedules

When callers selected Event Directions they could either say the name of an event (sport) or they could get a list of events (sports). The caller was then given the venue name and static directions to the venue from a set list of origins/origin areas (Salt Lake, Ogden, Heber City, "the north", etc.). There was an option to transfer to an Olympic representative for more information. When callers selected Daily Schedules, starting February 7 they were given the Olympic schedule for "today" and "tomorrow."

4.2.2 Assessment of Usage Patterns of 511 Service

Detailed usage statistics were maintained by the 511 host, Tellme, Inc. using their own tracking software package. All usage data reported in this section are based upon the information reported by that system.

<u>Definitions</u>:

Calls – The key measure of usage was "calls." This represents the number of times that any user successfully connected to the 511 service main number. When used in conjunction with items on the Main Menu or sub-menus, "calls" represents the number of callers who accessed that menu item during their call.

Visits – If the caller accessed the same menu item twice on the same call, it would be counted as one "call" but two "visits" to that menu item.

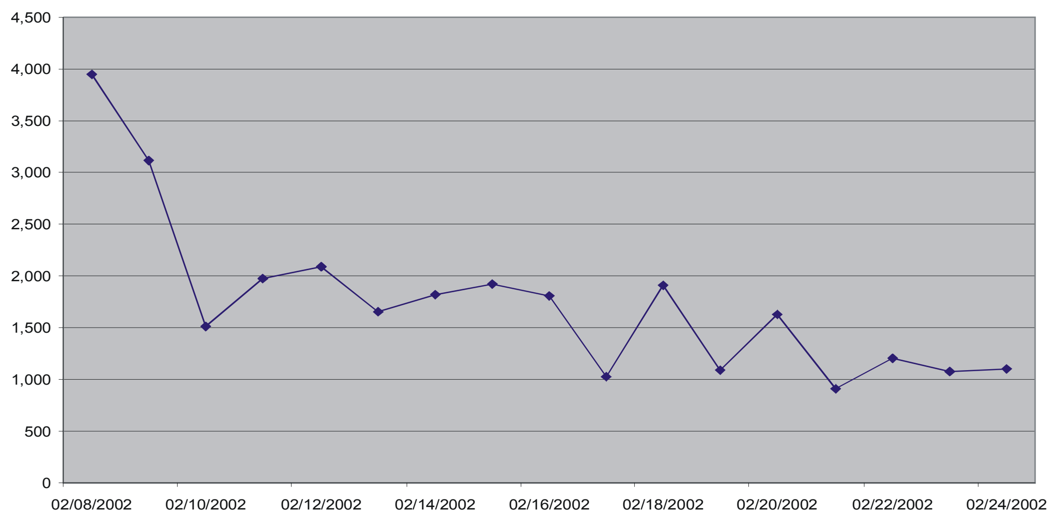
Average Duration – The total time spent connected to the 511 service, divided by the total number of calls, is the Average Duration. For specific menu items, Average Duration represents the total time spent on that menu item, divided by the total number of visits to that menu item.

<u>Usage Patterns</u>:

We will examine usage patterns in terms of calls and visits, at several levels: across the days of the Games, across the 24 hours of a typical day, across the types of information offered.

<u>Usage by day during the Games:</u>
The pattern of daily usage of the 511 service during the Games was quite similar to the CommuterLink Website. As is seen in Figure 4.9, 511 usage peaked sharply on the first

two days of the Games, reaching 4000 calls per day, then dropped quickly to about 2000 calls per day, then declined gradually for the remainder of the Games. On the morning of the first day of the Games, there was a mild snowstorm that caused a significant number of traffic incidents, probably contributing to the peak usage on that day. For comparison to non-Games patterns, see Figure 4.10 for the average 511 calls per day during the months following the Games (the comparisons start on the first Sunday in each month.).



Start Date	Number of Calls	Number of Minutes	% of All Minutes	Average Duration
02/08/2002	3,946	8,163	13%	2 min 4 sec
02/09/2002	3,114	6,440	10%	2 min 4 sec
02/10/2002	1,507	3,078	5%	2 min 3 sec
02/11/2002	1,980	4,314	7%	2 min 11 sec
02/12/2002	2,087	4,277	7%	2 min 3 sec
02/13/2002	1,652	3,451	5%	2 min 5 sec
02/14/2002	1,824	3,630	6%	1 min 59 sec
02/15/2002	1,927	4,616	7%	2 min 24 sec
02/16/2002	1,814	4,403	7%	2 min 26 sec
02/17/2002	1,028	2,219	4%	2 min 9 sec
02/18/2002	1,909	3,986	6%	2 min 5 sec
02/19/2002	1,091	2,333	4%	2 min 8 sec
02/20/2002	1,624	3,378	5%	2 min 5 sec
02/21/2002	915	1,835	3%	2 min 0 sec
02/22/2002	1,211	2,440	4%	2 min 1 sec
02/23/2002	1,075	2,198	3%	2 min 3 sec
02/24/2002	1,104	2,076	3%	1 min 53 sec
Entire Period	29,808	62,837	100%	

Figure 4.9 Incoming Calls Detailed Report for Feb. 8-24

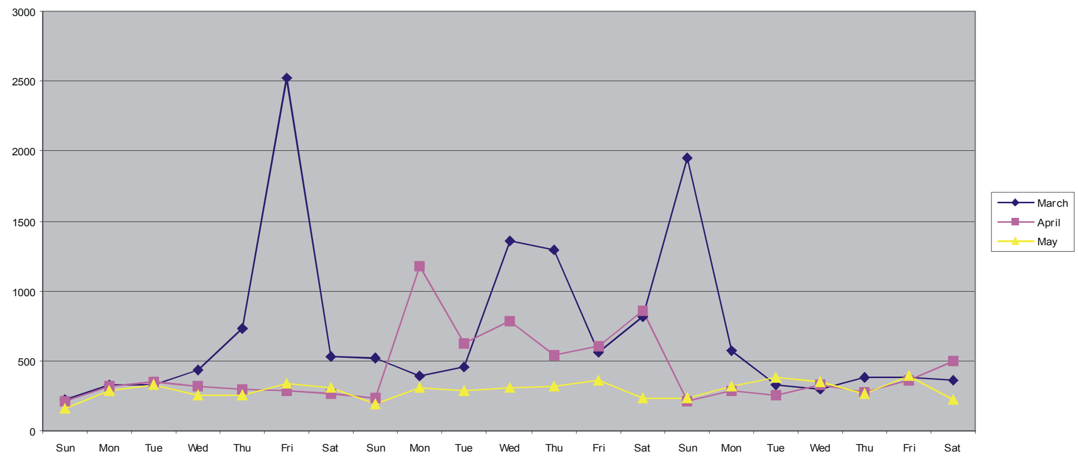
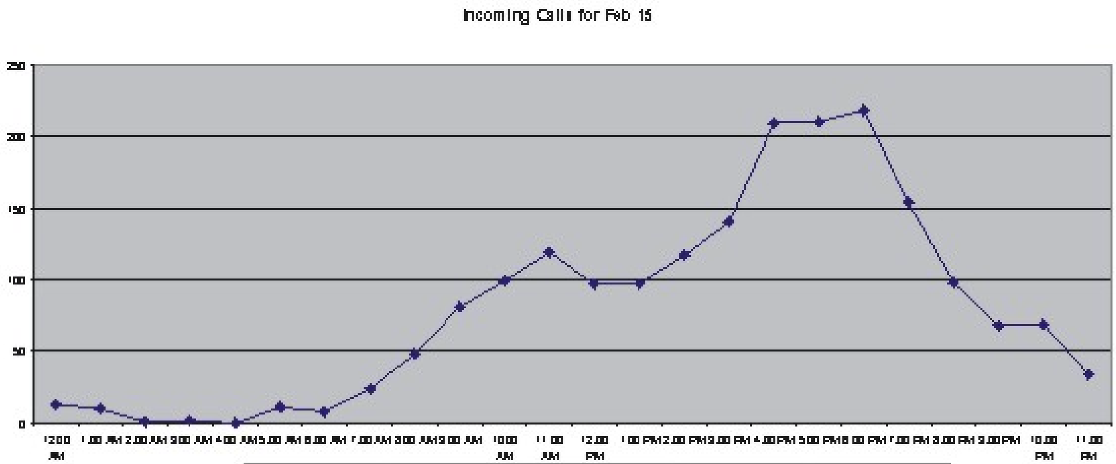


Figure 4.10 Incoming Calls in March-May

Two possible explanations of the sharp decline in 511 usage after the first two days of the Games are:
Because there was much less traffic congestion than was expected, travelers felt less of a need to seek real-time traffic information after the first few days of the Games.
After visitors learned their way around Salt Lake City in the first few days, they felt less of a need for transit and Olympics information.
These explanations could also apply to the decrease in usage of the CLW as the Games unfolded. Other explanations are, of course, also possible.

Unlike the call ***rate***, the average call ***duration*** did not change dramatically; it hovered very near 2 minutes per call throughout the Games. Thus, there was no evidence of a "learning effect" as users became more familiar with the menu structure and user interface.

Usage by hour of the day:
Although every day of the Games differed from the others in terms of the number and location of events, and other factors, it is informative to examine Friday, February 15 (the 8th day of the Games), as a "typical" day in the life of the 511 service. The hourly call volumes on that day are shown in Figure 4.11. There are no surprises here; the call rates build slowly throughout the day, peaking during the 4-7pm period. This is generally reflective of the pattern of events during the day. Perhaps one small surprise is the very low usage rates before 8 am, suggesting that SLC commuters were not among the primary uses of the 511 service.

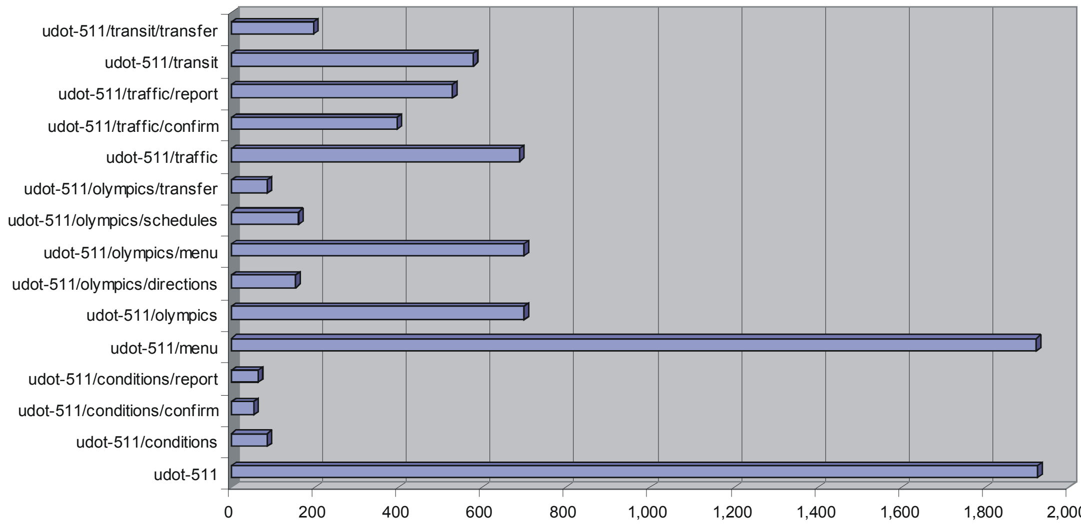


Start Time (MDT)	Number of Calls	Number of Minutes	% of All Minutes	Average Duration
12:00 AM	13	47	1%	3 min 39 sec
1:00 AM	10	24	1%	2 min 23 sec
2:00 AM	1	9	0%	8 min 53 sec
3:00 AM	2	11	0%	5 min 18 sec
4:00 AM	0	0	0%	
5:00 AM	11	25	1%	2 min 18 sec
6:00 AM	8	14	0%	1 min 45 sec
7:00 AM	24	63	1%	2 min 37 sec
8:00 AM	48	99	2%	2 min 4 sec
9:00 AM	81	205	4%	2 min 31 sec
10:00 AM	99	212	5%	2 min 8 sec
11:00 AM	119	286	6%	2 min 24 sec
12:00 PM	97	269	6%	2 min 47 sec
1:00 PM	97	195	4%	2 min 0 sec
2:00 PM	117	251	5%	2 min 9 sec
3:00 PM	140	319	7%	2 min 17 sec
4:00 PM	209	448	10%	2 min 9 sec
5:00 PM	210	492	11%	2 min 20 sec
6:00 PM	218	531	12%	2 min 26 sec
7:00 PM	154	441	10%	2 min 52 sec
8:00 PM	98	241	5%	2 min 28 sec
9:00 PM	68	175	4%	2 min 35 sec
10:00 PM	69	185	4%	2 min 41 sec
11:00 PM	34	73	2%	2 min 9 sec
Entire Period	1,927	4,615	100%	

Figure 4.11 Inbound Calls Detailed Report for Feb. 15

What information did 511 users want?

The short answer is: some of everything – except road conditions. Again examining February 15, it can be seen in Figure 4.12 that there were 1,923 calls to the 511 service on that day. Roughly the same fraction of callers – one-third – requested the traffic menu, the transit menu, and the Olympics menu. Less than 5% requested the road conditions menu, likely because the weather was good. Also please note that roughly 10% of the "Olympics" callers requested that their call be transferred to the SLOC phone number for additional information, and about 15% of the "Transit" callers requested that their call be transferred to UTA for further assistance. One interpretation of these low transfer rates is that the great majority of callers got the information they wanted from the 511 service.



Menu Option	Number of Calls	Number of Visits	Minutes in Visits	Average Duration	Transfer Attempts
udot-511	1,923	1,923	4,615	2 min 24 sec	0
udot-511/conditions	87	93	108	1 min 10 sec	0
udot-511/conditions/confirm	55	112	19	10 sec	0
udot-511/conditions/report	67	147	11	4 sec	0
udot-511/menu	1,921	2,591	1,171	27 sec	0
udot-511/olympics	698	810	1,450	1 min 47 sec	0
udot-511/olympics/directions	156	168	282	1 min 41 sec	0
udot-511/olympics/menu	698	840	782	56 sec	0
udot-511/olympics/schedules	160	164	226	1 min 23 sec	0
udot-511/olympics/transfer	86	90	160	1 min 46 sec	64
udot-511/traffic	690	766	929	1 min 13 sec	0
udot-511/traffic/confirm	398	807	121	9 sec	0
udot-511/traffic/report	527	956	226	14 sec	0
udot-511/transit	578	692	944	1 min 22 sec	0
udot-511/transit/transfer	197	210	368	1 min 45 sec	177
	1,924	1,925	1	0 sec	0

Figure 4.12 Menu Options Summary Report for Feb. 15

4.2.3 Assessment of 511 System Performance

As described in Section 4.2.1, the 511 service provides four general types of traveler information: traffic, transit, Olympics, and road conditions. As was also true of the CLW, the most challenging of these items is the delivery of real-time information about traffic incidents, which changes far more often that transit, Olympics or road-condition information. Performance of the 511 service can thus be viewed in several ways. But in the context of using the 511 service as an ATIS tool for distributing information about ***traffic incidents*** during the Games, the same three parameters again stand out as important:

1. Accuracy – Is the information provided correct and complete?
2. Timeliness – Is the information provided quickly enough to be of benefit?
3. Availability – Is the information available whenever it is needed?

To measure 511 performance in terms of these three parameters, two observers were assigned to monitor the 511 system for six or more hours per day, generally in the afternoon, for most days during the Games. One observer called 511 at regular intervals, and recorded any time periods during which the 511 was not available for any reason. Concurrently, a second observer monitored a broadcast radio station that gave frequent traffic reports, and also monitored the CLW congestion map and Alerts. When an incident was identified via any of these sources, the observer called the 511 service immediately to test for that incident. These data provided a rough measure of timeliness, a fair measure of accuracy, and a good measure of system availability. On that basis, the following findings were drawn regarding 511 accuracy, timeliness, and availability.

Accuracy:
Accuracy of traffic incidents reported on the 511 service was measured by comparing the 511 descriptions of each incident against information from one or more other sources. These sources consisted primarily of the CLW, and secondarily the accidents reported on broadcast radio stations. Methods for measuring accuracy were based upon the observers recording the description given by 511 for each incident, and comparing it against the descriptions given by the other sources. The results of these observations are given in Table 4.

Table 4 System Accuracy Tests for 511 Telephone Service

Date	Observation Period	# of Hours	# Incidents Observed	Comments or Accuracy Problems Observed
Feb. 8	11:00am-5:30pm	6.5	8	No comments were recorded. Data excluded.
Feb. 9				No comments were recorded. Data excluded.
Feb. 10	10:40am-5:45pm	8	4	No comments were recorded. Data excluded.
Feb. 11	8:00am-6:00pm	10	7	No comments were recorded. Data excluded.
Feb. 12	10:35am-6:25pm	8	2	No accuracy problems observed.
Feb. 13 Feb. 13	12:00pm- 7:10pm	7	5	No accuracy problems observed.
Feb. 14	10:30am-12:15pm 4:35pm- 8:00pm	2 3.5	7	Three incidents in a row from CLW did not appear on 511. The discovery times and incident #s were: 11:13am (#1557416), 4:35pm (#1557423), and 5:00pm (Alert only, no #given). After that, the next four incidents from CLW did appear on 511.
Feb. 15	9:35am- 5:00pm	7.5	11	One incident from CLW did not appear on 511. (Discovery time on CLW was 11:47am, and the incident number was #1557472.)
Feb. 16	10:30am- 7:00pm	9.5	9	Three incidents (not in a row) from CLW did not appear on 511. The discovery times and incident numbers were: 11:01am (#1557473), 3:28pm (#1557476), and 5:36pm (#1557478).
Feb. 17	11:15am- 5:15pm	6	4	No accuracy problems observed.
Feb. 18	11:00am- 7:00pm	8	3	One incident (12:30pm, #1557495) was not mentioned on SLC Full Report, but was listed under route report for SR-190. One incident (1:04pm, #1557496), did not appear on 511.
Feb. 19	10:30am- 6:00pm	7.5	5	One incident (10:58am, #1557508), did not appear on 511. One incident (12:57pm, #1557509) was not mentioned on Provo Full Report, but was listed under route report for Hwy-189.
Feb. 20	11:00am- 7:00pm	8	16	One incident (12:40pm, #1557534) did not appear. One incident (1:30pm, #1557535) was reported under I-15 north of SLC, but was not mentioned under Ogden, on whose map it was being shown. One incident (1:36pm, #1557536) not reported under I-215 but was reported under SR-201. One incident (2:25pm, #1557538) did not appear.
Feb. 21	11:00am- 5:00pm	6	7	One incident (4:08pm, #1557565) did not appear.
Feb. 22	10:00am- 6:00pm	8	7	No accuracy problems observed.
Feb. 23	11:30am- 7:00pm	7.5	2	No accuracy problems observed.
Feb. 24	11:00am- 7:00pm	8	8	Four incidents from CLW did not appear on 511: 11:37am (#1557615), 12:19pm (#1557616), 3:59pm (#1557620), 6:14pm (#1557624).
	Totals:	**96.5**	**86**	

It can be seen that from this table that, of the 86 incidents that were observed (all but two discovered from the CLW), 20 incidents were inaccurately reported on 511. Of those 20 incidents, 16 were not reported at all, and 4 were reported but had some discrepancy (usually minor).

Timeliness:
Timeliness is a difficult parameter to measure. In an ideal world, it would be possible to somehow know exactly when each incident occurred, and exactly what happened. In the "real" world, this is not possible except in the very rare instance when a control-room operator happens to see the incident occur on a CCTV camera. Thus, in essentially all incidents, some time elapses before the incident is detected and verified by the traffic-management system (whether by human or machine efforts). Although some research studies have attempted to measure this detection/verification period, there was no attempt in this study to do so. The initial study design envisioned obtaining internal data from the ATMS computers to determine, for each incident, when the system had detected and verified that incident. This data was not available for extended periods. Hence, the best available way to assess timeliness of 511 information was to compare it to other sources of incident information – the CLW system primarily, and (occasionally) broadcast radio accident reports. These comparisons looked at both the "start" and "end" times, that is, the times that each incident appeared and disappeared from the CLW and 511. The results of these observations are summarized in Table 5.

Table 5 System Timeliness Tests for 511 Telephone Service

Date	Observation Period	# of Hours	# Incidents Observed	Comments or Timeliness Problems Observed (Differences noted compare 511 vs. CLW, posting and removal times)
Feb. 8	10:30am-5:00pm	6.5	8	Max. difference = 3 minutes (on post & remove).
Feb. 9	3:30am- ? pm	?	2	Max. difference = 3 minutes. Data excluded.
Feb. 10	10:40am-5:45pm	8	4	Max. difference = 3 minutes.
Feb. 11	8:00am-5:00pm	9	7	Max. difference = 3 minutes.
Feb. 12	8:00am-6:30pm	12.5	3	Max. difference = 4 minutes.
Feb. 13	8:00am-6:30pm	12.5	6	Max. difference = 2 minutes.
Feb. 14	7:00am-8:30pm	13.5	9	Max. difference = 3 minutes.
Feb. 15	8:00am- 5:00pm	9	13	Max. difference = 5 minutes except 3 incidents posted 8, 10 & 12 minutes later than CLW).
Feb. 16	10:15am- 7:00pm	10	6	Max. difference = 5 minutes.
Feb. 17	11:15am- 7:15pm	8	4	Max. difference = 5 minutes.
Feb. 18	11:00am- 7:00pm	8	2	Max. difference = 5 minutes except one incident posted 25 minutes later and removed 8 minutes later than CLW.
Feb. 19	10:30am- 6:00pm	7.5	4	Max. difference = 7 minutes
Feb. 20	11:00am- 7:00pm	8	14	Max. difference = 5 minutes.
Feb. 21	11:00am- 7:00pm	8	6	Max. difference = 3 minutes.
Feb. 22	10:00am- 6:00pm	8	7	Max. difference = 5 minutes.
Feb. 23	11:30am- 7:00pm	7.5	2	Max. difference = 6 minutes.
Feb. 24	11:00am- 7:00pm	8	3	Max. difference = 2 minutes.
	Total Hours:	**143**	98	

It can be seen from this table that the ***maximum*** difference is generally around 2-5 minutes, with a few exceptions. There appeared to be consistent delays during the afternoon of Feb. 15, and one unusual delay on Feb. 18. Aside from that, there appeared to be good consistency between CLW and 511 posting and removal times. Both systems draw their data from the ATMS computers at the TOC, so consistency would be expected if both are working reliably. It appears they are, with rare exceptions.

Service Availability:

To be effective, traveler-information systems must provide information to people when they need it. Thus, one important measure of the performance of the 511 service is "availability." For this study, availability is measured in terms of system "up-time" or "down-time" as seen by users. To measure system availability, one of the data-collection crew was assigned to test the system by calling the 511 service at fixed intervals (generally every 15 minutes, but more frequently when problems were noted) and recording any instances when and why the service did not respond fully. This was generally done for 4-6 hours per day during the afternoon when 511 system usage was highest, but also included several morning and evening periods. These observations began on February 12, the fifth day of the Olympics. The results of these tests are summarized in Table 6.

Table 6 System Availability Tests for 511 Telephone Service

Date	Observation Period	# of Hours	Observation Frequency	Problems Observed
Feb. 8	No observations			
Feb. 9	No observations			
Feb. 10	No observations			
Feb. 11	No observations			
Feb. 12	10:35am-6:25pm	8	15 minutes	No availability problems observed.
Feb. 13 Feb. 13	12:05pm-8:15pm 8:30pm-9:05pm+	8.3 0.7	15 minutes 5 minutes	No problems observed. Beginning at 8:30pm and continuing thru 9:05pm (when observer finished his shift), the 511 system answered with the message: "An error has occurred and will improve shortly."
Feb. 14	10:30am-12:15pm 4:35pm- 8:00pm	2 3.5	5-15 minutes 15 minutes	No availability problems observed.
Feb. 15	9:35am- 5:00pm	7.5	15 minutes	No availability problems observed.
Feb. 16	10:30am- 7:00pm	9.5	15 minutes	No availability problems observed.
Feb. 17	11:15am- 5:15pm	6	15 minutes	No availability problems observed.
Feb. 18	No observations			
Feb. 19	11:00am- 5:00pm	6	15 minutes	No availability problems observed.
Feb. 20	11:00am- 5:00pm	6	15 minutes	No availability problems observed.
Feb. 21	11:00am- 5:00pm	6	15 minutes	No availability problems observed.
Feb. 22	10:15am- 6:00pm	8	15 minutes	No availability problems observed.
Feb. 23	11:30am- 6:00pm	6.5	15 minutes	No availability problems observed.
Feb. 24	11:00am- 7:00pm	8	15 minutes	No availability problems observed.
	Total Hours:	**86**		

Thus, out of a total of about 86 hours "sampled" there were problems observed for less than one hour, and during that time no 511 services were available. This sample yields **a "downtime" of roughly 1%**, or a **"system availability" of about 99%**, during the periods observed. The cause of the single system outage was not known. Please note that there was no sampling during the nighttime periods (11pm to 6am), when system maintenance is most likely to be performed. Thus, this estimate of system availability is applicable to the daytime periods when the 511 service was most heavily used during the Games.

4.2.4 Assessment of User Perceptions of 511

The 511 service was used by several parties, primarily including residents and visitors. To determine the perceptions of residents and visitors, surveys were conducted of each group. Residents were surveyed via telephone, based upon random selection from the SLC phone book white pages. Visitors were queried via intercept surveys, conducted while they were waiting in line to enter the downtown venues. Both surveys were conducted during the last half of the Games, by the same survey crew, using a highly similar set of questions. See Appendix A for copies of both questionnaires.

The surveys addressed multiple topics, with 511 service being one. The objectives were to measure three parameters regarding the 511 service: awareness, usage, and satisfaction.

Visitor Survey -- There were 443 visitor questionnaires with valid responses to this section, which yielded the following results:

Awareness – **25% of the visitors said they have heard of the 511 service**.

Usage – Of the visitors who heard of the 511 service, **17% had used it**.

Satisfaction – Of the visitors who used 511, **75% said it worked well for them**.

Of the visitors who used 511, the information they got was:

- 63% - traffic information
- 16% - road conditions
- 42% - Olympics information
- 37% - public transit
- 0% - other information.

Residents Survey -- There were 242 resident questionnaires with valid responses to this section, which yielded the following results:

Awareness – **44% of the residents said they have heard of the 511 service**.

Usage – Of the residents who heard of 511, **4% had used it.**

(Note that 4% represents only 4 respondents – a very small sample. The following data are not statistically significant at a high level of confidence.)

Satisfaction – Of the 4 residents who used 511, **100% said it worked well for them**.

Of the 4 residents who used 511, the information they got was:

- 75% - traffic information
- 0% - road conditions
- 0% - Olympics information
- 0% - commuter tips
- 0% - public transit
- 25% - other information.

Thus, the dominant purpose for both visitors and residents using 511 was to get traffic information.

4.3 Variable Message Signs

This section discusses the use of VMS for traveler information. Section 3 discusses their use for Traffic Management.

4.3.1 Description of Variable Message Signs

As previously described, there were 63 permanent Variable Message Signs installed across the SLC area primarily on freeways, plus some portable VMS that were used during the Games primarily on surface streets. See Figure 4.13 for map of VMS locations. All of these VMS devices were controlled electronically by the Navigator software at the TOC.

For traffic-management purposes, freeway VMS *generally* used a common message format, consisting of three lines.

1. The first line *identifies the problem*.
2. The second line generally *identifies the location*.
3. The third line generally *recommends action*.

This is illustrated in the sample messages below:

1st Line: Identifies Problem

2nd Line: Identifies Location

3rd Line: Recommends Action

For traveler-information purposes, it was often necessary to deviate from this message format in order to convey the necessary information within the constraints of the sign size. One traveler-information message that was displayed very often was:

DOWNTOWN
SHUTTLE BUS
STARTS 2:00PM

For both purposes, there were also some instances where one or more of the lines on the sign would alternated or “toggle” between two different lines of text. This was one technique used to display more information than would otherwise be possible given the size and layout of the VMS hardware.

Figure 4.13 Map of VMS Locations

4.3.2 Use of Variable Message Signs for Traveler Information

As discussed in section 3, the Variable Message Signs were used during the Games for both traffic management and traveler information. Although specific data was not available describing and counting all VMS messages that were displayed during the Games, the TOC Observers believed that the VMS were used ***far*** more heavily for traveler information. This included information about available park-and-ride lots, directions to venues, and general information messages. For example, the message: "Shuttle bus service begins at 2:00pm" was widely displayed on VMS across the SLC area in the morning during the Games.

Prior to the Games, a VMS plan was developed that included the messages to be posted on specific VMS locations at specific times during each day of the Games, primarily to direct motorists to nearby venues. As discussed above, the VMS were also used to direct motorists to appropriate park-and-ride lots. Some of these messages were pre-planned, and some were real-time based upon the unexpected changed to loading/filling patterns of some park-and-ride lots.

4.3.3 Assessment of Performance of Variable Message Signs

No significant reliability problems were noted with the VMS equipment, but one operational limitation was observed. It appeared that, when the same message had to be posted on multiple VMS displays, they must be done one at a time rather than in a group. This was not a practical limitation when VMS was used for their normal use – traffic management. However, when they were used for traveler information during the Games, it was a more common occurrence. For example, a message was posted on many VMS displays each morning giving the starting time of the shuttle buses. Once again, this situation was relatively unique to the Games.

4.3.4 Assessment of User Perceptions of Variable Message Signs

To measure the perceptions of visitors regarding the VMS, surveys were conducted. Visitors were queried via intercept surveys, conducted while they were waiting in line to enter the downtown venues. This survey was conducted during the last half of the Games. A copy the questionnaire appears in Appendix A.

The survey addressed multiple topics, with VMS being one. The objectives were to measure two parameters regarding the VMS service: awareness and satisfaction.

Visitor Survey -- There were 444 visitor questionnaires with valid responses to this section, which yielded the following results:

Awareness – **71%** of the visitors said they had seen the VMS on the roadways.

<u>Satisfaction</u> – Of the visitors who remembered seeing the VMS, **<u>89%</u>** said they "found them helpful."

Thus, both awareness and satisfaction regarding the VMS was very high among the Olympics visitors.

4.4 Highway Advisory Radio

Highway Advisory Radios (HAR) equipment was used during the Games for both traffic management and traveler information. As with the VMS, counts were not made, but the TOC Observers noted that the HARs were used much more heavily for traveler information. This included information about available park-and-ride lots, directions to venues and parking, and general information messages. This section discusses the use of HAR for traveler information. Section 3 assesses their use for Traffic Management purposes.

4.4.1 Description of Highway Advisory Radio

Highway Advisory Radio (HAR) can provide more detailed information in the verbal messages than can be communicated on VMS. During the Games, there were 12 HAR sites. As is inherent in all HAR systems, the geographic coverage area of each HAR unit's broadcast signal was limited. When any HAR unit was broadcasting a message, roadside signs within the radio coverage area would flash, indicating that motorists should tune their radio to a specific frequency for important traffic information.

All of the HAR units were controlled via a dial-up telephone, either landline or wireless. Hence, changes to HAR messages could be made from any location, but this task was performed from the TOC Control Room during the Games. However, the system for monitoring and updating HAR messages was "stand-alone," that is, entirely separate from the ATMS and other computer systems in the TOC.

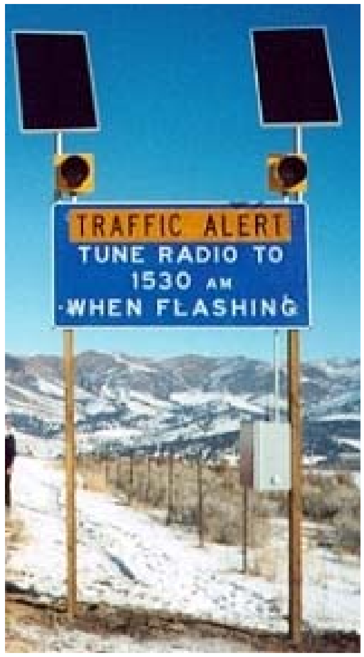


Figure 4.14 HAR Sign

4.4.2 Usage of Highway Advisory Radio for Traveler Information

As discussed in section 3, the HAR units were used during the Games for both traffic management and traveler information. Although specific data was not available describing and counting all HAR messages that were broadcast during the Games, the TOC Observers believed that the HAR were used ***far*** more heavily for traveler information. This primarily included information about available park-and-ride lots, and directions to parking for venues, plus some general information messages.

Prior to the Games, a number of HAR messages were recorded and stored in each HAR unit, to be used at pre-specified times during specific days of the Games, primarily to direct motorists to parking at nearby venues. There were also a number of real-time changes to these messages, in response to unexpected events, such as the loading/filling patterns of the venue parking lots. No detailed data was available describing the actual messages used at specific locations and dates/times.

4.4.3 Assessment of Performance of Highway Advisory Radios

In general, the HAR units performed their mission effectively and were well-received by motorists. Because of the unique demands of the Games, there were a few situations when unexpected problems arose. These included:

- Message Updating – A significant upgrade to HAR system was installed shortly before Games began, including new signs plus new software for updating messages. Some difficulties were encountered in learning to use the new system to change the message content. On several occasions this caused partial or incorrect messages to be transmitted for a period of time.

- Wireless-Phone Batteries – Some HAR units were accessed via wireless phones, and the phone at that HAR unit was powered by a battery that was recharged by solar panels. Because the HAR messages were changed much more frequently during the Games than normally, and because difficulty in changing messages resulted in increased air time on the wireless phones, there were a few instances when the batteries discharged and the HAR unit could not be accessed for a time.
- Wireless-Phone Traffic – There were a few situations during the Games when the heavier-than-normal cell-phone traffic in the area of a HAR unit prevented it from being updated promptly.
- Overlapping Broadcast Areas – Because the permanent and portable HAR units were deployed more densely and used much more intensely during the Games, UDOT staff noted a few situations when broadcast messages from two HAR units overlapped and made it difficult to understand either one.

4.4.4 Assessment of User Perceptions of Highway Advisory Radio

Surveys were conducted by the study team to measure the perceptions of visitors regarding the HAR. Visitors were interviewed via intercept surveys, conducted while they were waiting in line to enter the downtown venues. This survey was conducted during the last half of the Games. See Appendix A for a copy the questionnaire. The survey addressed multiple topics, with HAR being one. The objectives were to measure two parameters regarding the VMS service: awareness and satisfaction.

Visitor Survey -- There were 439 visitor questionnaires with valid responses to this section, which yielded the following results:

Awareness – **40%** of the visitors said they had seen the HAR signs on the roadways.

Satisfaction – Of visitors who remembered the HAR systems, **76%** said they "found them helpful."

Thus, *awareness* of HAR appears low, but *satisfaction* appears high among the Olympics visitors who used them.

Note of Caution: the surveyors reported that, despite their efforts to use clear language and offer supplemental descriptions when needed, a few respondents might have confused commercial broadcast radio stations with the HAR service. The low awareness rates indicate that most respondents did understand the distinction between the two types of radio information. However, the satisfaction results for the HAR should be interpreted with a bit of caution.

5 Travel Demand Management Findings

Because the Games were expected to dramatically increase the number of person-trips being made in the Salt Lake City area, a coalition of SLOC, UTA, UDOT, and other government agencies led an effort to reduce traffic problems by ***managing the demand*** for travel by private autos. This Travel Demand Management (TDM) Program included two overarching strategies for two primary groups:

1. Spectators – For visitors (and for residents attending events) provide convenient alternatives to driving an automobile. This included TRAX light-rail service, park-and-ride lots with shuttle buses to venues downtown and nearby, and shuttle vans to outlying venues in the mountains.

2. Residents – For residents of Salt Lake City traveling to sites other than the Games, provide encouragement to alter their travel patterns to avoid driving during the times when Games events were underway. This includes personal and business travel, as well as truck traffic within and through the Salt Lake City area.

This section describes and assesses both of these strategies. We begin with a description of the "TDM Plan," which primarily addressed strategy 2 above (non-Games travel). We then discuss overall traffic volumes and the reductions in traffic resulting from the TDM program. We then examine the reductions in truck volumes, because trucks can have a major impact upon traffic flow. The next section describes OSTS Plan and the range of transit services available to ***spectators*** during the Games, and it then describes the ridership on those spectator services. The final two sections describe travel by residents as measured via a telephone survey during the Games, and a discussion of the question "Where did all the traffic go?" arising from the fact that traffic counts were generally well below the predictions made before the Games.

5.1 Overview of TDM Plan

The TDM Plan defined a program of activities that sought to involve over a dozen transportation stakeholders in the Salt Lake City area. This included residents, major employers, commercial/retail businesses, schools, and other local interests, plus local and long-distance truckers who pass through the area. The Goal of the TDM Program was to reduce the "background" traffic by at least 20%. The strategies used included increased transit use, carpools, shifting work hours earlier, shifting travel routes and times (especially for trucks), and other TDM approaches to reduce traffic.

In a parallel effort, SLOC, UTA, UDOT and other agencies addressed the ***spectator*** population by developing the Olympic Spectator Transportation System (OSTS). This included 19 park-and-ride lots with shuttle buses to downtown, plus overflow parking lots for TRAX riders to maximize the use of the light-rail system, as well as a publicly subsidized contracted shuttle service to the mountain venues. This spectator-related is described more fully in Section 5.4 below.

5.2 Traffic Volumes

One key question about the TDM program is: "How much did it reduce background traffic?" (that is, traffic resulting from travel by ***residents*** rather than visitors). Alternatively, since the goal of the TDM Program was to reduce background traffic by 20%, a related question would be:

"Did the TDM Program achieve its stated 20% goal?"

This section examines some of the data that was collected by UDOT in an attempt to answer this question.

To avoid any unnecessary suspense, we will admit that it was not possible to answer this question precisely. However, the data does admit to two general conclusions:

1. Traffic to/from the downtown area was reduced by ***more*** than 20%, and probably much more.
2. No conclusions can be drawn about traffic in the outlying, mountain areas, based upon the data examined.

UDOT collected traffic volume data in two primary ways: (1) at Traffic Monitoring Stations (TMS), and (2) at Automated Traffic Recorder (ATR) stations. As described in Section 3.1.4 and 3.3.4, there were substantial gaps in TMS data that was archived. The ATR archived data was essentially complete, and there were an adequate number of collection stations spread around the region. Therefore, this analysis is based upon ATR data that was collected by UDOT during the Games and delivered to the Study Team in disaggregate form.

For comparison to non-Games traffic, this analysis used ATR data from 2001 that was also supplied by UDOT in a highly-aggregated form, on a day-of-the-week basis for February 2001. That means that all Mondays in February 2001 were averaged to produce one number for Average Daily Traffic (ADT) representing the "baseline" traffic on all Mondays.

We examined data from six ATR sites in the Salt Lake City area – three urban and three rural. The urban sites are all major state routes, and are surface streets that are used primarily to travel to/from the downtown area. These urban sites are:

1. SR-89 (State St.), I-80 to Downtown.
2. SR-71 (700 East), I-80 to Downtown.
3. SR-186 (500 South), Redwood Rd. to 300 West.

The three rural sites are major highways in outlying, mountainous areas. They are:

1. I-80, east of I-215E to Kimball Junction.
2. US-40 near Heber.
3. US-180 near Provo.

The data from each of these sites is described and interpreted next, beginning with the three urban locations.

__Site 1 – SR-89 (aka State Street),__ from I-80 to Downtown, is a north/south street on the south side of downtown Salt Lake City (ATR Station #325). Figure 5.1 shows the Average Daily Traffic (ADT) for an "average" February (based upon day-of-the-week averages from 2001). The second line on this graph shows the ATR counts for each Games day from February 9 thru 24. The graph displays one line for each of these two counts, plus bars depicting the percent ***difference*** between the Games vs. the Average February day. Note that all but one of the bars displays a ***negative*** number. This means that the traffic during the Games was ***less*** than during a comparable average day in previous Februarys. Although there is a great deal of variability in the day-to-day differences, the average difference is roughly a 25% ***decrease*** in traffic.

Average Daily Traffic Volumes								
Sta. No.	325				325			
February Date	Ave. Feb. ADT				SR-89 (I-80 to Downtown)			% Change from Ave. Feb. ADT
09-Feb	37300				23056			-38.2%
10-Feb	22500				20993			-6.7%
11-Feb	39100				21472			-45.1%
12-Feb	39100				21255			-45.6%
13-Feb	39100				21761			-44.3%
14-Feb	39100				27638			-29.3%
15-Feb	39100				31799			-18.7%
16-Feb	37300				30612			-17.9%
17-Feb	22500				23292			3.5%
18-Feb	39100				20847			-46.7%
19-Feb	39100				32135			-17.8%
20-Feb	39100				27185			-30.5%
21-Feb	39100				28439			-27.3%
22-Feb	39100				33133			-15.3%

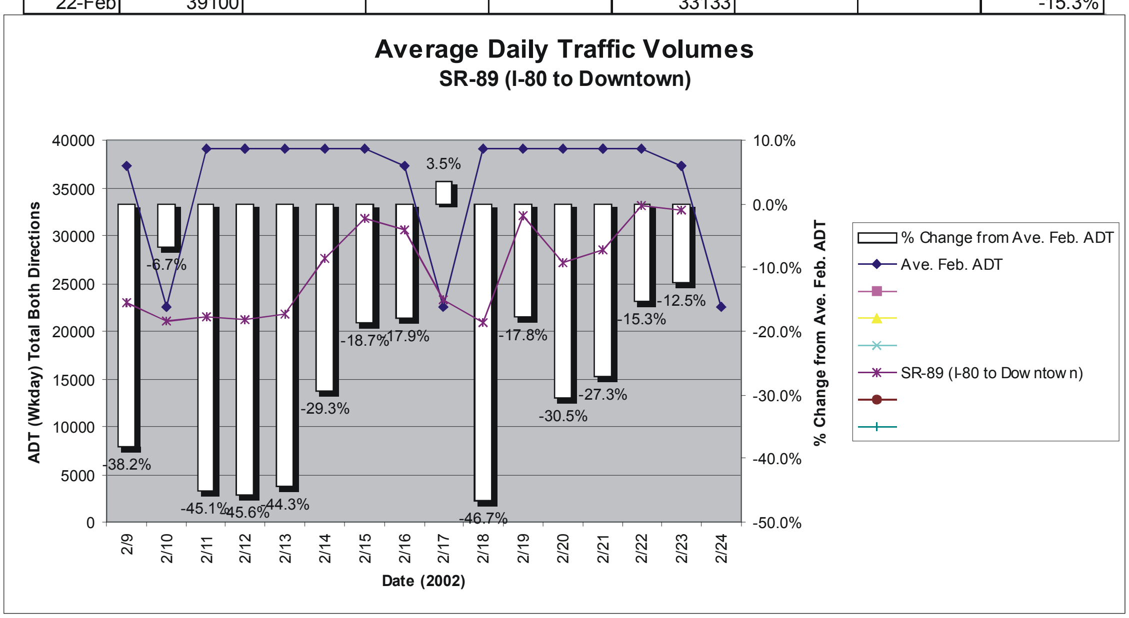


Figure 5.1 Traffic Volumes on State Street

These traffic counts include travel by residents ***and*** visitors. (Indeed, there is no way to separate them out.) This means that the traffic caused by ***residents and visitors*** during the Games was ***less*** than the traffic of ***residents alone*** during previous Februarys. Because there is no way to separate the traffic counts of residents versus visitors, the only safe conclusion is that the TDM Program reduced resident traffic by ***at least 25%*** on this street. Because visitors probably represented a substantial proportion of the traffic, it is reasonable to infer that the TDM Program reduced resident traffic by more than 25% – and possibly much more.

However, it is also possible that external factors might have affected this particular street. For example, it might have been used in pervious years as an alternate route into downtown while the parallel I-15 freeway was being reconstructed. Thus, we should examine several other routes into downtown.

Site 2 – SR-71 (aka 700 East), from I-80 to Downtown, is a north/south street on the south side of downtown, about one-half mile east of State Street (ATR Station #333). Figure 5.2 shows the ADT for an "average" February, and also the ATR counts for February 9 thru 24. The graph displays the same two lines plus a set of bars depicting the percent ***difference*** between them. Again, there is a lot of variability with several increases and many decreases. But overall, the average difference is roughly a **10%** ***decrease*** in traffic. It should also be noted that one of the major park-and-ride lots (Liberty Park) was located on 700 East so some of this traffic may have been destined to that lot rather than to downtown. Thus, the actual decrease of combined visitor and resident traffic into downtown may have been greater than 10%.

Average Daily Traffic Volumes								
Sta. No.	333					333		
February Date	Ave. Feb. ADT					SR-71 (I-80 to Downtown)		% Change from Ave. Feb. ADT
09-Feb	38400					31725		-17.4%
10-Feb	25000					24820		-0.7%
11-Feb	49400					40812		-17.4%
12-Feb	49400					39788		-19.5%
13-Feb	49400					47291		-4.3%
14-Feb	49400					51125		3.5%
15-Feb	49400					48994		-0.8%
16-Feb	38400					38055		-0.9%
17-Feb	25000					29434		17.7%
18-Feb	49400					34410		-30.3%
19-Feb	49400					45404		-8.1%
20-Feb	49400					42492		-14.0%
21-Feb	49400					45972		-6.9%
22-Feb	49400					52562		6.4%

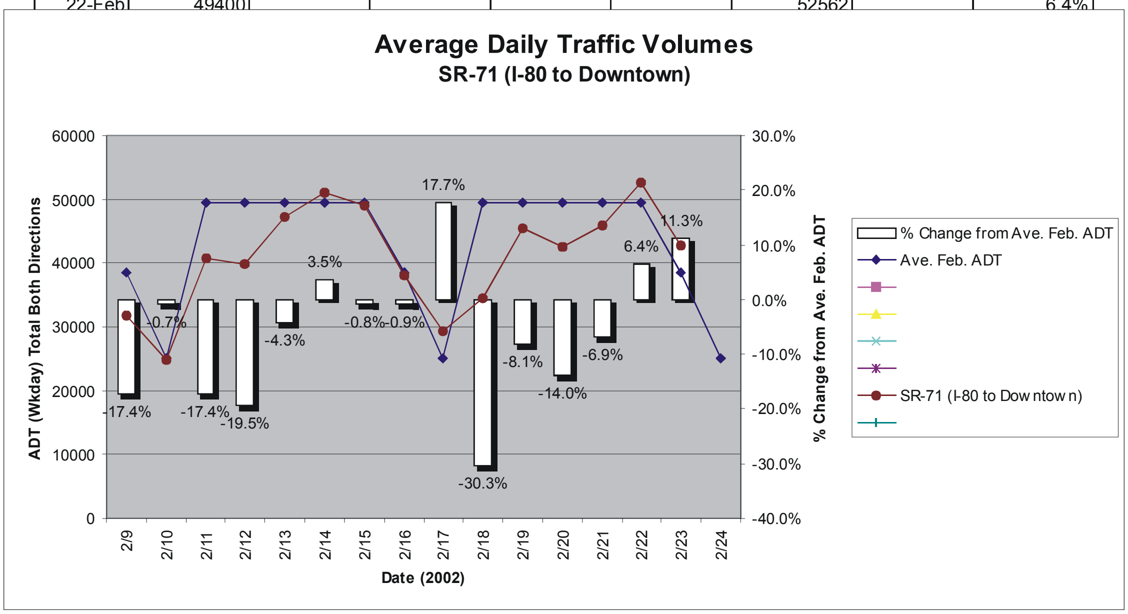


Figure 5.2 Traffic Volumes on 700 East

Once again, these traffic counts on 700 East include travel by residents ***and*** visitors. Because visitors probably represented a substantial proportion of the traffic, it is again reasonable to infer that the TDM Program reduced ***resident*** traffic by more than 10% – and probably much more.

Site 3: SR-186 (aka 500 South), from Redwood Road to Downtown, is an east/west street on the west side of downtown (ATR Station #409). Figure 5.3 shows the average February ADT, plus the ATR counts for February 9 thru 24. The graph displays the same information as the previous two figures. Again, there is some variability, but less than the others and with only one small increase and many decreases. Overall, the average difference is an approximate 20% ***decrease*** in traffic during the Games.

Average Daily Traffic Volumes								
Sta. No.	409						409	
February Date	Ave. Feb. ADT						SR-186 (SR-68 to 300 W.	% Change from Ave. Feb. ADT
09-Feb	26100						21865	-16.2%
10-Feb	19500						17987	-7.8%
11-Feb	35500						24336	-31.4%
12-Feb	35500						24845	-30.0%
13-Feb	35500						25514	-28.1%
14-Feb	35500						25746	-27.5%
15-Feb	35500						27641	-22.1%
16-Feb	26100						24503	-6.1%
17-Feb	19500						19707	1.1%
18-Feb	35500						22533	-36.5%
19-Feb	35500						26030	-26.7%
20-Feb	35500						25404	-28.4%
21-Feb	35500						26100	-26.5%
22-Feb	35500						28749	-19.0%

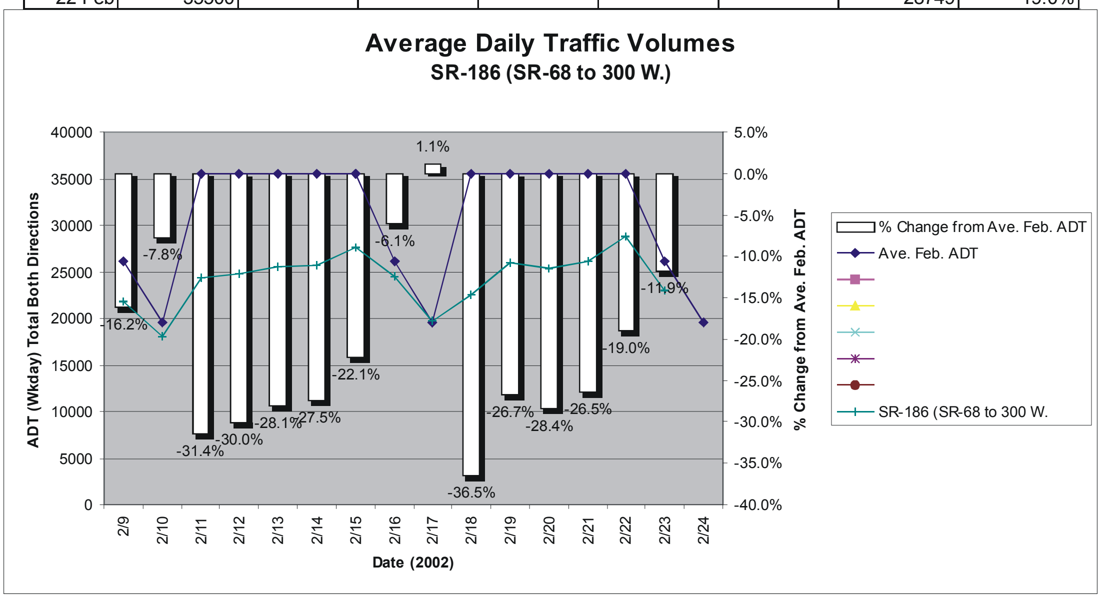


Figure 5.3 Traffic Volumes on 500 South

Once again, these traffic counts on 500 South include travel by residents ***and*** visitors. Because visitors probably represented a substantial proportion of the traffic on 500 South, it is again reasonable to infer that the TDM Program reduced ***resident*** traffic by more than 20%.

Considering the three sites together, they demonstrate that combined resident and visitor traffic to/from the downtown area actually ***decreased*** during the Games by 15-20%. Although it is not possible to separate the visitor traffic from the resident traffic, it seems safe to assume that there were a significant number of visitors in this traffic to downtown. On this basis, the reduction in ***resident*** traffic was ***much*** greater than 15-20%. With even a small fraction of visitors in the traffic mix, that reduction would calculate at 30 to 40% – far exceeding the 20% goal of the TDM Program.

Because it is impossible to determine what the Salt Lake City residents would have done in the absence of the TDM Program, we will attribute that entire decrease in downtown traffic to the TDM Program.

Unfortunately, the traffic and TDM story is quite different for the rural sites, as is discussed next.

<u>Site 4: I-80, east of I-215E to Kimball Junction (aka "Parley's Canyon")</u>, from I-215E to Kimball Junction, is just east of Salt Lake City (ATR Station #301). This 3-lane roadway is on a transcontinental Interstate Highway route. Figure 5.4 shows the average February ADT, plus the ATR counts for February 9 thru 23. The graph displays the same information as the previous graphs. Again, there is some variability, but all of the changes are ***in***creases – and big ones at that. The average difference is roughly an 80% ***increase*** in traffic during the Games.

Average Daily Traffic Volumes								
Sta. No.	301	301						
February Date	Ave. Feb. ADT	I-80 (I-215 E to Kimbal Jct.)						% Change from Ave. Feb. ADT
09-Feb	40500	48845						20.6%
10-Feb	31000	51386						65.8%
11-Feb	36000	55346						53.7%
12-Feb	36000	59552						65.4%
13-Feb	36000	58949						63.7%
14-Feb	36000	59871						66.3%
15-Feb	36000	68400						90.0%
16-Feb	40500	74306						83.5%
17-Feb	31000	61387						98.0%
18-Feb	36000	69244						92.3%
19-Feb	36000	60422						67.8%
20-Feb	36000	59515						65.3%
21-Feb	36000	65572						82.1%
22-Feb	36000	72249						100.7%

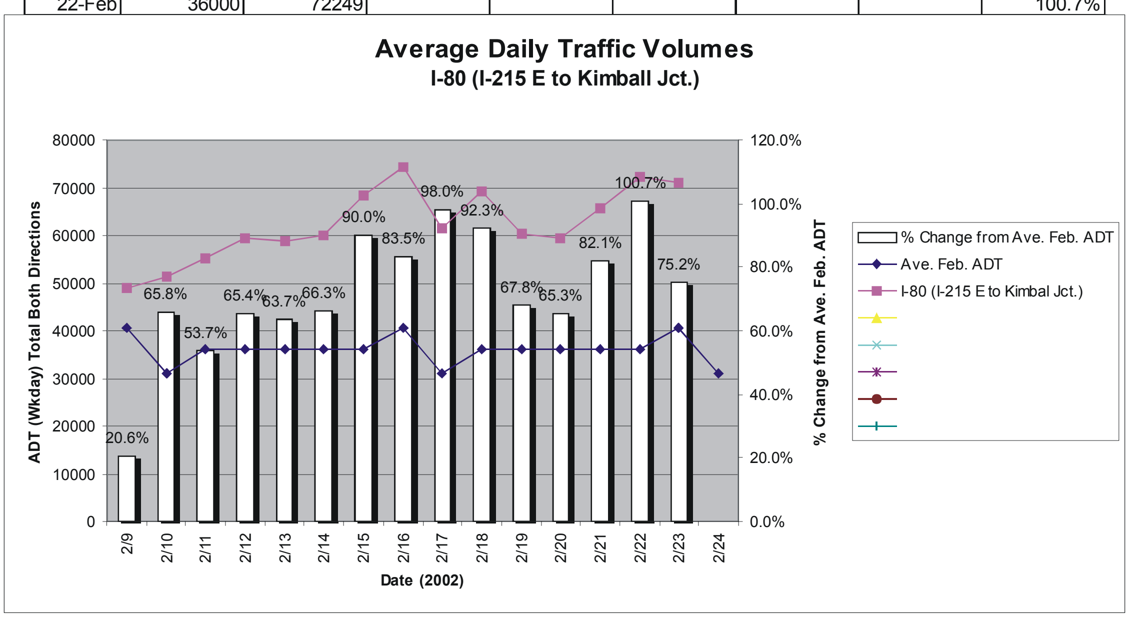


Figure 5.4 Traffic Volumes on I-80 in Parley's Canyon

Once again, these traffic counts on I-80 include travel by residents ***and*** visitors, and this was the primary route to three very popular venues near Park City. Because visitors probably represented a large proportion of the traffic on I-80 in Parley's Canyon, it is impossible to determine or even to infer what impact the TDM Program had on ***resident*** traffic.

<u>**Site 5: US-40, in Heber area**</u>, is in the mountains southeast of SLC (ATR Station #509). This four-lane lane divided freeway west of Heber is a rural roadway, primarily serving mountain towns and resorts. Figure 5.5 shows the average February ADT, plus the ATR counts for February 9 thru 23 (except for the 10th). The graph displays the same information as the previous graphs. Again, all of the changes are ***in***creases, and the average is about a **90% *increase*** in traffic during the Games.

Average Daily Traffic Volumes								
Sta. No.	509		509					
February Date	Ave. Feb. ADT		US-40 (Heber Area)					% Change from Ave. Feb. ADT
09-Feb	13700		21339					55.8%
10-Feb	10000							
11-Feb	12500		20820					66.6%
12-Feb	12500		21894					75.2%
13-Feb	12500		22405					79.2%
14-Feb	12500		21876					75.0%
15-Feb	12500		21876					75.0%
16-Feb	13700		27870					103.4%
17-Feb	10000		24535					145.4%
18-Feb	12500		26000					108.0%
19-Feb	12500		24142					93.1%
20-Feb	12500		22613					80.9%
21-Feb	12500		22992					83.9%
22-Feb	12500		25575					104.6%

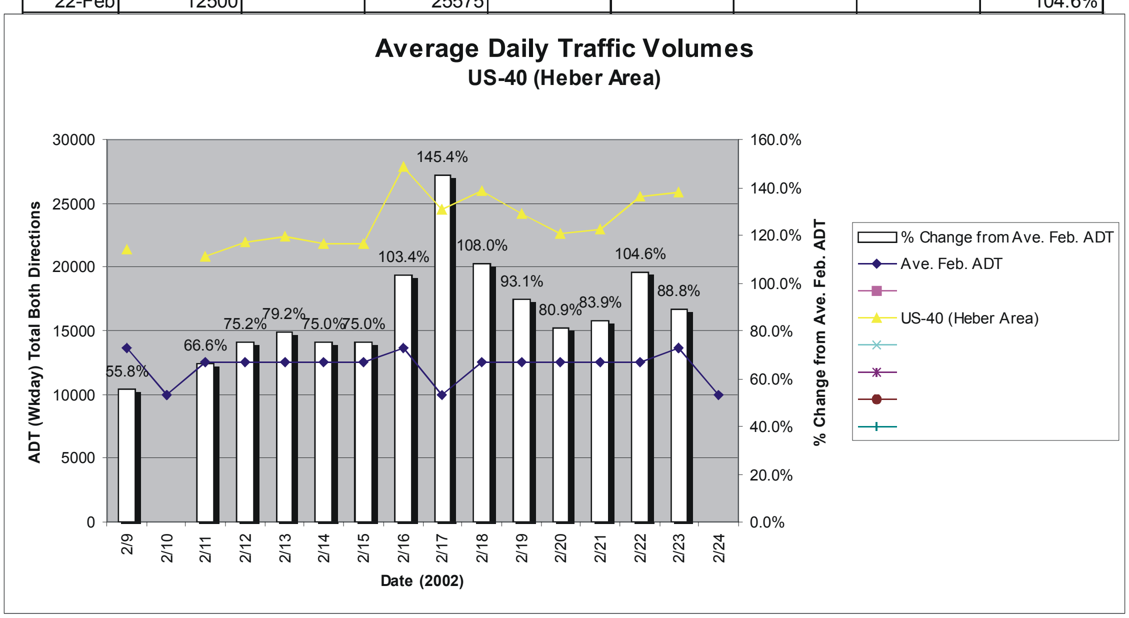


Figure 5.5 Traffic Volumes on US-40 in Heber Area

These traffic counts include travel by residents ***and*** visitors, and visitors likely predominated during the Games, so it is once again impossible to infer what impact the TDM Program had on ***resident*** traffic in this area.

<u>Site 6: US-189, in Provo Canyon</u>, is in the mountains south of SLC, near Provo (ATR Station #319). This four-lane roadway is also a rural highway, primarily serving mountain towns and resorts. Figure 5.6 displays the same type of information as the previous graphs. For the third time, all of the changes are ***in***creases, and the average is about a **60% *increase*** in traffic during the Games.

Average Daily Traffic Volumes								
Sta. No.	319			319				
February Date	Ave. Feb. ADT			US-189 (Provo Canyon)				% Change from Ave. Feb. ADT
09-Feb	13100			15319				16.9%
10-Feb	8100			12344				52.4%
11-Feb	9900			13385				35.2%
12-Feb	9900			14143				42.9%
13-Feb	9900			14505				46.5%
14-Feb	9900			15162				53.2%
15-Feb	9900			17424				76.0%
16-Feb	13100			19663				50.1%
17-Feb	8100			14283				76.3%
18-Feb	9900			19134				93.3%
19-Feb	9900			14601				47.5%
20-Feb	9900			14117				42.6%
21-Feb	9900			15443				56.0%
22-Feb	9900			17340				75.2%

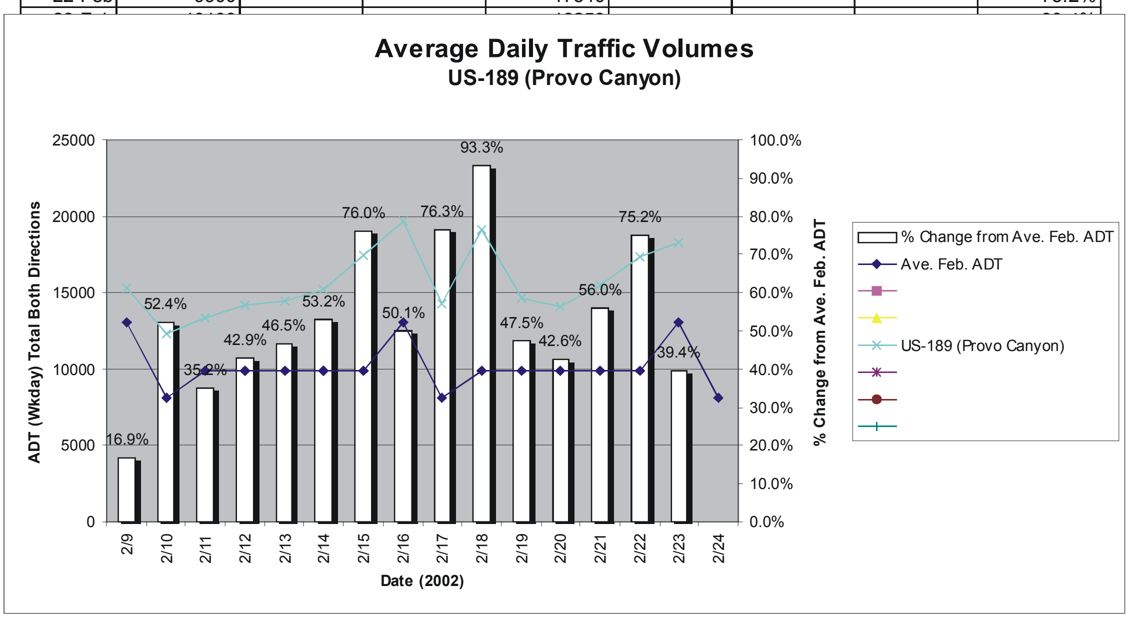


Figure 5.6 Traffic Volumes on US-189 at Provo Canyon

For the same reasons as the previous two mountain sites, it is not possible to infer what impact the TDM Program had on ***resident*** traffic in the Provo Canyon area.

Summary Assessment:
The ATR data from these six sites paint a mixed picture, revealing two different conclusions:

1. Downtown Traffic – Non-Games traffic to/from the downtown area was reduced by ***at least*** 15-20%, and probably ***much*** more. The 15-20% figure includes all visitor traffic. If the mix of visitors in the downtown traffic mix was about one-third of all vehicles, then the reduction in resident (non-Games) traffic would calculate to be in the range of 30% to 40%.

2. Rural Traffic – ***No conclusions can be drawn*** regarding the impact of the TDM Program on traffic in the outlying mountain areas, based upon the data examined. If the proportion of visitor in the traffic mix there was high, then it is possible that resident traffic actually was reduced substantially. If the percentage of visitors in the mix was lower, then there was no reduction in resident traffic. The lack of this key data item (which is extremely difficult to collect in those circumstances) makes it impossible to draw any conclusions.

5.3 Truck Volumes

Reduction in truck traffic was seen as an important part of the TDM Plan, because one truck has a far greater impact on traffic flow than one automobile. There are two types of impacts. The first is the effect upon traffic flow, because trucks occupy more lane space, they accelerate and decelerate much more slowly, and they climb hills more slowly than cars. The second impact is the effect upon the delays incurred when there is a collision, because truck accidents generally impact more lanes, and for a longer period of time, than auto accidents. For these reasons, the TDM campaign included a significant outreach effort to the trucking industry, encouraging them to avoid truck movements in the Salt Lake City area during the Games.

The effect of trucks on traffic flow is true region-wide, but the impact is even greater in certain locations. Perhaps the most notable case in point is I-80, east of the I-215E interchange and downtown Salt Lake City (aka “Parley’s Canyon”). This roadway is on a transcontinental Interstate highway that carries a heavy truck traffic. It is also a long, steep uphill grade in the eastbound direction. It was also the main access route to three major venues during the Games, and congestion was predicted on this roadway during days with major events in the Park City. Because of this, the data analyzed in this section focuses upon use of this roadway by large trucks (greater than 50 feet long) before and during the Games.

The TDM campaign sought to reduce truck impacts by managing the demand for truck travel in two ways:
1. To ***reduce*** the total number of truck trips made within and through the Salt Lake City area.

2. To ***shift*** some of the remaining truck trips to the nighttime hours, when there were no Games events.

Thus, the assessment question is: How effective was this effort to manage truck demand? To answer this question, the Study Team used both automated and manual data-collection techniques to measure truck traffic at several locations in the Salt Lake City area. However, because of inconsistencies in this data that could not be reconciled, the valid data available for answering the truck-impacts question is quite limited.

To identify whether trucks were changing the number of trips made or the time of day at which they passed through Salt Lake City, it is necessary to examine the counts of truck volumes during each one-hour period of the (24-hour) day. Figure 5.7 displays the hourly pattern of truck traffic in Parley's Canyon on the two days before the Games (February 6-7) and on twelve days during the Games (February 9-20). The top line represents the "before" truck traffic, and the bottom line shows traffic "during" the Games.

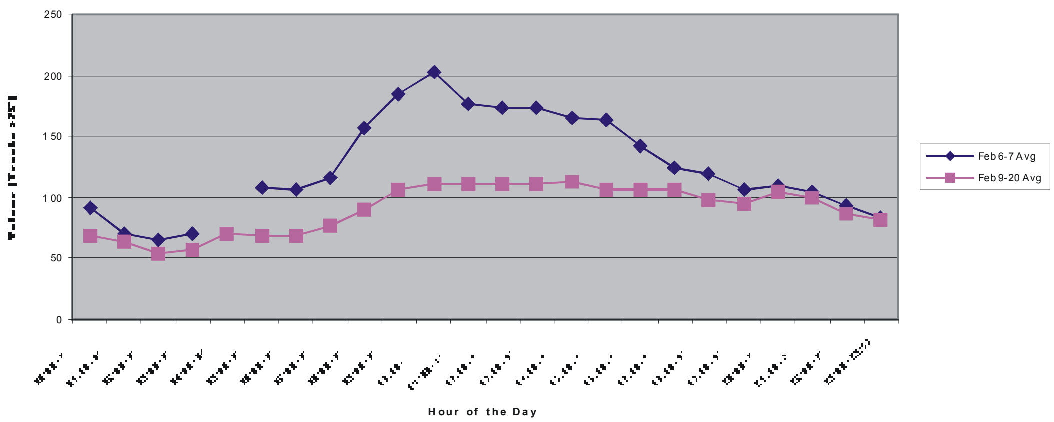


Figure 5.7 Truck Traffic in Parley's Canyon by Time of Day

Although the "before" data is limited to only two days, a clear before/during difference is evident on this graph. The hourly counts of large trucks during the daytime (6am to 5pm) are 30-45% lower during the Games compared to before, between 5:00am and 5:00pm. During the nighttime hours, truck traffic is also lower during the Games, but by a very small amount. This indicates that there was little or no shift of truck traffic from the daytime to the night hours. This analysis suggests that ***the predominant mode of truck-traffic demand management was not time-shifting, but appeared to be trip reductions.***

However, two caveats to this conclusion are necessary. First, the "before" data is very limited and was very close in time to the Games, so it may not be representative of "normal" truck traffic. Second, it is also possible that some of the daytime trips reduced on I-80 were not foregone, but were shifted to another route in the Salt Lake City area (e.g. I-84). This "route shifting" tactic was also one of the truck measures in the TDM Plan. To be certain, it would be necessary to obtain more "before" data for this site and also to examine a number of other sites plus their alternate routes. Perhaps an aspiring PhD student would rise to this challenge.

UDOT also collected truck counts at the truck Ports of Entry (POEs) operated by UDOT. A UDOT Press Release on March 11 summarized reductions in total truck traffic at the POEs, as described in the following quotation from that Press Release:

"Truck traffic on I-80, a primary travel route to mountain Olympic venues, decreased significantly during the Games.

- Truck counts at Utah's Echo Westbound I-80 port decreased by more than 1800 vehicles during the Games.
- At the Wendover East and Westbound I-80 port on the Utah-Nevada border, truck counts plummeted by more than 3700 for the 17 days during the Salt Lake 2002 Olympic Winter Games.

Truck Traffic on I-84, another important road leading to mountain Olympic venues, also dropped during the Games.

- Truck counts at Utah's Perry North and Southbound I-15/84 port revealed a reduction of nearly 7000 vehicles during the Games.

Commercial motor vehicle travel times shifted during the Games, allowing trucks to avoid peak Olympic spectator travel times.

- Under normal circumstances at the Echo I-80 port, an average of 1,500 trucks pass through per day during the day shift and 300-500 at night. During the Games, port officials counted an average of 800-1000 trucks per day during the day shifts and 500-800 at night."

The two data sources are not directly comparable, because the locations differ greatly. However, the two analyses agreed that there was a ***reduction*** in total truck traffic, but reached differing conclusions regarding time-shifting of truck travel patterns. Once again, both analyses have significant limitations in their ability to determine exactly what changes in truck travel patterns took place ***within*** the Salt Lake City area.

5.4 Transit Ridership

The following section is quoted from a UTA report: "Olympic Spectator Transportation System – UTA After-Action Report" by Randy Park, July 9, 2002. A summary and interpretation of key transit ridership findings regarding the TDM Program appears in the "Assessment" at the end of this section, for readers who wish only that information. In the discussion below, the Olympic Spectator Transportation System (OSTS) includes TRAX and the Park-and-Ride Shuttle-Bus system, plus the shuttles to the E-Center, Olympics Oval, etc.

"Over 2.52 million rides were taken on public transit during the 2002 Winter Games – 1.7 on TRAX light rail and 0.8 on the OSTS shuttle buses. Figure 5.8 provides a ridership summary by mode for each during the games period.

Ridership on the OSTS system for Salt Lake County averaged 120,400 rides per day. Weekends (Friday and Saturday) nights and the second week of the games had the highest ridership days. TRAX carried almost twice the number of riders than the OSTS shuttle buses as was expected, however it was anticipated that the shuttle buses would perform better.

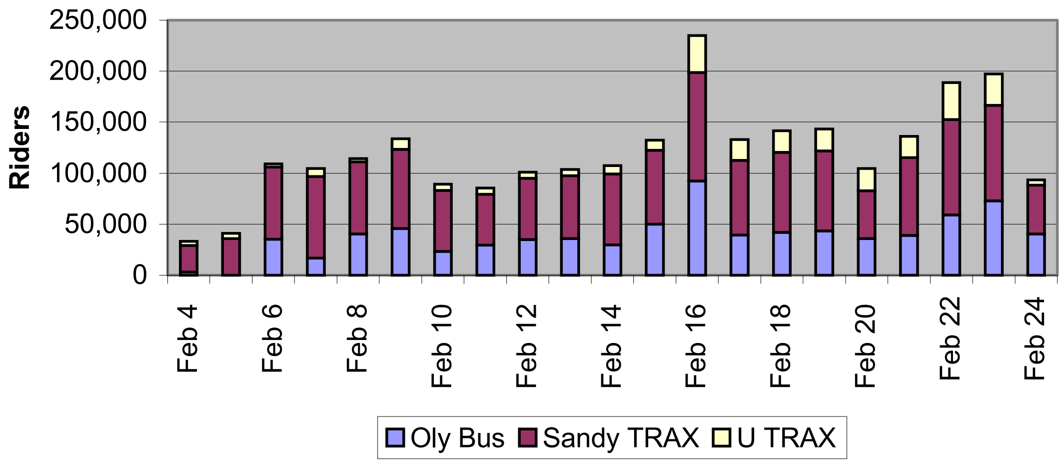


Figure 5.8 Ridership Summary 2002 Winter Olympics

In the downtown Salt Lake City area, overall general spectator transit trips increased dramatically to an estimated 50-60% range with the Rice-Eccles Olympic Stadium achieving 85-90% of trips to the opening, closing and dress rehearsal ceremonies. The first week of the games, overall person trips into the downtown area were lower due to the perception that the downtown area was difficult to access. By the second week, the Mayor of Salt Lake City made a press conference announcement informing local residents that the downtown area was accessible and to come to the downtown area. This encouragement increased automobile travel and TRAX. Shuttle bus usage remained in the 50-60% of capacity range—lower than expected. Many people learned that the shuttle bus system was convenient, frequent and reliable.

Many people, both local residents and visitors, used mass transit for the first time. However, the impact to long-term ridership is yet to be determined. Limited automobile parking at and near venues in combination with a frequent shuttle bus and TRAX light rail transit system provided resulted in higher than normal public transit usage.

The regular fixed route bus system saw only marginal increases in ridership. Additional fixed route ridership was the result of increased service implemented on targeted local and regional express routes. Increased bus service was added to weekday routes 8, 23, 34, 48, 51, 52, 56, 60, 61, 62, 63, 72, 73, 84, 334, 337, 347, and 802. These commuter routes were selected for additional service that arrived in the downtown area prior to 6:00 a.m.

It was necessary to supplement the existing fixed route service to meet the shift in commuter demand that was the result of the Olympic Travel Demand Management program that encouraged employers to start work by 6:00 a.m. and leave the downtown area by 2:00-3:00 p.m. Many local commuters took advantage of this additional service. The add-on service was discontinued at the end of the day on Wednesday, February 27, 2002."

"The following table (Table 7) provides an inventory of the OSTS shuttle bus park-and-ride lots and the parking space capacity used during the games.

Table 7 - OSTS Shuttle Bus Park-and-Ride Lots

Lot	Address	Parking Spaces
Weber State University	Dee Event Ctr. Harrision 4300 S. Ogden	300
LDS Regional Center	400 West 900 North N. Salt Lake	1,000
Eagle Crest	Hwy 89 300 South SLC North Salt Lake	1,875
Granite North and South	Warm Springs Road 1050 and 950 South	1,000
Park and Jet	2200 West North Temple SLC	600
Utah Power & Light Gadsby	1200 West North Temple SLC	412
State Fair Park Main Lot	1025 West 200 North SLC	768
State Fair Park White Ball Park	1075 West North Temple SLC	1,060
Hogle Zoo	2600 East Sunnyside Ave. SLC	550
This Is The Place State Park	2600 East Sunnyside Ave SLC	176
Research Park University of Utah	600 South 3000 East SLC	1,750
Salt Lake Community College	1500 South 200 East SLC	900
Salt Lake Community College	4450 South Redwood Rd. Taylorsville	3,800
Liberty Park	900-1300 S. 500-700 East SLC	1,200
Sugar House Park	2100 South 1500 East SLC	1,500
Skyline High School	3800 South 3200 East	750
Cottonwood Mall	4835 South Highland Dr. (2000 East)	750
Utah Valley State College	1200 S. 800 West Orem, Utah	400
UTA Lot	1300 South 500 West, SLC	1,300
Total Shuttle Bus Spaces:		20,091

Approximately 15 park and shuttle bus parking lots, 11 TRAX permanent and 17 temporary overflow TRAX lots were used during the games. Permanent parking capacity at 8 of 11 TRAX station parking lots was increased by a total of 2,100 spaces increasing the permanent parking inventory from 1,900 to 4,000 spaces as a legacy benefit to UTA customers and the Salt Lake area. Construction took place over a period beginning two years and continuing to three months before the games began. Overflow parking was leased to accommodate large parking demand on peak demand days. Overflow parking was used generally at the 13th South, 21st South, and 100th South TRAX stations.

The OSTS shuttle bus parking plan consisted of leasing both existing business parking lots, public parks, State community colleges, high schools, LDS Church property and undeveloped property owned by UTA. These lots were within one to one and one-half blocks from the TRAX stations and between 2-10 miles from the destination venues.

Although UTA staff negotiated the agreements and operated the lots for SLOC, all park and ride lot use agreements were between SLOC and the property owner.

Negotiating OSTS park-and-ride lot use agreements were very time consuming and required close to two years to complete. TRAX permanent and overflow lots, shuttle bus parking lots and shuttle bus hub unload/load lots made up 59 properties representing 30 separate agreements that had to be negotiated with over one half of the agreements requiring unique financial compensation for games time use. One additional temporary staff member was added to the OSTS planning team two months preceding the games to finalize use agreements for about six properties. Four UTA staff members completed the park and ride agreement work with the assistance of two members of SLOC's legal staff.

Most TRAX station permanent lots filled to capacity each day. The three stations closest to downtown Salt Lake City, 13th South, 21st South and 33rd South, filled quickly and remained full most of each day. It was expected that the suburban TRAX stations at 10000 South, 9000 South, 7800 South and 7200 South would also reach capacity. This pattern did happen as predicted in the planning phase, however, the 9000 South station didn't fill to capacity as often as was anticipated. The following TRAX Park-and-Ride Lot Usage table (Figure 5.9) shows the average percentage of use each day of the games at each TRAX station.

Figure 5.9 TRAX Park and Ride Lot Usage

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2002 Winter Olympics

Station	Mon Feb 4	Tue Feb 5	Wed Feb 6	Thu Feb 7	Fri Feb 8	Sat Feb 9	Sun Feb 10	Mon Feb 11	Tue Feb 12	Wed Feb 13	Thu Feb 14	Fri Feb 15	Sat Feb 16	Sun 17-Feb	Mon Feb 18	Tue Feb 19	Wed Feb 20	Thu Feb 21	Fri Feb 22	Sat 23-Feb	Sun 24-Feb		Ave
1300 South	95%	100%	200%	100%	100%	100%	120%	80%	200%	190%	190%	190%	200%	180%	190%	180%	190%	190%	185%	195%	175%		160%
2100 South	90%	80%	195%	95%	90%	95%	80%	95%	90%	160%	120%	120%	200%	145%	125%	190%	170%	200%	170%	150%	125%		133%
3300 South	85%	90%	110%	105%	100%	105%	125%	95%	70%	110%	155%	150%	175%	135%	179%	120%	120%	145%	135%	150%	150%		124%
3900 South	65%	70%	80%	90%	100%	100%	80%	30%	90%	80%	90%	95%	200%	100%	125%	75%	90%	70%	100%	130%	65%		92%
4500 South	50%	60%	75%	80%	100%	100%	70%	50%	60%	75%	85%	90%	135%	85%	50%	55%	80%	90%	100%	60%	40%		76%
5300 South	50%	65%	100%	85%	85%	85%	75%	90%	80%	97%	70%	95%	170%	80%	75%	75%	75%	85%	100%	85%	40%		84%
6400 South	80%	80%	95%	100%	100%	100%	90%	60%	95%	85%	100%	100%	95%	100%	95%	90%	95%	98%	95%	90%	85%		92%
7200 South	65%	75%	95%	100%	5%	100%	130%	85%	100%	110%	100%	115%	135%	120%	115%	110%	100%	110%	120%	125%	95%		100%
7720 South	85%	100%	95%	120%	100%	100%	80%	50%	110%	115%	110%	125%	130%	110%	100%	105%	105%	110%	105%	130%	75%		103%
9000 South	80%	90%	100%	100%	5%	100%	100%	98%	98%	90%	100%	110%	125%	95%	95%	85%	95%	90%	80%	105%	100%		92%
10000 South	90%	95%	160%	90%	5%	200%	70%	173%	115%	157%	50%	125%	135%	65%	100%	95%	105%	170%	70%	120%	50%		107%
Average	76%	82%	119%	97%	72%	108%	93%	82%	101%	115%	106%	120%	155%	110%	114%	107%	111%	123%	115%	122%	91%		106%

The average daily peak hour usage at each station was between 5:00 p.m. and 8:00 p.m. TRAX spectator loading managers at each station counted the usage of each parking lot on one-half hour intervals starting at 2:00 p.m. and reported to the OSTS Radio Control Center (RCC). This data was then relayed to the UDOT Traffic Operations Center (TOC) where it was tracked daily. The data was used to anticipate the peak hour departure loads on the TRAX system. TRAX parking capacity averaged 106% of capacity meaning that the existing parking was generally full and the adjacent overflow spaces were used. Friday and Saturday evenings of the second and third week of the games were received higher use than the first week. This condition seemed to follow the behavioral attitude of the Olympic spectators that the games were coming to a close, access into the downtown area was possible and there was confidence in the OSTS transportation system.

During games time, three bus shuttle park-and-ride lots filled to capacity and in some cases to overflow conditions almost each night of the games. These lots were in South Davis County and east Salt Lake County where the regional population is greater. These lots filling to over 100% capacity almost daily were the LDS Regional Center, Sugar House Park and Skyline High School requiring I-15 and I-80 interstate variable message signs to be turned which directed spectators to drive to alternative parking lots. OSTS shuttle bus parking capacity averaged only 49% through out the games. Friday and Saturday evenings use was higher in the 66% range as was expected. This usage pattern was very much consistent with planning estimates although it was anticipated that shuttle bus parking usage would be 10-15% higher. The following OSTS Park and Ride Lot Usage table (Figure 5.10) provides a summary of average daily lot usage for each lot during the games.

Figure 5.10 OSTS Park and Ride Lot Usage Summary

2002 Winter Olympics

Lot	Parking Spaces	Mon Feb 4	Tue Feb 5	Wed Feb 6	Thu Feb 7	Fri Feb 8	Sat Feb 9	Sun Feb 10	Mon Feb 11	Tue Feb 12	Wed Feb 13	Thu Feb 14	Fri Feb 15	Sat Feb 16	Sun Feb 17	Mon Feb 18	Tue Feb 19	Wed Feb 20	Thu Feb 21	Fri Feb 22	Sat Feb 23	Sun Feb 24	Ave
LDS Regional Ctr	***1,000***	0%	0%	100%	80%	80%	100%	60%	95%	100%	80%	95%	100%	100%	75%	65%	100%	85%	95%	100%	95%	75%	88%
Eagle Crest	***1,800***	0%	0%	55%	5%	10%	70%	35%	30%	65%	10%	30%	100%	100%	30%	45%	80%	15%	30%	85%	100%	33%	49%
Warm Springs	***500***	0%	0%	50%	5%	10%	35%	1%	15%	15%	10%	15%	50%	85%	4%	35%	4%	15%	5%	30%	65%	15%	24%
State Fair Park	***750***	0%	0%	20%	30%	65%	50%	60%	40%	50%	65%	40%	50%	65%	45%	40%	65%	65%	30%	70%	65%	10%	49%
White Ball Park	***1100***	0%	0%	20%	30%	20%	50%	13%	50%	50%	20%	50%	90%	92%	60%	55%	80%	30%	75%	70%	85%	40%	52%
UP&L Gadsby	***412***	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
UTA 1300 S 500 W	***1300***	0%	0%	20%	20%	45%	50%	50%	45%	60%	45%	45%	80%	90%	40%	60%	100%	50%	90%	80%	80%	40%	57%
Liberty Park	***1200***	80%	0%	75%	50%	65%	65%	45%	45%	65%	65%	45%	65%	100%	45%	55%	65%	60%	40%	55%	65%	70%	60%
SLCC South City	***900***	0%	0%	0%	0%	50%	65%	25%	25%	40%	50%	25%	55%	70%	30%	50%	45%	55%	30%	55%	50%	50%	41%
SLCC Redwood	***3800***	0%	0%	0%	0%	20%	45%	25%	20%	45%	20%	20%	48%	70%	9%	28%	40%	25%	20%	40%	45%	12%	28%
Sugar House Park	***400***	0%	0%	100%	15%	95%	100%	35%	80%	100%	95%	80%	100%	100%	60%	100%	70%	90%	20%	100%	100%	120%	82%
Skyline H.S.	***750***	0%	0%	100%	30%	100%	70%	75%	35%	65%	100%	35%	75%	85%	40%	50%	50%	100%	20%	60%	70%	100%	66%
Cottonwood Mall	***750***	0%	0%	100%	15%	85%	80%	40%	60%	75%	85%	60%	80%	87%	50%	25%	40%	80%	40%	60%	65%	90%	64%
Utah Valley State	***300***	0%	0%	0%	0%	0%	25%	20%	25%	25%	20%	25%	30%	45%	15%	20%	20%	25%	25%	35%	40%	0%	25%
Weber State Univ.	***300***	0%	0%	0%	0%	0%	30%	25%	0%	100%	0%	0%	0%	40%	20%	20%	20%	20%	25%	40%	45%	0%	24%
Research Park	***2200***	0%	0%	30%	0%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	75%	65%
Hogle Zoo	***500***	0%	0%	30%	0%	80%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	75%	62%
Total	***17,962***																						
Average		5%	0%	41%	16%	48%	49%	30%	33%	50%	39%	33%	54%	66%	31%	38%	46%	42%	32%	52%	57%	47%	49%

There were three separate parking lot use schedules developed depending the event day. For Rice Eccles Olympic Stadium events, lots opened at 3:00 p.m. For events in the downtown area the lots opened each day at 2:00 p.m. On Saturdays, lots opened at 11:00 a.m. to meet the demand for the LDS Church Conference Center show "Light of the World." The first week of the games there was some confusion by the general public as to when the lots opened. After the first week, spectators became educated to the shuttle bus park and ride lot operation schedule. Spectators were encouraged to listen to Olympic radio on KSL 1160 for daily Olympic travel updates six times per hour. Regular radio broadcasts about travel conditions including the park-and-ride lot schedule and availability."

Once again, the entire section above was quoted verbatim from the aforementioned UTA report.

Assessment of Transit Ridership:
In summary, the key transit-ridership facts related to the TDM program are:

- TRAX lines and the OSTS Shuttle Buses carried over 2.5 million passenger trips during the Games. (This does not include the regular UTA fixed-route service.) Because these are actually "boardings" and many trips included transfers, this translates to roughly one million "complete round trips."
- Over two-thirds of those Games-related trips were carried by TRAX, while almost one-third were carried by the Park-and-Ride Shuttle Buses.
- Shuttle-Bus ridership was somewhat below projections. The Park-and-Ride lots were about 50% full, **on average**, while roughly 66% was predicted.
- Usage was unevenly spread between lots – three lots consistently filled to capacity. Although we do not have specific data, this undoubtedly required that some people were turned away.
- The highest daily ridership on TRAX and P&R Shuttles was 221,000 trips, and the highest P&R lot usage was 66%. Both peaks occurred on Saturday, February 16. The next highest day was Saturday, February 23. Both days were characterized by numerous Games events plus heavy cultural and entertainment activity in downtown Salt Lake City.
- Fixed-route bus ridership increased a little. This was attributed to the new runs that arrived before 6:00 am to accommodate the work-schedule shift to 6am-3pm that was recommended to local employers. It is likely that these new "early-bird" riders were actually previous riders who shifted to earlier trips, but it is not clear whether the riders that replaced them during regular hours were residents (who were diverted to transit by the TDM campaign) or visitors to the Games.

5.5 Travel by Residents

Changes in personal travel patterns can be assessed in several ways. Section 5.2 took a "macroscopic" approach by examining empirical data (i.e. traffic counts at six sites across the Salt Lake City area) to determine how these traffic volumes changed during the Games. It concluded that travel by residents ***to the downtown area*** was reduced dramatically – by at least 20% and probably more. This section takes a "microscopic" approach by examining what Salt Lake City residents ***said*** they did during the Games, using the results of the Resident survey described above in Section 5.2. There are several possible ways in which travel patterns could have changed:

- Arrive at and leave work earlier (this was encouraged in the TDM campaign)
- Switch from drive-alone to public transit or carpool or walk
- Work at home (telecommute)
- Travel less

The Resident survey asked several questions about changes in travel patterns. These are discussed next.

Work Schedules:
The survey asked SLC Residents several questions about how they traveled to work ***before*** and ***during*** the Games. This included:
"Before the Olympics, what time did you normally **arrive** at work?"
and
"During the Olympics, what time do you normally **arrive** at work?"

15% of the respondents reported different arrival times before versus during the Games. Of those with different arrival times before vs. after, most (75%) shifted earlier but some (25%) shifted later. The ***average*** arrival time at work before the Games was 8:23am and the average arrival at work during the Games was 7:59am. Hence, on average, ***there was a shift of 24 minutes to earlier arrival at work***.

The Resident Survey asked a comparable question about work departure time, and **19%** of respondents reported different departure times before versus during the Games.
Of those with different departure times before vs. after, many (63%) shifted earlier but some (37%) shifted later. The average departure time from work before the Games was 3:56pm and the average departure time from work during the Games was 3:46pm. Hence, on average, ***there was a shift of 10 minutes to earlier departure from work,*** based upon self-reported data. Speculation is possible that ingrained work habits made it difficult to leave work early.

Thus, it appears ***there was a substantial change in work schedules during the Games***. However, the shift in work ***departure*** times – which was more important than arrival times from a TDM perspective – was much less than the shift in arrival times.

The Resident Survey also asked:
"Did your employer make any changes during the Olympics?"
About one-fifth (19%) of the respondents said "Yes." For those respondents, we also asked:
"What changes?"
The 45 open-ended responses were categorized and tabulated as follows:
36% - changed their work times
27% - changed to flexible schedules

11% - changed their work times and allowed flexible schedules
4% - changed to telecommuting (work at home)

This implies that ***almost half of all employers changed their work schedules***. However, there is a discrepancy because ***less than 20% percent of employees reported different arrival/departure times at work.*** This discrepancy is discussed further below.

Commute Mode:
The Resident Survey also asked:
"How did you normally travel to work, **before** the Olympics?"
and
"How do you normally travel to work, **during** the Olympics?"

Analysis of the responses indicated ***there was no significant change in commute modes***, in the aggregate.

Travel Patterns:
The Resident Survey also asked a general question about travel patterns:
"Did the Olympics cause you to change your normal travel patterns in any way?"
About one-quarter of the respondents said "Yes." For those respondents, we also asked:
"In what way?"
The 35 open-ended responses were categorized and tabulated as follows:
29% - changed their route to work
11% - changed their commute mode
29% - shifted their travel time earlier
9% - said they shifted their travel time, but did not specify which way

Summary of Assessment of Resident Travel Patterns:
The survey of residents indicates ***there were substantial changes in their travel patterns*** during the Games. The major change was in work (and commuting) schedules, with the net change being a shift to earlier schedules by 20-30% of all commuters. Changes in commuting modes played a much smaller role, affecting roughly 10%. However, the work-schedule shifts in the afternoon were relatively small – ten minutes on average.

5.6 Predicted vs. Actual Traffic Volumes

As noted earlier, the "actual" traffic volumes observed during the Games were consistently lower than the "predicted" traffic volumes that were developed for planning. A post-Games analysis of "Planned" versus "Observed" values for traffic volumes was performed to explore the differences between the two, using a limited amount of data. It examined two locations outside the metro area on routes feeding major venues, on February 12 (a expected "peak" day). It analyzed the following seven major variables affecting traffic volumes at those two locations on that day:

1. Arrival Time Distribution
2. Roadway System Distribution
3. Background Traffic Reduction
4. Heavy Truck Volumes
5. Vehicle Occupancy
6. Transit Ridership (Mountain Venue Express)
7. Day-Skiers at the Resorts (near the Venues)

No consistent pattern was identified among the seven variables. Most were observed to be "better" than the original planning estimates (more transit riders, fewer day skiers, lower background traffic, wider distribution of traffic on the roadway system, and wider distribution of arrival times). But some variables were observed to be "worse" than the planning estimates (heavy truck volumes, vehicle occupancy). The analysis concluded "… in most cases, SLOC and UDOT planned for the worst and observed the best possible scenario for the transportation system."

6 Transferable Findings

This section summarizes the key findings of the study that are likely to be transferable to other sites planning major events. It draws upon the observations of the study team in the TOC, the follow-up interviews with UDOT and other agency staff who worked on the Olympics effort, and the data that was collected and analyzed.

Know Your Most Valuable ITS Players
CCTV emerged from this study as the “most valuable player” in the traffic-management toolbox. It was used extensively by all levels within the TOC, for surveillance, decision-making, and response execution. In a new security-conscious era, it also serves as a preventative public-safety tool for transportation-related situations. The traffic-management story during the 2002 Olympics would have been dramatically different with the extensive CCTV coverage that was available on highways and streets.

The transferable finding is:
CCTV deployment is expensive, but once a “critical mass” of coverage is reached, it delivers unequalled benefits for traffic management and public-safety.

It must also be added that many other technical and organizational elements contributed great value also. One notable “organizational” example would be the TDM program, which helped avoid traffic problems by reducing travel demand.

Prepare the TOC Computer System
The TOC computer system was “pushed to the max” throughout most of the Games – far beyond any previous experience. All of the normal, day-to-day functions were operating, at full capacity, and there were many new demands resulting from the Games. System enhancements were made during the week before the Games, and these resulted in some malfunctions that were visible internally but not to the public.

The transferable finding is:
Make no changes – even seemingly small ones -- to the computer systems for at least one month before the Games, to ensure adequate time for testing.

Deploy Traveler-Information Tools Synergistically
The CommuterLink Website was heavily used during the Games for traveler information, by visitors and residents. Both the website and 511 telephone service were highly-rated by residents and visitors, although the 511 service was not as heavily used as the website. Both worked synergistically with the printed material and media coverage also used for distributing traveler information during the Games.

The transferable finding is:
Technology can play an important role in efficiently delivering traveler information, but it must be implemented compatibly with the traditional distribution channels.

Prepare the People

The extensive and detailed planning and preparations paid off. There were no major transportation surprises for which preparations had not been made. There was one minor situation observed that was not fully anticipated, but it was handled expeditiously by the existing structure.

The transferable finding is:
Detailed contingency planning and preparations are expensive, but they are absolutely essential and should be viewed as "event insurance."

Define Clear Levels of Responsibility and Authority

The division of decision-making into three-plus levels of responsibilities within the TOC proved to be effective and efficient, because each level had a wide range of authority and clear definition of when to escalate a problem to higher levels. Similarly, the Area Traffic Engineers and other field crews were empowered to act autonomously to handle most of the problems they saw.

The transferable finding is:
Divide decision-making into appropriate levels, and empower people at each level.

Structure For Cooperation

Interagency cooperation during the Games was remarkable. The seamless decision-making of the multi-agency staff in Room 230 enabled rapid response to virtually all problems that developed, and true multi-modal coordination in all actions they took.

The transferable finding is:
Strong interagency cooperation is essential for effective transportation management, and proper structures must be created to engender it.

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Salt Lake 2002 Winter Olympics Official Materials including:

- Olympic Transportation Guide
- Official Spectator Guide

Memo from M. Kaczorowski to A. Gemperline, May 9, 2002

ITS ACRONYM LIST

Acronym	Definition
AASHTO	American Association of State Highway and Transportation Officials
ABS	Antilock Brake System
AD	Archived Data
ADA	Americans with Disabilities Act
ADMS	Archived Data Management Subsystem
ADUS	Archived Data User Service
AFD	Architecture Flow Diagram
AHS	Automated Highway System
AID	Architecture Interconnect Diagram
AMPS	Advanced Mobile Phone System
ANSI	American National Standards Institute
APTS	Advanced Public Transportation System
ASP	Application Service Provider
ASTM	American Society for Testing and Materials
ATC	Automatic Train Control, Advanced Transportation Controller
ATIS	Advanced Traveler Information System
ATM	Asynchronous Transfer Mode
ATMS	Advanced Traffic Management System
AVCS	Advanced Vehicle Control System
AVI	Automated Vehicle Identification
AVL	Automated Vehicle Location
AVO	Automated Vehicle Operation
CAA	Clean Air Act
CAD	Computer Aided Dispatch
CASE	Computer Aided Systems Engineering, Computer Aided Software Engineering
CCTV	Closed Circuit TV
CD	Compact Disc
CDMA	Code Division Multiple Access
CDPD	Cellular Digital Packet Data
CD-ROM	CD Read Only Memory
CMS	Changeable Message Sign (see also DMS, VMS), Congestion Management System
CMP	Congestion Management Plan
COTR	Contracting Officer Technical Representative

Acronym	Definition
CSP	Communication Service Provider
CV	Commercial Vehicle
CVAS	Commercial Vehicle Administration Subsystem
CVCS	Commercial Vehicle Check Subsystem
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial Vehicle Operations
CVS	Commercial Vehicle Subsystem
DAB	Digital Audio Broadcast
DC	Double Click (or District of Columbia)
DD	Data Dictionary
DDE	Data Dictionary Element
DFD	Data Flow Diagram
DGPS	Differential Global Positioning System
DMS	Dynamic Message Sign (see also CMS, VMS)
DMV	Department of Motor Vehicles
DOD	Department of Defense
DOT	Department of Transportation
DSRC	Dedicated Short Range Communications
DTA	Dynamic Traffic Assignment
DVD	Digital Video Disc
E9-1-1	Enhanced 9-1-1
ECPA	Electronic Communications Privacy Act
EDI	Electronic Data Interchange
EDP	Early Deployment Plan
EMC	Emergency Management Center
EMMS	Emissions Management Subsystem
EMS	Emergency Management Subsystem
EPA	Environmental Protection Agency
ESMR	Enhanced SMR
ETA	Expected Time of Arrival
ETS	Emergency Telephone Services
ETTM	Electronic Toll and Traffic Management
EVS	Emergency Vehicle Subsystem
FARS	Fatal Accident Reporting System
FCC	Federal Communications Commission for the U.S.
FHWA	Federal Highway Administration
FIPS	Federal Information Processing Standard
FMC	Freeway Management Center

Acronym	Definition
FMCSA	Federal Motor Carrier Safety Administration
FMS	Fleet and Freight Management Subsystem
FOT	Field Operational Test
FPR	Final Program Review
FTA	Federal Transit Administration
FTP	File Transfer Protocol
GIS	Geographic Information System
GPS	Global Positioning System
HAR	Highway Advisory Radio
HAZMAT	HAZardous MATerial(s)
HOV	High Occupancy Vehicle
HRI	Highway Rail Intersection
HSR	High Speed Rail
HTF	Highway Trust Fund
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
HUD	Head-Up Display
IBC	International Border Clearance
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IFB	Invitation for Bid
IP	Internet Protocol
IPR	Interim Program Review
ISO	International Standards Organization
ISP	Information Service Provider
ISTEA	Intermodal Surface Transportation Efficiency Act
ITE	Institute of Transportation Engineers
ITI	Intelligent Transportation Infrastructure
ITS	Intelligent Transportation Systems
ITS-A	Intelligent Transportation Society of America
IVHS	Intelligent Vehicle Highway Systems
IVIS	In-Vehicle Information System
JPO	Joint Program Office
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LEO	Low-Earth Orbit satellite system
LPD	Liability and Property Damage
LRMS	Location Reference Messaging Standard

Acronym	Definition
MAN	Metropolitan Area Network
MCMS	Maintenance and Construction Subsystem
MCO	Maintenance and Construction Operations
MCVS	Maintenance and Construction Vehicle Subsystem
MDI	Model Deployment Initiative
MIS	Major Investment Studies
MMDI	Metropolitan MDI
MMI	Man-Machine Interface (or Interaction)
MOE	Measure Of Effectiveness
MOU	Memorandum of Understanding
MPA	Metropolitan Planning Area
MPH	Miles per Hour
MPO	Metropolitan Planning Organization
NAV	Navigation
NEMA	National Electrical Manufacturers Association
NHPN	National Highway Planning Network
NHTSA	National Highway Traffic Safety Administration
NII	National Information Infrastructure (aka Information Superhighway)
NPRM	Notice of Proposed Rule Making
NTCIP	National Transportation Communications for ITS Protocol
OEM	Original Equipment Manufacturer
OSI	Open Systems Interconnection
OTP	Operational Test Plan
PC	Personal Computer
PCS	Personal Communications System
PDA	Personal Digital Assistant
PIAS	Personal Information Access Subsystem
PMS	Parking Management Subsystem
PSPEC	Process Specification
PSTN	Public Switched Telephone Network
PTS	Positive Train Separation
R&D	Research and Development
RDS	Radio Data Systems
RDS-TMC	Radio Data Systems incorporating a Traffic Message Channel
RFP	Request For Proposal
RFQ	Request for Quotation
RS	Roadway Subsystem
RTA	Regional Transit Authority

Acronym	Definition
RTP	Regional Transportation Plan
RTS	Remote Traveler Support Subsystem
SAE	Society of Automotive Engineers
SC	Single Click
SDO	Standards Development Organization
SIP	Statewide Implementation Plan
SMR	Specialized Mobile Radio
SNMP	Simple Network Management Protocol
SONET	Synchronous Optical Network
SOV	Single Occupancy Vehicle
SOW	Statement of Work
SQL	Structured Query Language
SSR	Standard Speed Rail
STIP	Statewide Transportation Improvement Program
STMF	Simple Transportation Management Framework
STMP	Simple Transportation Management Protocol
TAS	Toll Administration Subsystem
TCIP	Transit Communications Interface Profiles
TCP	Transport Control Protocol
TCS	Toll Collection Subsystem
TDM	Travel Demand Management
TDMA	Time Division Multiple Access
TEA-21	Transportation Equity Act for the 21st Century
TIP	Transportation Improvement Program
TM	Traffic Management
TMA	Transportation Management Area
TMC	Traffic Management Center
TMDD	Traffic Management Data Dictionary
TMS	Traffic Management Subsystem
TOC	Traffic Operations Center
TRB	Transportation Research Board
TRMC	Transit Management Center
TRMS	Transit Management Subsystem
TRT	Technical Review Team
TRVS	Transit Vehicle Subsystem
UDP	User Datagram Protocol
USDOT	United States Department of Transportation
USR	User Service Requirement

Acronym	Definition
VMS	Variable Message Sign (see also DMS, CMS)
VRC	Vehicle/Roadside Communications
VS	Vehicle Subsystem
WAN	Wide Area Network
WIM	Weigh-in Motion
WWW	World Wide Web

APPENDIX A: Telephone Survey of Residents Regarding ATIS and TDM

1. Name ____________________________

2. How did you normally travel to work, before the Olympics?

   Drive Alone ________ Drive with Others __________

   Carpool ___________ # in Carpool ______________

   Bus or Trax ________ Walk ____________________

   Bike ______________

3. Before the Olympics, what time did you normally arrive at work? _______________

4. What time did you normally leave work, before the Olympics? _________________

5. Are you working during the Olympics? Yes ____ No _____

6. How do you normally travel during the Olympics?

   Drive ________ Drive alone _________Drive with others __________

   Carpool ______ With how many people? __________

   Bus or TRAX _________ Walk _______ Bike _________

   Other _________

7. During the Olympics, what time do you normally arrive at work? __________Arrival

8. During the Olympics, what time do you normally leave for work? ________ Departure

9. Did the Olympics cause you to change your normal travel patterns in any way?

   No ______ Yes _______

10. Did your employer make any changes during the Olympics?

   No ______ Yes _______

11. Have you heard of the Utah CommuterLink Website?

   No ______ Yes _______

12. Have you used the CommuterLink website?

   No ______ Yes ________ How many time have you used it? __________

13. When was the last time you used it? _______ days ago

14. What information did you get from it?

Traffic ______ Road Conditions ______ Olympics ________ Weather _____

Other _______ See Attachment _______

15. Did it work well for you? Yes ______ No ______

16. Have you heard the new 5-1-1 telephone service for traveler information?

No _____ Yes ______

17. Have you used the 5-1-1 telephone service?

No _____ Yes _____ How many time have you used it _____

18. When was the last time you used it? _____ days ago _____

19. What information did you get from it?

Traffic _____ Roadway Conditions _____ Weather _____

Olympics _____ Transit _____ Other _____

20. Did it work well for you?

Yes _____ No _____

21. Did you have other comments about transportation during the Olympics?

____

____

____

____

____

APPENDIX B: Intercept Survey of Visitors Regarding ATIS

1. Where are you from? Country ____________________ State _________

2. How long have you been here in Salt Lake City? _____

3. In what part of the SLC area are you staying? __________________________

4. Which Olympic Events have you attended?

Rice-Eccles Olympic Stadium Total: _____
- Opening Ceremonies _____

Utah Olympic Oval Total: _____
- Speed Skating _____

Salt Lake Ice Center Total: _____
- Figure Skating _____
- Short Track _____

Soldier Hollow Total: _____
- CrossCountry _____
- Biathlon _____

Deer Valley Resort Total: _____
- Freestyle Moguls _____
- Slalom _____
- Aerials _____

Utah Olympic Park Total: _____
- Ski Jump _____
- Luge _____
- Bobsleigh _____
- Skeleton _____

Downtown Visitors Total: _____

Park City Mountain Resort Total: _____
- Snowboarding _____
- Giant Slalom _____

Nordic Combined Total: _____
- Soldier Hollow _____
- Utah Olympic Park _____

Snow Basin Ski Area Total: _____
- Apline Combined _____
- Super-G _____
- Downhill _____

The Ice Sheet at Ogden Total: _____
- Curling _____

Hockey: Peaks Ice Total: _____

Hockey: E-Center Total: _____

No Olympic Events Total: _____

5. How do you usually travel to the Olympic Events?

Car _____ Alone _____ With Others _____ With how many other people? _____

TRAX or train _____ Somebody else drives _____

Bus _____ Shuttle _____ Mountain Venue Express _____ UTA _____

Walk _____ Other _____

6. Have you seen the electronic overhead signs on he highways here? Yes _____ No ___

7. Did you find them helpful?   Yes _____   No _____

8.Have you heard the radio stations along the highways that give information about traffic and parking?

Yes _____   No _____

9. Did you find them helpful? Yes _____   No _____

10. Have you heard of the Utah CommuterLink Website?No _____   Yes _____

11. Have you used the Utah CommuterLink Website?   No _____   Yes _____

How many time have you used it? _____

12.When was the last time you used the CommuterLink Website? _____days ago

13. What information did you get?

Traffic _____   Road Conditions _____   Olympics _____   Weather _____

Other _____

14. Did it work well for you?   Yes _____   No _____

15. Have you heard of the new 5-1-1 telephone service for traveler information?

N0 _____   Yes _____

16. Have you used the 5-1-1 telephone service?   No _____   Yes _____

How many times have you used it? _____

17. When was the last time you used it? _____   days ago

18. What information did you get from it?

Traffic _____   Transit _____   Commuter Tips _____   Road Conditions _____

Olympics _____   Other _____

19. Did it work well for you?   Yes _____   No _____

20. Do you have any other comments about transportation during the Olympics?

____
____
____
____