specific water emergency incidents. Lifeguards/Water Safety personnel handle a multitude of incidents ranging from routine single victim water rescues to multi-casualty incidents, vessel grounding, and downed aircraft. Adequate tactical voice communication paths are required to support multiple incidents simultaneously.

4.3.8.1.2 Command Voice. Command and Control voice communication requirements exist at each successive level of command above the tactical levels. Clear and distinct command voice communication paths must be immediately available and assigned with regard to geographic beach/ water use locations. The quantity of command voice communication paths must be sufficient to support multiple incidents occurring at separate geographic beach/ water use locations simultaneously. This need can be illustrated by examining the jurisdictional area of the County of Los Angeles Fire Department Lifeguards. The County manages 76 miles of coastline on the mainland and the entire coastline of Catalina Island, 28 miles off shore. The mainland shoreline alone is subdivided into 31 separate public beaches. Each beach location requires a clear and distinct command voice path to support rescue operations in that area.

4.3.8.1.3 Interoperability Voice. The Interoperability subcommittee report examines the need for interoperability voice in detail, but this communication need must be stressed and catalogued as an operational requirement. Lifeguard and water rescue operations often involve multiple jurisdictions and public safety agencies. This shared service posture requires the ability to communicate by voice with a wide variety of assisting and cooperating agencies such as, fire, law enforcement, swift water, Coast Guard, public works, flood control, highways and transportation and EMS. Adequate voice communication paths must be provided for safe, efficient, and effective operations at all Lifeguard/Water Safety incidents.

4.3.8.2 Data Requirements. The basic need for data is immediate, clear multiplex wireless transfer and display of data (text and graphics) for all Lifeguard/Water Safety personnel upon all demands, major and minor, created by Water-related emergencies. The ability to transmit, receive, and display intelligent data will greatly enhance and support the overall mission of Lifeguard/Water Safety personnel. The advantage of digital text and graphic data in conjunction with voice is accuracy and storage for future recall. Text can be recalled unlimited times to assure correct interpretation of the information. In addition, digital information can be stored and integrated into other data for the purposes of incident reporting and documentation. Data transmission requires less air time than voice, allowing increased availability of voice communication paths.

4.3.8.2.1 Mobile Data Computer/Terminal applications. A need exists for communications support of wireless mobile and portable computer systems capable of transceiving incident specific data and intelligence. Support for these systems should accommodate transmission of text such as secure and unsecure individual and group messaging, multilayered geographic information data (GIS), as well as real time data such as automatic vehicle and personnel location, as well as weather and atmospheric conditions.

4.3.8.2.2 Automatic Location Information. A need exists for automatic communication of location information generated to report accurate location of vehicles, personnel, and

victims into a synthesized computer command and control system. This system should also accommodate associated data, such as emergency situation alert function, personnel vitals, and equipment status and needs. Automatic location information will accomplish several goals in the mission of life and property protection: Emergency responders dispatched with regard to actual incident proximity will trim precious life and property saving response times; incident commanders will accurately assign and monitor units/ personnel to accomplish strategic efficiency; victim location may be accurately tracked to support proper placement of resources; and Lifeguard/ Water Safety personnel will report emergency situation location by the push of a button, speeding help their way and reducing the likelihood of injury or death. Additionally, search and rescue represents a major responsibility for Lifeguard/ Water Safety personnel. Watercraft in distress or aircraft lost can quickly turn into tragedy if passengers are not rapidly located and rescued. Automatic Location Information can be utilized to establish grid search patterns that will efficiently streamline search and rescue operations.

4.3.8.2.3 Robotics support. Lifeguards/Water Safety personnel will utilize the support of robotics devices in underwater search and rescue operations when persons, planes, and ships are submerged in water depths greater than 200 feet. At these depths robotics equipment becomes the preferred method of retrieval. Use of human divers at these depths requires considerable decompression time. The utilization of remote control recovery vehicles eliminates the need to further risk human life to recover a dead body or salvage from ships or planes.

4.3.8.2.4 Interoperability Data. The Interoperability subcommittee report examines the need for data interoperability in detail, but this communication need must be stressed and catalogued as an operational requirement. Lifeguard/ Water Safety personnel incidents require the aid of a multitude of public safety and public service agencies including the Coast Guard, Harbor Police, local Law enforcement, Fire and EMS agencies. It is impossible to effect efficient command and control without the ability to communicate with assisting and cooperating agencies on water rescue incidents.

4.3.8.3 Video/Imagery Requirements. The basic requirement for video/imagery is immediate, clear wireless transfer of video/ imagery for all Lifeguard/Water Safety personnel upon all demands, major and minor, created by water rescue-related emergencies. Video/imagery capture and display systems must be capable of transceiving incident specific replications and should accommodate video and imagery from all available sources including privately owned and agency controlled. For example, automatic aid agreements with commercial broadcast agencies would often provide quality video/imagery of incident scenes for command personnel, either directly or through retransmission. Remote surveillance of little frequented beaches, underwater inspections of submerged aircraft or vessels, aerial observation of oil spills or major off shore incidents are just a few applications of video/ imagery utilization.

4.3.8.3.1 Incident Video/ Imagery. The ability to transmit clear video/ imagery to the incident commander provides invaluable information for incident management. Large offshore incidents such as cruise ship disasters, aircraft disasters, or oil spills will be greatly enhanced by video/imagery transmission.

4.3.8.3.2 Aerial Observation Video/ Imagery. A need exists for the transmission of video/imagery and multi-spectral interrogation from airborne platforms to the incident command post. This information will greatly assist efforts related to operations such as oil spill management and multiple victim searches created by disasters caused by cruise line or aircraft incidents.

4.3.8.3.3 Robotics Video/ Imagery. Remote and lightly-used beaches are not staffed with daily water safety and lifeguard personnel due to fiscal restraints. Staffing of these water use areas is determined daily by on-site Lifeguard/ Water Safety personnel inspection. Robotics Video/Imagery will allow continuous staffing decisions based on actual real time water use area populations.

4.3.8.3.4 Interoperability Video/Imagery. The Interoperability subcommittee report examines the need for video/ imagery interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. Lifeguard/Water Safety personnel incidents require the aid of a multitude of public safety and public service agencies to effectively save lives. Additionally, video and imagery is gathered from multiple sources, both public and private, during Water Rescue incidents. The ability to utilize video and imagery from multiple sources, as well as the ability to share this information among assisting and cooperating agencies, will greatly enhance incident operations.

4.4 EMERGENCY MANAGEMENT AND DISASTER SERVICES

4.4.1 Mission. The mission of the Emergency Management and Disaster Services (EMD) working group is to catalog operational requirements for emergency management and disaster services at the federal, state and local levels.

4.4.2 Introduction. Communications system requirements for emergency management and disaster services are characterized by very low usage patterns during routine operations and extremely high usage patterns during a major event. Thus, radio systems designed and used by emergency management agencies appear to be virtually unused on a day-to-day basis, yet when a major event occurs, these same systems are inadequate for meeting the need to communicate. Although individual communications systems performed properly, incident needs still were not met due to interoperability issues in New York at the World Trade Center, in Miami following Hurricane Andrew, in Oklahoma City, in Los Angeles during the Rodney King riots and following the Northridge Earthquake, in San Francisco following the Loma Prieta Earthquake, and countless other times.

We should not look at large-scale events as being an anomaly. True, major earthquakes do not occur that often. Nor do hurricanes or floods. Taken all together though, they occur more often than we would like to think. Furthermore, few years pass without a major forest or wildland fire such as those in Yellowstone National Park and in Malibu, California being battled by one thousand or more firefighters from hundreds of fire agencies. Special events such as the Olympics, political conventions, and the "Million Man March" occur each year. The reality is, large-scale events happen every year at unpredictable locations and at

unpredictable times. Public safety agencies must be prepared to respond to these events when they occur and they need effective communications to aid in their response. While the unpredictability of these events makes it impractical to have adequate wireless communications facilities in place, we can identify and protect a block of frequencies from which such facilities can be rapidly developed. Portable repeaters and programmable multi-channel radios have provided the needed technology. It is time for frequency planners to provide the spectrum.

4.4.3 Voice Requirements.

Routine Operations. Emergency management agencies require at least one voice communications path (encryption capable) and one data communications path for command and control of their own personnel during routine operations. These same links would be used for a similar function during a disaster or major emergency. Agencies having this need include the Federal Emergency Management Agency (FEMA), state disaster control agencies and county disaster control agencies.

Mutual Aid. Large-scale emergencies and disasters place a particular burden upon the operation of public safety communications systems. Many of these events exceed the capability of local agencies and they turn to outside agencies to provide mutual aid. While the outside agencies provide the personnel and equipment needed to handle the situation, they also produce an increased demand for communications. A major forest fire, for instance, may involve over one thousand firefighters from over 100 different agencies.

Currently, one channel has been designated nationwide for law enforcement use (155.475 MHz), four channels have been designated nationwide for fire use (45.88 MHz, 154.265 MHz, 154.280 MHz, and 154.295 MHz), and five channels have been designated nationwide for public safety use (866.0125 MHz, 866.5125 MHz, 867.0125 MHz, 867.5125 MHz, and 868.0125 MHz). The Boise Inter-agency Fire Cache (BIFC) provides a resource of equipment which operates on Federal channels which are reserved nationwide for deployment of the BIFC equipment. Some state and local agencies have set aside additional channels to improve the situation, but there remains a dearth of channels to handle a large-scale event. This becomes a particular problem in the major metropolitan areas where all other public safety are already in use for normal operations. Specific recommendations regarding the number of communications paths needed for mutual aid purposes is a subject of the Interoperability Subcommittee report. While those links are desperately needed for mutual aid functions during a disaster or major emergency, to have all of those links remain unused at other times is a misuse of the limited spectrum. Therefore, the Operational Requirements Subcommittee recommends that the mutual aid links be available for use based upon a system of priorities such as the following:

Priority 1	Disaster and extreme emergency operations for mutual aid and interagency communications
Priority 2	Emergency or urgent operations involving imminent danger to the safety of life or property

Priority 3 Special event control activities, generally of a preplanned nature, and generally involving joint participation of two or more agencies

Priority 4 Single agency secondary communications

It may be desirable to restrict Priority 3 and 4 communications to a particular sub-set of the set aside mutual aid channels, with different channels available for police, fire, EMS, and other public safety users. While Priority 4 communications do not seem to satisfy the mutual aid requirement, they provide an incentive to public safety agencies to implement the mutual aid capability in their mobile/portable radios.

Inter-Agency Communications. Many public safety emergencies, particularly large-scale emergencies and disasters, require a response from multiple agencies. The response from these agencies needs to be coordinated and controlled. Currently, much of this coordination occurs over the public switched telephone network (PSTN). History has shown, however, that the PSTN network is disrupted during a large-scale emergency or disaster due to damage or overload. During a major event, at least one voice and one data communications path are needed between each of the following points:

Federal Emergency Management Agency (FEMA) and State Disaster Services Agency

State Disaster Services Agency and Event Command Center

Event Command Center and County Government Command Center (provide 10 sets of links (both voice and data) to allow for multiple counties to be involved in the event. The Loma Prieta Earthquake, for example, affected eight counties).

County Government Command Center and Major City Command Center (provide 10 sets of links (both voice and data) to allow for multiple counties and cities to establish communications)

The voice links should be capable of encryption.

Some of these voice and data communications requirements may be satisfied by the long-range communications systems discussed below.

Long-Range Communications. Public safety response to large-scale emergencies and disasters usually requires the assistance of agencies from outside the "event area." One characteristic of such events, however, is disruption of the normal long-range communication networks through which such assistance might be requested. The public telephone network, for instance, may be unusable due to actual damage resulting from the event or due to system overload. Thus, there is a requirement for long-range communications which either are sufficiently robust as to withstand the initial event or are rapidly deployable.

High-frequency single-sideband (HF-SSB) communications systems are one method by which public safety agencies currently satisfy this requirement. These systems have been established under Section 90.264 of the Federal Communications Commission Rules and Regulations. They operate in the 2-10 MHz portion of the radio spectrum and offer communications over distances of several hundred miles.

RECOMMENDATION: Maintain the current frequency allocations but eliminate the inter-state restrictions on the points of communications. Federal Communications Commission licensing practices on these paths currently restrict use of certain channels to "inter-state use only" and, in some cases, to communications with specified other states. These restrictions fail to recognize the usefulness of HF systems for communications within a large state. The distance between Los Angeles and Sacramento, CA, for instance, is nearly 400 miles. Also eliminate "day/night" restrictions on the use of certain frequencies. The choice of frequency is dependent on many different factors, including not only the time-of-day but also the distance between communication points and the propagation conditions. The determination of which frequency is used should be based upon that frequency which provides the needed communications, not the position of the sun.

Satellite based communications are another method by which public safety agencies currently satisfy the requirement. Systems utilizing very-small aperture (VSAT) technology are capable of providing both voice and data services over virtually any distance.

Urban Search & Rescue. Several Urban Search and Rescue (USART) teams have been established across the country. These teams have proven their value during the Northridge Earthquake and the Oklahoma City bombing through their ability to conduct difficult rescue operations in downed buildings. By their very nature, USART operations are high-risk events where effective communications may affect personnel safety. Currently, the communications for these teams is based upon radio equipment and frequencies used in their home area and are subject to causing/receiving interference with other public safety agencies within the area of the event.

RECOMMENDATION: Set aside communications paths on a nation-wide basis for use by USART personnel. As a minimum, the following is needed:

1 ea repeater pair	National USART command channel for communications between the USART team leaders and the event command center.
3 ea repeater pair	Team command channel for communications between USART team leaders and members of their team. This is based upon three teams being "on-duty" at any given time. Specific channels would be assigned to each team on a "per-event" basis.
10 ea simplex	On-scene tactical communications for USART team members. This is based upon different groups working different parts of a building in close proximity, each needing a "clear" channel for safety reasons.

2 ea simplex	Robotics control channels. This is based upon two different robotics operations in close proximity.
2 ea simplex	Robotics video/audio channels. This is based upon two different robotics operations in close proximity.

The National USART Command channel should be maintained as a clear channel nationwide. The three repeater capable team command channels should be available for local search and rescue operations on the proviso that USART teams have priority access to those channels. Similarly, the simplex tactical and robotics channels should be available for local search and rescue, ski patrol, lifeguard and related activities with the same proviso that USART teams have priority access to those channels in the event of a disaster.

Disaster Medical Assistance. Similar to the USART teams formed by FEMA, the U.S. Public Health Service has formed Disaster Medical Assistance Teams. These DMAT teams provide medical personnel and equipment to handle mass casualties which might result from a major disaster. DMAT teams need to exchange information regarding the numbers and types of casualties, the availability of resources, and requests for additional resources.

RECOMMENDATION: Set aside communications paths on a nationwide basis for use by DMAT teams. As a minimum, the following is needed:

1 ea repeater pair	National DMAT command channel for communications between the DMAT team leaders and the event command center.
1 ea data channel	National DMAT data channel for communications between DMAT teams and the event command center.

Damage Assessment and Infrastructure Repair. Immediately following a major disaster such as an earthquake, floor or hurricane, the amount of damage needs to be inventoried. From this inventory, damage to critical infrastructure such as roads, water works and utilities can be identified, prioritize and repaired.

RECOMMENDATION: Establish one voice and data communications path nationwide for each of the following infrastructure services. In each case, private utility and governmental disaster services agencies should be eligible to use the link for purposes of exchanging information regarding damage/repair.

Electric power providers
Natural gas distributors
Water providers
Road agencies

The Operational Requirements Subcommittee recognizes that each of these infrastructure services have requirements for radio spectrum to support their disaster response. Although

the committee supports these requirements, discussion of the requirements and the spectrum requirements are not within the scope of the PSWAC report.

Non-Public Safety Agency Communications. Many non-public safety agencies provide valuable services during a disaster or major emergency. These agencies include the American Red Cross, the Salvation Army, the Civil Air Patrol and the National Guard. Public officials managing the disaster or event need voice and data communications with these agencies to exchange information regarding the care and feeding of victims.

RECOMMENDATION: Establish 5 nationwide voice/data channels in each band for communications between event command centers and these agencies. Eligibility for use of these channels should include the American Red Cross, the Salvation Army, Civil Air Patrol and National Guard and other non-public safety agencies providing similar disaster relief functions.

These agencies also have a need for communications internal to their operations during the disaster. Although these needs are not a subject of this report, the Operational Requirements Subcommittee recognizes these needs and supports providing radio spectrum for these functions. Communications requirements include internal operation of a shelter to provide security, food, water, clothing, bedding and other supplies.

News Media & Emergency Broadcast. Public officials managing any event have an obligation to inform the public about the emergency. The Emergency Broadcast System and the news media provide a valuable means by which information can be distributed to the public. A weak link in the system, however, is the link between the public official and the media. Currently, these messages are passed to the media either at a news conference or via telephone calls.

The State of California has implemented a system called the Emergency Digital Information System (EDIS) which utilizes land-mobile radio channels to pass digital messages directly to commercial broadcasters. These messages are formatted such that radio/TV announcers can "rip and read" as if the message were a teletype message and TV broadcasters can scroll the message across the screen. Messages can be generated by any public official

RECOMMENDATION: Establish a nationwide communications path for EDIS-type messages from appropriate public officials to broadcasters.

RACES. Radio Amateur Civil Emergency Service (RACES) operates on radio amateur frequencies by authority of the Federal Communications Commission in support of public safety. RACES can augment existing systems, substitute for damaged and inoperable systems, and establish communications links with otherwise inaccessible areas. RACES uses HF, VHF, and UHF equipment operating on packet (data), voice, CW Morse code, radio-teletype, and television (ATV). While not a public safety spectrum requirement, the services provided through RACES should be continued and protected.

4.4.5 Data Requirements.

Global Positioning. Access to the Global Positioning System (GPS) is a valuable tool in a disaster. Following an earthquake, flood, hurricane, or other disaster it is not uncommon for normal landmarks to have disappeared. Buildings are destroyed, streets are covered, and road signs are missing. Emergency management personnel need a means by which they can map the event so that they can better understand where the problems lie and dispatch personnel to deal with situations appropriately. Although access to the GPS signal itself does not create a path or channel requirement, use of location data at any other location will create a path or channel requirement for transport of GPS-generated data, as described in paragraph 4.2.4 and similar paragraphs included in other portions of section 4.

4.5 HIGHWAY MAINTENANCE

4.5.1 Mission. The mission of the Highway Maintenance working group is to catalog operational requirements for highway maintenance at the state and local levels.

4.5.2 Introduction. Organizations at federal, state and local levels are charged with specific highway maintenance activities. Activities of these organizations include maintenance and construction of roads, highways, tunnels, bridges required to allow safe thoroughfare of the general public. Highway maintenance organizations also respond to events such as snow storms, mud slides, flooding, and hazardous material spills in order to allow safe passage on transportation infrastructures. Communications needs are based on official duties.

The Highway Maintenance mission is to serve the public by establishing, operating and maintaining a high quality cost effective transportation system that emphasizes safety, vehicle throughput and environmental preservation.

4.5.3 Voice Requirements

Two-Way Voice Communications. Dispatch requirements usually fall into the categories of emergency response, maintenance and construction activities. These require dispatch operation to insure timely response and to control and manage activities. Wireless voice dispatch is critical to controlling costs, coordinating projects, and promoting safe, efficient traffic flow.

Voice communications are necessary from dispatcher control points to field units; field units to multiple field units; or individual to individual through either mobile mounted, hand held portable or desktop radios.

Telephone System Access. Interconnect capabilities are required for management level to interface with the public and provide semi-private contact at a management level. Mobile mounted or hand held portable radios which have system access to the public switched telephone network would be necessary.

Interoperability. Mutual aid considerations are vital to highway operations. Highway maintenance crews are often the first to arrive on the scene of accidents and require a method of contacting appropriate emergency response entities. Incidents occurring on or adjacent to highway right of way also require response by highway maintenance units to provide primary traffic control, vehicle relocation, emergency repair, detours along with providing general assistance to other public safety responders. Highway maintenance organizations are equipped with heavy equipment which is necessary to respond to public safety incidents involving multiple public safety disciplines. A primary consideration is weather associated operations such as snow removal which is very critical to public safety entities being able to perform their function. The ability to interface with other aspects of public safety are essential.

Connections to remote traveler information systems such as localized broadcast transmitters providing the public with timely road condition information.

4.5.4 Data Requirements

Two-Way Mobile and Portable Data Terminals. Field computers capable of remotely accessing information systems and files may be used for dispatch or field support to perform real time changes to system data. Equipment may be vehicle mounted or a hand held portable unit.

Mobile unit status and control provide essential cost and time saving abilities to day to day operations. Unit status as well as road condition status can be transmitted by data exchange increasing the timeliness and accuracy of information.

Administrative data transfer allows for overhead information exchange for a work force that is remote and mobile.

Telemetry Systems. Monitoring of infrastructure integrity such as pavement temperature, salt content, water flow and height at bridges, mud flow areas, high wind areas provide instant information and warning freeing up personnel and equipment to perform their functions more efficiently.

Monitoring of equipment and fleet productivity increase effectiveness of operations.

Supervisory Control and Data Acquisition (SCADA). Monitoring systems and providing control functions to lighting, traffic control, pumping and specialized equipment such as toll collection and lane access control equipment.

Infrastructure inventory and control can be transmitted as data allowing better control of required maintenance of structures such as bridges and signs.

Remote Public Information Systems. Changeable signs and traveler information radio systems. Weather and road condition data transfer from remote sites.

Vehicle and Device Location Tracking. Vehicle location information allows more efficient use of equipment utilization, equipment management inventory and location control. The amount and location of material such as sand and asphalt both in storage and application. Road maintenance management including bridge, buildings and signs. Road surface condition and repair needs inventory data acquisition. Road construction survey information requires differential Global Positioning System (DGPS) accuracy. Accuracy for all of these requirements depend on the availability of DGPS. DGPS is provided by many means including transmission over dedicated public safety frequencies.

4.5.5 Video Requirements

One-Way Video. Ability to view specific locations or interests through either snapshot, real time or close to real time accuracy to monitor traffic flow, facilitate incident response, and manage traffic control gates from remote sites.

4.5.6 ITS - Intelligent Transportation Systems. Many of the ITS requirements fall to the highway programs. These range from public information dissemination to monitoring transport vehicles regarding weight/height/fuel permits. Section 4.6 provides a detailed description of services that fall into this range of applications.

4.6 INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

4.6.1 Purpose. Innovative applications planned within this services may be unfamiliar to many in the public safety community especially those designed to aid in emergency vehicle response. ITS represents a broad range of applications that, because of their ability to enhance performance of different public safety communities' transportation and operations, apply horizontally across many other public safety communities' requirements. As a result, ITS-related operational requirements appear in some of the other sections of this report. It should be noted that the operational requirements for ITS defined in this section of the report are derived from the ITS National Architecture and the user services on which the architecture is based.

Many of the applications will enhance the safety of the individual traveler, and will be available to both personally owned vehicles as well as vehicles owned and operated by traditional public safety agencies. This creates an environment where spectrum use may be shared between public safety-related, public service and non-safety related functions.

4.6.2 Introduction. The Intermodal Surface Transportation Efficiency Act was passed by Congress and approved by the President in December 1991. It formally established the Intelligent Transportation Systems (ITS) program, which seeks to apply advanced communications and computer technologies to surface transportation systems in order to decrease traffic congestion, improve safety, reduce transportation related environmental impacts, and increase productivity. Public safety goals of the Intermodal Surface Transportation Efficiency Act (ISTEA) legislation being addressed by ITS are reducing the frequency of accidents, reducing the severity of accidents, reducing congestion due to incidents and enhancing traveler security.

In order to reduce the time and cost of implementing such a system, existing communications services will be used to the extent possible, provided they can meet ITS requirements. Some systems will require wireless data communications technologies such as dedicated short range communications (DSRC using roadside readers and vehicular mounted transponders) or may require the use of collision avoidance radar. There are likely to be ITS-specific systems or applications requiring new spectrum. Intelligent Transportation Systems may also require dedicated and shared use of frequencies currently allocated to public safety and other services.

The relationship between ITS and public safety has several aspects including: the safety of the traveler and the safety of public safety personnel performing mission related functions.

4.6.3 Operational Needs. Channels will be required for point to point and point to multi-point control of subsystems. Public safety features of the Intelligent Transportation Systems network include:

.. Emergency vehicle location tracking
.. Emergency vehicle route guidance
.. Emergency vehicle signal priority
.. Driver and personal security
.. Automatic collision notification
.. En-route driver information
.. In-vehicle signing
.. Incident detection and management
.. Probe data for traffic control
.. Transit management
.. Priority treatment for transit
.. Public travel security
.. Automated roadside inspections
.. Weight in motion
.. Automated vehicle classification
.. International border crossings
.. Electronic clearance
.. On-board safety monitoring
.. Hazardous materials incident response
.. Collision avoidance
.. Intersection collision avoidance
.. Safety readiness
.. Pre-crash restraint deployment
.. Automated highway system check-in
.. Highway-rail intersection safety

4.6.4 Descriptions of each Typical Operational Requirement

Emergency vehicle location tracking: Wireless data communications will be used to collect position or location information and data from emergency vehicles to improve the

monitoring and display of emergency vehicle locations and help dispatchers efficiently task the units that can most quickly reach an incident site. Direct field access to vehicle position-location information will help field forces to coordinate incident response.

Emergency vehicle route guidance: Route guidance information is sent via wireless data communications to direct emergency vehicles equipped with guidance and navigation displays to an incident location. Directions are provided based on real-time information collected concerning traffic conditions and road closures in developing the best route.

Emergency vehicle signal priority: Signal priority uses wireless data communications to clear traffic signals in an emergency vehicle's route. In order to facilitate speedy movement for emergency vehicles, the vehicle can (with the help of an "onboard transceiver") alter the timing of traffic signals in the immediate vicinity (via the "fixed reader" mounted beside the traffic lights) to generate a "green wave" (a series of green signal lights in the desired direction of travel).

Driver and personal security: Wireless communications will be used for user initiated distress signals for incidents ranging from mechanical breakdowns to car jackings.

Automated collision notification: Sensor technology is used to identify when a vehicle has had a collision and information is automatically sent via wireless data communications regarding location, nature, and incident severity to emergency personnel.

Enroute driver information: Wireless data communications are used to provide driver advisories conveying information about traffic conditions, incidents, construction, and weather conditions to drivers of personal, commercial, emergency, and public transit vehicles. The information may be provided by state and local authorities, transit authorities, and emergency management centers.

In-vehicle signing: Transmitters installed at critical points of a roadway are used to transmit data containing driver safety advisories and warnings on road hazards which could be displayed, enunciated or both to travelers in vehicles.

Incident detection and management: Sensor technology, digitized video and wireless data communications are used to help public officials quickly and accurately identify a variety of transportation system incidents, and to implement a response which minimizes the effects of these incidents on the movement of people and goods.

Probe data for traffic control: Continuous collection and transmission of vehicle counts, flow data, and travel times by wireless data communications incorporating position-location data provides information needed for traffic management, emergency fleet management and route guidance. This also provides state and local traffic management centers with real-time detection of obstructions due to traffic incidents and road hazards (this is a special case of the surveillance capability needed to effectively manage the transportation system).

Transit management: Wireless data communications are used to maintain position location information on transit vehicles and to transfer data between transit management centers and transit vehicles. Transit vehicles can be instructed to adjust their schedule or route to allow for incidents or bad road conditions. Within the transit vehicle, this information can also be utilized to provide automatic signage and annunciation of the next stop.

Priority treatment for transit: Identification of transit vehicles at access points of HOV lanes or at intersections can be used to provide priority treatment for these vehicles via appropriate adaptation of signal timing. This is accomplished by wireless data communications between the transit vehicle and the control signal or a transit vehicle and a traffic/transit management center that can exercise signal control.

Public Travel Security: Wireless video and data communications can be used for systems monitoring the environment in transit stations, parking lots, bus stops, and transit vehicles and generate alarms either automatically or manually as necessary. This improves security for both transit riders and operators.

Automated roadside inspections: Inspections are performed on commercial vehicles using wireless data communications allowing "real-time" access at the roadside to the safety performance records of carriers, vehicles, and drivers. This enables safety inspectors to access these records from the roadside.

Weight-In-Motion (WIM): Weight measuring equipment (fixed sensors embedded in the pavement or portable and temporarily deployable equipment) can ascertain the weight of a commercial vehicle at highway speeds to ensure the vehicle is operating within the rated safety limits. Wireless data communications systems are used to match the weight data obtained with the relevant credentials in the official database while the vehicle is in motion.

Automatic Vehicle Classification (AVC): In-pavement sensors, in conjunction with the roadside wireless data transceivers (and, perhaps, an inspection facility computer), are used to count the number of axles of a commercial vehicle for classification, and match the data with the vehicle.

International border crossing: Using automated vehicle identification (AVI), commercial vehicles are identified via wireless data transmission to a roadside reader and matched to its Pre-cleared credentials, allowing the vehicle to proceed without stopping. This service enables the carriers to Pre-clear vehicles at international border crossings. Automating this process implies cooperation of registration, fuel tax, immigration, safety enforcement, and customs agencies, as well as the state transportation agencies.

Electronic clearance: A wireless data communications system would be used to identify a commercial vehicle and its electronic credentials would be verified automatically while the vehicle is traveling past the roadside reader at highway speeds. This would allow commercial vehicles to travel across state borders without being stopped for verification of paperwork and permits regarding fuel usage and tax, registration, safety clearance, etc. Combined with the networking infrastructure, which would connect roadside readers to central

databases and administration centers, this service will facilitate state tax report preparation, auditing, and insurance requirements.

On-board safety monitoring: Safety data is provided to enforcement personnel, carriers, transit authorities, and drivers to review the safety status of a commercial vehicle, its cargo, and its operator, over a wireless data communications link as the vehicle passes the roadside reader while traveling at highway speeds. Safety conditions of the vehicle and the driver including the condition of critical vehicle components such as brakes, tires, and lights, and sensing unsafe conditions such as shifts in cargo while the vehicle is in operation would be stored as data on the vehicle, and interrogated using wireless data communications from the roadside.

Hazardous materials incident response: The safety of shipments of hazardous materials is enhanced by providing enforcement and response teams information from the vehicle via wireless data communications on the nature and location of any incident, and the type of material involved in order to enable safe and efficient response.

Collision avoidance: Radar is used to provide crash warnings and some degree of vehicle control for lane changes, road departures, and potential or impending collisions. It will help reduce the number of longitudinal and lateral collisions involving two or more vehicles, and crashes involving a single vehicle leaving the roadway.

Intersection Collision Avoidance: Drivers are warned of imminent collisions when approaching or crossing an intersection that has traffic control (e.g., stop signs or traffic signals). This application uses wireless data communications at the various arms of an intersection to sense the speed and direction of passing vehicles, which in turn, is coordinated by a roadside processor (or master reader for that intersection). Appropriate messages are dynamically transmitted to vehicles warning them of a potential collision.

Safety readiness: Radar equipment onboard the vehicle will be used to detect unsafe road conditions, such as bridge icing and standing water on a roadway, and provide warnings to the driver.

Pre-crash restraint deployment: Radar identifies the velocity and direction of vehicles and objects involved in a potential crash. Responses include tightening lap-shoulder belts, arming and deploying air bags at an optimal pressure, and deploying roll bars.

Automated highway system (AHS) check-in: Automated check-in using wireless data communications between the roadside and the vehicle at the entrance of (AHS) lanes will be used to examine lane-worthiness of a vehicle by verifying qualifying credentials for the vehicle, driver and carrier on their safety ratings and status. This ensures that both the driver and vehicle have passed the necessary safety checks to travel on automated highways.

Highway-rail intersection safety: Vehicle Proximity Alerting Systems (VPAS) will use wireless communications to provide warning messages to vehicles concerning the approach of trains at highway-rail intersections.

4.7 FORESTRY

4.7.1 Mission. The mission of the Forestry working group is to catalog operational requirements for forestry operations at federal, state and local levels.

4.7.2. Introduction. Organizations at federal, state and local levels are charged with the specific oversight of our nation's environmental and agricultural resources. Activities of these organizations include management of forests, riparian environments, parks and various other environmental and agricultural resources for the common good of the general public.

The Forestry/Conservation mission is to serve the public through its activities directed to conserve, improve, and protect natural resources and environment. Communications needs are based on the performance of official duties.

Major activities in the management of the fragile and limited public resources associated with forest, wildlife, fish, recreation and other renewable resources include enforcement of environmental conservation laws; maintenance of air & water quality; hazardous, toxic, and solid waste management; mined land reclamation; wetland protection; environmental impact analysis; pesticide use regulation; fish & wildlife management; stream protection; park & primitive area management; and forestry.

The Forestry/Conservation mission emphasizes safety, environmental preservation, cost-effectiveness and quality. A specific component of Forestry/Conservation activity includes public safety response in such areas as law enforcement, rural and rural/urban interface fire protection, first response medical assistance, search and rescue, and boating safety.

Varied and wide area response including air support require dynamic frequency assignments for all operational categories through well coordinated procedures. Forestry/Conservation Communications systems require areas of operation covering entire states or regions.

4.7.3 Voice Requirements

Two-Way Voice Dispatch. Dispatch requirements usually fall into the categories of maintenance and management activities. Both require dispatch operation to control and manage activities. Wireless voice dispatch is critical to controlling costs and coordinating projects including mutual aid interoperability with other Public Safety Service providers. Law enforcement actions in Forestry/Conservation usually take place in remote isolated areas dealing with groups or individuals who are often difficult to deal with emphasizing the importance of a robust communications infrastructure and mutual aid interoperability requirements.

Voice communications are required from dispatcher control points to field units; field units to multiple field units; or individual to individual through either mobile mounted or hand held

portable radios. In addition, voice communications in harsh terrain may require the use of vehicular communications repeaters to retransmit signals.

Air to Ground. Air to ground communications are necessary when aircraft perform wildfire detection and suppression, conservation law enforcement investigations and patrol, inspections of reclamation projects and contamination sites, and while tracking wildlife and transporting personnel.

Fisheries Operations. Voice communications are necessary to support transportation of fish, fish tracking, habitat and species studies, fish catching for species development, and fish ladder construction and operation.

Conservation Law Enforcement. Conservation officers in most states are full-time peace officers. Voice communications are required to support conservation law enforcement operations, marine safety enforcement and patrol, hunter safety training, poaching investigations, citizen evacuations, traffic control, and search and rescue missions. Conservation officers also must have the ability to contact other law enforcement officers to request and provide mutual aid.

Wildlife Management: Voice communications are required by conservation officers and staff to support transportation of animals, along with tracking and general management of various species of wildlife.

Wildfire Detection and Suppression. Voice communications are required for mutual aid with other states agencies, foreign governments, Department of Defense, federal agencies, and local municipal fire suppression agencies. Forestry or conservation agencies provide the first response in many states because of the heavy equipment resources of such agencies, the availability of a reliable state-wide radio communications system and the availability of caches of handheld communications devices for on-scene activities.

Park and Recreation Area Management. Voice communications are required to support operation of state parks and mooring facilities by forestry and conservation agencies. Activities involved in this requirement include construction of facilities, traffic control, facilities maintenance, fire suppression, boating safety, beach patrol and life guard services, basic first aid and emergency medical response. The essential nature of these services often is magnified by the geographically remote nature of park.

Environmental and Waste Management Operations. Voice communications are required to support contamination investigations and site management during cleanup and restoration.

Telephone Interconnect. Interconnect capabilities are required for management level to interface with the public and provide semi-private contact at a management level. Telephone System Access would be accomplished through mobile mounted or hand held portable radios which have system access to the public switched telephone network.

Interoperability. Mutual aid considerations are vital to Forestry/Conservation operations. Forestry/Conservation crews are often the first to arrive on the scene of accidents in remote areas and require a method of contacting and coordinating with appropriate emergency response entities. The ability to interface with other aspects of public safety during ongoing natural disaster incidents are essential.

Wireless Public Announcement System. Public announcement broadcast information systems such as localized broadcast transmitters providing the public with timely area specific resource and safety information.

4.7.4 Data Requirements

Portable & Mobile Data Terminals. Mobile unit status and control provide essential cost and time saving abilities to day to day operations. Unit status as well as resource condition status can be transmitted by data exchange increasing the timeliness and accuracy of information. Routine administrative data transfer allows for overhead information exchange for a work force that is remote and mobile. Resource management and condition reporting are an essential component of large scale incidents such as wildland fires.

Data collection and monitoring of public environmental resources such as water flow and quality provide instant information and warning freeing up personnel and equipment to perform their functions more efficiently. Infrastructure inventory and control can be transmitted as data allowing better control of required maintenance of resource support facilities.

Public Information Systems. Remote public information systems such as changeable signs and public information radio systems. Weather and resource condition data transfer from remote sites linked to administrative sites.

One Way Data Transmission/Telemetry. Data monitoring of fish and wildlife to allow better resource management.

Vehicle, Device, and Wildlife Location Tracking. Location information allows more efficient use of equipment utilization, equipment management inventory and location control. The location and control of limited resources during routine and extended emergency incidents is crucial to safe and quick mitigation of such incidents.

Facilities management. Facilities management includes oversight of bridges, buildings and signs. Data transmission support assists infrastructure and repair through maintenance of inventory and status information. Also, resource identification requires survey information utilizing differential Global Positioning System (DGPS) accuracy. Accuracy for all of these requirements depend on the availability of DGPS. DGPS is provided by many means including transmission over dedicated public safety frequencies.

Wildfire Detection and Suppression. Data transport is required to support transmission of weather-related data and area vegetation and combustible materials inventory data.

Environmental and Waste Management Operations. Data transport is required to support transmission of data regarding water quality, well contamination and other data from remote monitoring or control systems.

4.7.5 Video Requirements. Real time and close to real time incident monitoring from remote sites (including airborne) provide up to date information on such incidents as wildland fires as well as crowd control in routine parks environments. Infrared real time mapping of fire via airborne resources.

4.8 GENERAL GOVERNMENT

4.8.1. Mission. The mission of the General Government working group is to catalog operational requirements for general government operations at federal, state and local levels.

4.8.2. Introduction. The general governmental group's needs are diverse in nature since they perform a myriad of tasks to carry out their respective mission. This group includes any United States territory, possession, state, county, city, town, village or similar governmental entity, including a district and an authority. The need is for essential communications necessary to fulfill official governmental responsibilities.

A major portion of this section is based on the needs of large urban regions since there are a broad range of uses in densely populated areas. In addition, the needs of surrounding suburban and rural areas were also taken into account for these regions. General Governmental services focus on legislative, community and general matters all of which are a function of government.

4.8.3 Voice Requirements. Voice communications is the most widely used method of communications for the general governmental agency. Dispatch requirements are necessary for day to day operations to accomplish specific agency missions in a timely and cost effective manner.

Communications are directed towards management of field personnel, control of workload distribution, and coordination of services affecting public safety. Agencies in the general governmental category are most likely the "public safety support" service providers who provide the tools necessary for emergency responders to fulfill their tasks.

Another aspect of the general governmental service is direct public safety. Many times a general government service is called upon to act on a routine matter of public interest such as a housing, heating, or community assistance matter only to be faced with a potentially volatile situation requiring immediate attention from specific governmental groups. Immediate

action on these matters from the general government groups calms the tension of the public and involved parties reducing the risk of major public safety incidents such as riots.

Typical voice communications would be from dispatcher control points to field units; field units to multiple field units; or individual to individual through either mobile mounted or hand held portable radios.

Telephone System Access: Interconnect capabilities are required for certain management levels to interface with the public and provide semi-private contacts at with other public services. Telephone System Access would be accomplished through mobile mounted or hand held portable radios which have system access to the public switched telephone network through dedicated links or through commercially available services. A necessary consideration is that the device utilized for voice communications be a singular piece of equipment capable of all voice features. Mobile mounted or hand held portable radios would be necessary in order to facilitate the field office workers' needs.

Interoperability. Mutual aid considerations are vital to General Government. Governmental services require interaction among other regional public safety services and public service entities for both routine and emergency situations.

4.8.4 Data Requirements

Two-Way Mobile and Portable Data Terminals. General Government uses field computers capable of remotely accessing information systems and files. Field Computers may be used for dispatch or field support to perform real time changes to system data. Equipment may be vehicle mounted or a hand held portable unit.

Mobile unit status and control provide essential cost and time saving abilities to day to day operations. Administrative data transfer allows for information exchange for a work force that is remote and mobile.

One-way Data Transmission & Telemetry Systems. General Government requires real time information transfer from field locations (fixed, mobile, or portable) to fixed control points. Transmission is used to monitor the functions of a system, site, or device. This may also incorporate a type of personal paging device used to alert personnel with limited alphanumeric messages.

Remote Public Information Systems. Changeable signs and public information systems with the ability of the authorized entity are used to dynamically change visible street signs/bulletin boards and alert the public to potential hazards or delays.

Vehicle, Personal, and Device Location Tracking. Location information allows more efficient use of equipment and personnel utilization, equipment management inventory and location control. The ability of dispatch control point or other vehicles to monitor apparatus locations within the geographical service area would improve efficiency of services provided by the governmental agency.

Since many general governmental field personnel are not assigned to a vehicular mandated task, there is a need for a personal location device to track the location of an assigned individual in the event of an emergency. This tracking device may be incorporated within the voice communications equipment or be a separate personal device.

As stated within previous sections, the accuracy for all of these requirements depend on the availability of DGPS. DGPS is provided by many means including transmission over dedicated public safety frequencies.

4.8.5 Video Requirements

Two-Way Portable Video. Two-way portable video capabilities enhance the voice communications need for general government since field units and dispatch control points would be able to communicate using real time video with voice from mobile or hand held portable radios.

One-Way Video. One way video gives the ability to remotely view specific locations or interests through either snapshot or real time video as necessary throughout the jurisdiction.

4.9 PUBLIC MASS TRANSIT

4.9.1. Mission. The mission of the Public Mass Transit working group is to catalog operational requirements for public mass transit operations at regional, state and local levels.

4.9.2. Introduction. Governmental Public Mass Transit organizations operate transportation systems (i.e. trains and buses) which on a regular basis transport passengers. These organizations have direct responsibility for the safety and general welfare of the passengers during transportation.

Emergency mass transportation incidents can arise as a result of human error, equipment failure, and environmental factors such as weather conditions. Operational needs to address these issues are incorporated within this report and represent operational concerns, system safety concerns, and the protection and maintenance of facilities and equipment. The need for communications is based on these safety and operational concerns and the need to provide the appropriate response to conditions as they arise.

The majority of the operational requirements are based on the needs of major metropolitan areas where government is charged with providing these services, where massive numbers of people are transported daily, and services are essential to the general public.

4.9.3 Voice Requirements

Two-Way Voice Communications. Dispatch requirements are in the categories of passenger operations, system safety, train location, passenger and property protection, and

maintenance and coordination of internal and external emergency response activities. All require prompt and reliable communications to control and manage activities. Immediate access to a dedicated wireless voice dispatch system is critical to safety and coordination of operations.

Incidents occurring on or adjacent to roadways or train track right of ways require immediate action by public mass transportation providers. Public transportation personnel are often the first to report, respond, and arrive on the scene of emergencies (for example fires, collisions, derailments, crime incidents, medical emergencies affecting passengers) occurring within their systems. Field crews work to rectify the underlying problem and must provide necessary updates to responding personnel.

The central communications command center must notify and coordinate emergency personnel, must re-direct other trains around the danger zone, must coordinate activities, such as the removal and restoration of power, to protect passengers and response personnel while directing field personnel assisting passengers.

If, for example, a train is stranded in an underground river tunnel without power due to a mechanical failure, its passengers are subjected to extreme conditions. In this instance, personnel on scene as well as response personnel are posed with a major problem due to the lack of emergency exits. The absence of emergency exits in such locations makes it critical for the situation to be satisfactorily addressed promptly. Climate control systems and main lighting in this disabled train may be inoperable. Other trains may be within the same tunnel behind the incapacitated train, forcibly trapped by the first. The cramped passengers of these trains become increasingly apprehensive of the situation and a rapid response from crews and emergency personnel is essential. The condition may grow to a multiple casualty incident due to passengers exposure to extreme conditions of temperature and confinement. Immediate communications to appropriate emergency response maintenance personnel is imperative to avoiding a major public safety incident with potentially disastrous results.

Voice communications are necessary from dispatcher control points to field units; field units to multiple field units; or individual to individual through either mobile mounted or hand held portable radios. The area of operation for Public Mass Transportation Providers communications may be in harsh locations such as below ground or waterway tunnels in addition to outdoor areas ranging from dense urban areas through mountainous rural areas.

Telephone System Access. Interconnect capabilities are required for limited management levels to interface with the public and provide semi-private contact at a management level. Telephone system access would be accomplished through mobile mounted or hand held portable radios which have system access to the public switched telephone network through dedicated links or through commercially available services.

A necessary consideration is that the device utilized for voice communications be a singular piece of equipment capable of all voice features. Mobile mounted or hand held portable radios would be necessary in order to facilitate the transportation personnel s needs.

Interoperability. Mutual aid considerations are essential to public transportation operations. Public Transportation agencies require a method of contacting and being contacted by emergency response entities.

Public mass transportation is a dynamic tool for the emergency management services. Buses and rail cars are routinely used to transport police, fire, and other personnel, including military personnel, to the scenes of incidents. In addition, public transportation entities in large urban areas are used to evacuate large number of people when necessary.

Wireless Public Address/Announcements. The ability of dispatchers or controllers to issue announcements to passengers on board buses or trains and those in the vicinity of stations regarding emergency conditions and other aspects of service enhances public safety. Passengers need to be advised of conditions on a real time basis, both to reduce panic and to facilitate emergency evacuation, when needed.

Passenger Emergency Notification. A voice communications system primarily utilized to alert train crews of an emergency situation involving passenger safety such as medical emergencies or criminal activity is the passenger s only way of reaching out for assistance. This system would not only notify the on-board crew but also be capable of accessing a distress channel linked to public safety answering points.

4.9.4 Data Requirements. The data requirements of the Public Mass Transit entity are also directed toward improving safe operations and overall system safety, as well as general functions. In this connection, vehicle and train locator systems can be used to ensure that trains carrying hundreds of passengers are not permitted to enter the zone of danger when emergencies ensue.

Two-Way Mobile and Portable Data Terminals. Field computers capable of remotely accessing information systems and files are increasingly used in all transportation methods. Data systems may be used for dispatch or field support to perform real time changes to system data. Equipment may be vehicle mounted or be in the form of a rugged hand held portable unit.

One-Way Data Transmission. Telemetry or real time information transfer from field locations (fixed, mobile, or portable) to fixed control points is key in maintaining the integrity of equipment, track, signal system and other safety features. Transmission is used to monitor the functions of a system, site, or device can alert transportation vehicles, maintenance, and emergency workers to potential hazards. One way signaling devices can be used to alert these vehicles or persons and transmit limited alphanumeric messages.

Train Signal Data. A combination of on-board train data with information provided through an Intelligent Transportation System (ITS) suited to railroad operations is paramount in the avoidance of train collisions and improvement of system safety.

Variable Information Distribution. The ability of an authorized entity to dynamically change signs/bulletin boards etc., to alert the public of potential hazards or delays

on-board transportation vehicles and at stations is necessary for the transportation provider. This improves efficiencies and gives up to date information to the public on any conditions affecting transportation.

A number of Intelligent Transportation System (ITS) features listed in the ITS portion of the report are also suited for the Public Mass Transportation provider. They are noted below:

Vehicle route guidance

Driver and personal security

Automated collision notification

Enroute driver information

In-vehicle signing

Transit management
Priority treatment for transit

Public Travel Security

Hazardous materials incident response

Collision avoidance

Safety readiness

Pre-crash safety system deployment

Automated highway system (AHS) check-in

Highway-rail intersection safety

4.9.5 Video Requirements. Video requirements are classified regarding local operations, system safety and property protection aspects of transit.

One-Way Video gives the ability to remotely view specific locations or interests through either snapshot or real time video as necessary. For example, this feature allows railroad crews to monitor safety within train cars in response to incidents or activation of passenger emergency alarms plus view upcoming stations and track for safety risks.

Two-Way Portable Video would be necessary on a limited basis when system or passenger safety is necessary when responding to a remote station. Field units and dispatch

control points could communicate using real time video with voice from mobile radios, hand held portables, or fixed sites.

4.10 PUBLIC SERVICE

4.10.1 Mission. The mission of the Public Service working group is to catalog operational requirements for public service entities at the federal, state and local levels.

4.10.2 Introduction. One classification of public safety wireless communication users are those entities that rely on wireless systems to prevent catastrophes which endanger life and property. Entities such as transportation companies and public utilities operate communications networks that interface with local, state, Department of Defense and federal public safety entities on a daily basis. One primary purpose of these networks is to minimize risk to the public. These networks also aid other public safety providers in performing their missions when a catastrophe does occur. This section of the report briefly identifies many of the current communications requirements of this class of wireless communication users. A more detailed description of these requirements can be found in Appendix C.

4.10.3 Voice Requirements.

Dispatcher to Crews. This is a typical communications path between dispatchers and field personnel. The call types are typically business oriented with emphasis on operating the business in a safe and efficient manner.

Crew to Crew. This function relates to the typical communications between field users. These communications are used for the coordination of daily activities to maximize the safety and efficiency of operations.

Emergency Call. This function is typically initiated from a field user to a dispatcher. As the name implies, the call type is that of an emergency where loss of life or property is imminent or has already taken place.

"Talk Around". In many operations between field users, routing a call through the network or a repeater is not feasible for reasons such as access delay or being out of range of the system. A talk around mode is necessary so that the field users can communicate with each other, within the range of their mobiles and portables, without the assistance of a network or repeater.

Interconnect. In nearly all field activities, users have a need to communicate with people by way of land line telephones. Telephone interconnect is a necessary option for many of the present day radio systems.

4.10.4 Data Requirements. The Public Services entities have a substantial need for data communications which is typically very specific for each type of entity. As an example, the railroad industry relies on data communication links to assist the engineer in safe train