Conceptual
And
Logical Architecture
For A
Statewide Wireless
Communications
Plan

State of Minnesota
Department of Transportation
Office of Electronic Communications

(Revised July 2002)

A Conceptual
And
Logical Architecture
For A
Statewide Wireless
Communications Plan

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PREFACE

The document that follows is the first step in developing a Statewide Wireless Communications Plan for the State of Minnesota. The second step in the planning process will be to develop a detailed technical design based on comments received as a result of this document. There are two main components to the Conceptual Statewide Wireless Communications Plan. The first component is a Digital Microwave Network. The second is an 800 MHz Trunked Radio System.

This plan focuses on the technical feasibility and a budgetary estimate to implement the above noted systems. The designs presented in this plan are conceptual in nature, and should not be construed as detailed engineering designs. The conceptual system design takes advantage of the latest technological developments that will meet the State's current extensive requirements for day-to-day operations, as well as assuring effective and coordinated communications in times of emergency. Future capacity and system growth capability are also a major consideration in the design of the Wireless Communication System. In addition, the planning effort gave special consideration to accommodate the various political subdivisions of the State of Minnesota who may elect to jointly share in the utilization of the 800 MHz trunked system.

The contributions made by the engineering staff of the Office of Electronic Communications are greatly appreciated. As a result of their efforts, we are confident that the information contained herein will provide a solid foundation on which the State can base future decisions for meeting state government and public safety radio communication requirements.

Sincerely,

Michael D. Hogan,
Communications Planning Director
Office of Electronic Communications

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Reference: Copies of documents referenced in this document may be obtained from the MN/DOT-OEC library. For further information, or to obtain a copy please contact the Office of Electronic Communications at (651) 296-7421 or e-mail to: mike.hogan@dot.state.mn.us

- 800 MHz Executive Team Report to the 2001 Minnesota Legislature
- Network Management & Operational Management Standards
- Project 25 Standards
- Policy for Licensing Excess Space on Mn/DOT Towers
- National Public Safety Planning Advisory Committee (NPSPAC)

FORWARD

The purpose of this plan is to develop a conceptual model for a statewide digital radio network comprised of a digital microwave system, and a statewide 800 MHz digital trunked voice radio system.

Many of the decisions to implement a digital microwave and 800MHz Trunked Radio networks are based three factors. First, a study prepared by the 800 MHz Executive Team which included representatives from the Minnesota Departments of Public Safety, Administration and Transportation, is entitled "800 MHz Executive Team Report to the 2001 Minnesota Legislature, 800 MHz Statewide Shared Public Safety Radio System" dated February 1, 2001. The purpose of this study was to evaluate and determine the needs and concerns of the local units of government as they pertain to two-way radio communications. The results of this study were presented to the 2001 Minnesota Legislature. Please refer to Exhibit 1 for a complete copy of the Report. Second, the proposed system is an extension or natural growth from the system being implemented in the nine (9) county metro area. And finally, trends within the industry and the successful implementation of other similar systems throughout the United States.

This plan consists of four sections.

- Section I outlines the background, need, and impact of implementing a statewide digital microwave system and 800 MHz Trunked radio system.

- Section II contains conceptual site information and specifics about the plan in general. This section should give readers a general idea of the design and requirements of the proposed systems.

- Section III addresses the standards for the "Network Architecture" and "Operational Management" of the proposed Statewide Shared Radio System.

- Section IV contains appendix material, consisting mainly of tables, costs sheets, attachments, and maps. This material is provided to support the data and statements made in Sections I & II.

SECTION I

800MHz Trunked Radio
and
Microwave

BACKGROUND
NEED
IMPACT
FEASIBILITY

SECTION I

TWO-WAY RADIO

SCOPE

This plan will attempt to provide a conceptual or preliminary design that will serve as the basis for future planning and design. This plan is primarily for budgetary and general guideline purposes. Specific detailed engineering planning will be completed at a later date.

BACKGROUND

The Mn/DOT VHF statewide mobile radio system is primarily used to provide wireless two-way voice communications for Mn/DOT personnel responsible for constructing and maintaining the state's highway system. The Minnesota Department of Public Safety (DPS) also owns and operates a statewide VHF radio system. The primary users of this system include the State Patrol, the Bureau of Criminal Apprehension, and the Department of Natural Resources, Criminal Division. The Department of Natural Resources (DNR) owns and operates a VHF radio system that supports the operations of the Forestry and Parks divisions. The DNR system provides coverage to approximately 70% of the State as opposed to a total statewide system. In addition to the VHF radio portion of the system, Mn/DOT owns, operates, and maintains an analog microwave system that plays a vital role in the successful operation of the Mn/DOT mobile radio system today. It has proven to be the most reliable and economical method for linking mobile radio dispatch centers with remote radio tower sites.

Current Mobile/Portable/Base Station Number

MOBILES	PORTABLES	BASE STATIONS
5,600	4,200	741

These numbers represent the number of radio units (subscribers) in operation in 2002 for Mn/DOT, DPS, and DNR only. It does not include the Dept of Corrections, State Collages & Hospitals, or any other state facility currently using two-way radios in their operations.

The three VHF systems and microwave system represent an investment in radio sites valued at over $ 75,000,000 including towers, shelters, radio equipment, microwave radios and dishes, and power generators.

NEED

Public safety, and local government radio communications needs throughout the state have grown steadily over the past several years and are expected to grow significantly during the next ten (10) years as a result of regional population growth coupled with an increase in per capita public safety incidents. At the same time that communications needs are growing so rapidly, the ability of governmental and public safety agencies to upgrade their existing VHF/UHF systems is limited due to the lack of available frequencies, and limitations caused by the aging technology of their equipment and system performance in general. Maintaining the systems, and obtaining replacement components for the aging analog systems is becoming more difficult with each passing year. Operational problems are becoming more prominent with increased demands for

channel access. Interference from one district to another is a limiting factor in expanding the current systems. In addition, interference jeopardizes the reliability of the current systems, which affects employees and the general public's safety. These problems are difficult if not impossible to remedy due to the lack of available clear radio spectrum in the VHF/UHF bands. The ability to intercommunicate with other state agencies today is difficult and in some cases non-existent. The requirement for interoperability between multiple agencies and jurisdictions has become a necessity for local government and public safety communications systems.

IMPACT

What if the current VHF systems used by the state are not replaced? In other words, "do nothing". Doing nothing to improve or replace the current VHF radio systems will have broad implications. The current VHF two-way radio systems used by state agencies has reached its capacity. These systems use analog, 25KHz bandwidth equipment. This technology was developed over 40 years ago. This does not mean that the equipment is that old, only that the technology behind the overall operation is slowly being replaced by manufactures with digital, 12.5 and 6.25 KHz equipment. Manufacturers have indicated that they are placing their R&D resources into the development and manufacture of narrowband digital radios. This means that replacement radios and parts will become more difficult to obtain in the future.

FEASIBILITY

An 800 MHz digital trunked radio system is proposed to replace the current systems in use by the State of Minnesota agencies today. A shared 800 MHz digital trunked radio system can fulfill the interoperability requirements, as well as solve numerous other problems facing the aging mobile communication systems in use today. The radio system proposed in this plan will create a seamless statewide system or network. This single shared system could gradually replace the hundreds of individual radio systems currently operated by state agencies and local units of government. This system could provide for a high degree of reliability and interoperability between state agencies as well as between state and local and federal agencies.

This is a quantum leap in technology, going from the old 1965 technology to the state of the art system of the next century. The digital network represents improved performance, increased capacity and new capabilities. The statewide shared system or network will enable instantaneous interoperability among multiple state agencies as well as those jurisdictions routinely working with state agencies. The 800 MHz digital trunked radio system will enable users in one area of the state, to communicate to another individual or group of individuals in another area of the state. The 800 MHz trunked system will provide 95% reliable coverage for portable radios throughout the state. The statewide system will be fully compatible with, and utilize components implemented in the Metro 800 MHz system.

PHASED IMPLEMENTATION

Implementation of the new 800 MHz trunked system in Greater Minnesota will occur in four (4) phases. Each phase will consist of implementing components of the system within two to three complete Patrol districts. For operational purposes, it is highly recommended that complete districts be converted to the new system, rather than portions of a district or specific highway corridors. The tables below show the cost details of each phase. Please refer to **EXHIBIT 2** for phase maps.

The work to be completed during each phase consists of constructing and or installing the following components: towers, 800 MHz base stations, Interop base stations (VHF), controllers, switching equipment, and microwave transmitters/receivers.

Specific tasks that must be completed in each phase are as follows: (Refer to **Exhibit 3** for timeline for each phase)

- Form planning group with local government/public safety entities within district
- Locate suitable existing local government towers in required areas. If none then;
- Identify land parcels for tower construction
- Purchase land
- Prepare specifications for towers and shelters
- Bid for towers and shelters
- Prepare site for tower erection
- Erect towers and place shelters, generators
- Prepare specifications for trunked radio system and microwave
- Bid for trunked radio system and microwave
- Finalize detailed design with successful vendor
- Order trunked radio equipment (base stations) and microwave
- Factory staging of all electronic components
- Equipment delivery and installation
- Testing
- Acceptance

Special consideration will be given to the interoperational system (Interop) that will be needed to permit communications between users of the new 800 MHz trunked system and the users who chose not to migrate or join the new system. See page I-7 for a more detail description of the Interop requirements.

Phase 3- Phase 3 will begin in FY2004 if funding is made available. This phase will provide coverage throughout 23 counties in the Rochester and St. Cloud Patrol districts.

	Numbers	Costs
Counties Involved	23	-
New Towers: Includes Land,Shelters,Generators, Site Prep Work	31	$10,788,000
Existing Towers Modifications	8 13	$ 0.00 $ 1,666,000
800 Fixed Equipment	5 chnl stations	$10,561,690
Interop Eqp/Control	52 sites / 1 Zone Cont	$ 4,728,000
Microwave Eqp	Loop, High cap, Hot Stand-by	$ 9,984,340
Engineering	Trunk & Microwave	$6,500,000
TOTALS		$44,228,030

Refer to map in Exhibit 2. Budget information can be found in Exhibit 4-6.

Phase 4 – Phase 4, which will begin in FY2005 or one year after the start of Phase 3. This phase will cover the Duluth and Brainerd Patrol districts. The two districts cover 12.5 counties (half of St. Louis Co.)

	Numbers	Costs
Counties Involved	12.5	-
New Towers: Includes Land,Shelters,Generators, Site Prep Work	39	$13,472,000
Existing Towers Modifications	27 3	$ 0.00 $ 498,000
800 Fixed Equipment	5 chnl stations	$10,669,200
Interop Eqp/Control	69 sites / 1 Zone Cont	$ 4,966,000
Microwave Eqp	Loop, High cap, Hot Stand-by	$13,065,000
Engineering	Trunk & Microwave	$6,500,000
TOTALS		$49,170,200

Refer to map in Exhibit 2. Budget information can be found in Exhibit 4-6.

Phase 5 – Phase 5 will begin in FY2006 or 1 year after the start of Phase 4. This phase encompasses three Patrol districts – Mankato, Marshall, and Detroit Lakes. This phase will include 31 counties.

	Numbers	Costs
Counties Involved	31	-
New Towers: Includes Land,Shelters,Generators, Site Prep Work	40	$13,920,000
Existing Towers Modifications	15 7	$ 0.00 $ 689,000
800 Fixed Equipment	5 chnl stations	$ 9,727,800
Interop Eqp/Control	62 sites / 1 Zone Cont	$ 4,868,000
Microwave Eqp	Loop, High cap, Hot Stand-by	$15,640,000
Engineering	Trunk & Microwave	$6,500,000
TOTALS		$51,344,800

Refer to map in Exhibit 2. Budget information can be found in Exhibit 4-6.

Phase 6 – Phase 6, will begin in FY2007 or 1 year after phase 5 begins. This phase will cover the Virginia and Thief River Falls Patrol districts. These two districts include 11.5 counties.

	Numbers	Costs
Counties Involved	11.5	-
New Towers: Includes Land,Shelters,Generators, Site Prep Work	32	$11,136,000
Existing Towers Modifications	15 7	$ 0.00 $ 1,220,000
800 Fixed Equipment	5 chnl stations	$ 8,315,700
Interop Eqp/Control	54 sites / 1 Zone Cont	$ 4,756,000
Microwave Eqp	Loop, High cap, Hot Stand-by	$12,200,000
Engineering	Trunk & Microwave	$6,500,000
TOTALS		$44,127,700

Refer to map in Exhibit 2. Budget information can be found in Exhibit 4-6.

PROJECT TOTALS

Phase 3	$44,228,030
Phase 4	$49,170,200
Phase 5	$51,344,800
Phase 6	$44,127,700
Project Total	**$188,870,730**

MOBILE & PORTABLE EQUIPMENT (SUBSCRIBER)

The costs reflected in the Exhibit portion of this Plan do not include the cost of the mobile and portable radios, also referred to as subscriber units. It is anticipated that the cost of the subscriber units will be borne by the individual agencies that participate in the System. This is the same model that was followed for the Metro 800 MHz Radio System. Below is an estimate of the approximate cost for mobile and portable radio units. These costs are provided for fiscal planning purposes and should not be construed as actual price quotes. These costs are based on current prices and the current numbers of subscribers as noted in Section I "Background" of this report.

SUBSCRIBER UNIT COSTS

Approximate cost for Mobile Radios = $2,800 ea.
Approximate cost for Portable Radios = $2,800 ea.

State Mobiles – 5,600 units. Cost $15,680,000

State Portables – 4,200 units. Cost $ 11,760,000

Total Subscriber costs $27,440,000

This estimate is for DPS, DNR and MN/DOT users only and does not include other state agencies

SHARED SYSTEM CONCEPT

Due to the size of the statewide system there are certain economies of scale and predicted cost savings that can be realized by sharing in the implementation and use of the statewide 800 MHz System. The State will make every effort to include city and county governments in the initial planning phase of this system. State representatives will conduct regional presentations as well as one-on-one meetings with representatives from local government entities explaining the benefits of a cooperative effort to develop a coordinated public safety communications network to be shared among state, and local agencies. Efforts will be made to enter into cooperative agreements with local units of government similar to the agreements used with participants in the Twin City metro area.

INTERFACE TO METRO REGIONAL SYSTEM

The infrastructure portion of the Metro Regional 800MHz Trunked Radio System is complete and will be operational in October of 2002. Therefore, there is little or no mention of design requirements for the remaining communities that have yet to join the Metro radio system. Each community within the Metro has submitted plans to the Metropolitan Radio Board (MRB) for their future participation if they should so chose to do so. Simply because the Metro is not addressed in this Plan, does not mean to imply that the Metro System is not part of the Statewide System concept. It is planned that the Greater Minnesota (non-metro communities) radio system will be interfaced with the portion or layer of the Metro System called the "Regional Layer". The term "layer" is used because there are three separate layers to the entire Metro System: Regional, Hennepin County, and Minneapolis. The Regional layer serves the state agencies, while the

other layers support their respective agencies. Yet all three share components of each other's system, and can actually roam (use) to one another's layer if needed.

As stated, the Greater Minnesota System described in this Plan will be interfaced or connected into the Metro Regional Layer. However, it may be premature to speculate on how that may be accomplished at this time. Many factors must be considered before system integration can occur. Since each layer of the Metro System is owned and managed by independent entities, a through study must be conducted to determine the impact to the Metro Layers (and users) as well as the Greater Minnesota system before interfacing the two systems. System compatibility should not be a major concern, since the Plan requires that the same standards used for the Metro System also be applied to the Greater Minnesota system.

Costs to interface the two systems have not been provided for in the Plan.

INTEROPERATIONAL SYSTEM (VHF TO 800MHz)

A separate plan will be needed to establish detail requirements for providing an interoperational system (Interop) that will facilitate communications between non-participating entities and those who choose to join the 800 MHz Trunked System.

A couple of options are under consideration at the time of this writing. It should be noted that these are only offered as topics for discussion.

- Use the existing Minnesota State Patrol VHF radio equipment that exists today. While some of this equipment is somewhat old in terms of electronics, it may serve as a temporary link between entities of dissimilar radio systems. Since the Patrol system and most equipment used by public safety agencies in the state are already programmed with the State Mutual Aid channels (MINSEF, MIMS and the Fire Mutual Aid frequencies) it may be the least expensive route to pursue.
- Use the existing county sheriff's radio systems and equipment. However, this option would require all counties within the district being upgraded to participate in the shared statewide trunked system. It is unlikely that all counties will convert to the new system during the initial implementation phases, which would leave major gaps in the Interop system.
- Use a combination of the two previously described options.

This plan has provided some costs figures to provide for interoperability between the old and the new. Best estimates indicate that the cost to implement the Interop System statewide would be approximately $3.3 million. Please refer to **Exhibit 5** for details.

Estimates and details of how the Interop issue can be satisfied will be better addressed once funding has been approved and meetings begin with local units of government to determine their interest in participation on the Trunked System as well as their requirements.

MICROWAVE

SCOPE

The microwave system proposed in this plan is capable of supporting large volumes of data. However, it is not the intent of this project to replace existing data transport systems. The main objective of this project is to support mobile voice, data and video applications of the state. The conceptual design for the statewide system will provide a multi-loop digital microwave system operating in the 6.7 GHz frequency range, with hot protected spurs to meet the requirements of the 800 MHz trunked system, conventional 800 MHz system, VHF/UHF stations, dispatch communication centers, ITS initiatives, Mobile Data Computer system, and other future applications that may arise.

BACKGROUND

The current microwave system used by the State of Minnesota was implemented over 20 years ago. The current system uses analog technology operating in the 2 GHz frequency band. The System is comprised of 188 transmitter/receiver sites. The microwave system is used to transmit voice information (two-way radio traffic) back and forth from the radio communication towers located throughout the state back to the dispatch centers located within the districts. The current demands of the two-way radio systems used by DPS, DNR and Mn/DOT have used all available channels of the system.

NEED

A wide area digital microwave network will satisfy two basic criteria: the digital network will replace the aging analog wide area communication system and ultimately show a cost savings to the state, and secondly, the digital network will accommodate and satisfy the new initiatives and requirements of user agencies.

Another reason for the need to migrate to digital has to do with the 2 GHz frequency band that is used by the microwave system. The FCC reassigned the portion of the 2 GHz band used by microwave systems to the Mobile Satellite Service (MSS). Microwave users such as the State of Minnesota has been permitted by the FCC to continue to use these frequencies on a primary basis. However, any modification, including an upgrade, to these systems and or licenses will place the user into a secondary status to the MSS, or even result in the loss of the frequency if the frequency is needed by the primary user in the MSS.

An increase in circuit capability or bandwidth between dispatch centers and radio tower sites is a key requirement for upgrading the current microwave system. More circuits or bandwidth will enable departments to implement systems that lower organizational operating costs, increase productivity, and enhance employee safety, provide information to the traveling public, and provide greater services to the citizens of the State of Minnesota. An example of this is the Mobile Data Computer (MDC) system that is being developed under a separate initiative for the Minnesota State Patrol. The implementation of the MDC is dependant on the development of the digital microwave backbone system. The MDC system will provide statewide mobile data services for the Minnesota State Patrol, Mn/DOT, DNR, and other agencies wishing to participate in the development and cost of the MDC system. Other examples of initiatives that require the digital microwave are: RWIS, VMS/CMS, HAR, AVL, Mayday System, and other ITS initiatives. Connectivity between the Transportation Operations Communication Centers

(TOCC) is also a major function being planned for in the microwave project. Projects requiring connectivity from the right-of-way, or roadside, to the main network will be able to make use of the digital microwave system being developed under this plan. Specifics of how these applications will connect to the proposed system cannot be defined at this time. Each application operates under a proprietary protocol that requires nonstandard equipment that must interface into the proposed system. Therefore, until the requirements and architecture of the ITS initiatives are defined, the actual connectivity requirements cannot be defined.

IMPACT

If the current microwave system is not replaced with a digital microwave system at this point, we could continue to use the present combination of leased analog circuits and the existing Mn/DOT analog microwave system for a limited period of time. However, in doing so, many state government requirements for new and existing applications cannot be satisfied. The state will pay a significant cost for leasing circuits to perform some of the required tasks. The current age of the existing microwave system is approximately 20 years old; the industry trend is migrating to digital wideband services. Because of this industry trend, it has become difficult if not impossible to expand the channel capacity of the existing system. Parts for the existing equipment are nearly non-existent, and this situation will only become worse.

SECTION II

800 MHz TRUNKED RADIO

and

BACKBONE (MICROWAVE)

RADIO SYSTEM DESIGN CONCEPT

SECTION II

800 MHz TRUNKED SYSTEM

DEFINITIONS

- Trunking is defined as the: "A communications path between two locations. Communications needs of a large number of users can be provided for by efficiently sharing a small number of trunks. Trunking is the automatic sharing of a group of communications paths (trunks) among a large number of users. Trunked radio is simply multiple radio repeaters controlled by a Central Processing Unit (CPU) device that allows a large number of mobile and portable users to share the repeaters". Trunking combines traditional radio base station technology with network switching technology. A single radio system can be shared by a number of different user groups, eliminating the need for each group to own, operate and maintain its own system. The proposed system is also capable of employing technologies such as "simulcast", "multi-site", and "digital modulation".

- Simulcast simply means that a radio message is simultaneously broadcast from multiple transmitters to cover a large area.

- Multi-site is another trunking technique using multi-site controllers. These controllers track the location of every mobile or portable unit and determine which transmit site has coverage. This allows wide area coverage without using simulcast. Multi-site technology can connect several different trunked systems, some of which are simulcast and some not. (in effect, a multi-site controller treats a simulcast system as if it were a single site system.)

- Digital modulation means that the radio converts the analog voice information into 1's and 0' much the same way a computer handles data. The radio then transmits the digitized data packets over the airwaves. This process is then reversed at the receiving radio. Digitized transmission provides for improved audio quality, secure communications, increased user capacity, and other enhanced operational capabilities.

CONCEPTUAL DESIGN

There are a number of conceptual designs that could accommodate the needs of the users throughout Minnesota. Each design has its strong and weak points. No one method may be suitable for the entire state. It is believed that a blend of designs will be used to meet the diverse needs of the users. Areas of high population and large volumes of communications traffic may require the seamless coverage offered by a simulcast system, while a less densely populated area of the state may be best served using a multi-site type of system. This plan will attempt to provide technical and cost data based on anticipated use of both simulcast and multi-site system technology. However, local government involvement in a specific area could result in unforeseen design changes that could effect the overall cost of the system.

NETWORK CONTROLLER

The proposed System will extend the 800 MHz digital trunked simulcast radio system that has been or is currently being implemented in the nine (9) county Twin City Metro area. Although the Metro system is not slated for completion until the year 2002, much of the basic planning principles can be applied to the statewide System.

In a simulcast system the operation and functionality of the 800 MHz system is dependent on continued operation of the network controller. Network controller equipment is very reliable with built in redundancy. While the controller has self-monitoring and switchover capability to limit system failure, there are circumstances that could destroy all equipment at a site. For this reason it is necessary to house a redundant backup controller at a separate physical location. It is anticipated that as many as four (4) additional network controllers will be needed to meet statewide needs. The network controllers will be strategically located at designated MnDOT communications centers located at District Headquarter facilities. Each network controller will be capable of operating a specific portion of the network, as well as perform as a back up to another portion, or several portions, of the network.

TOWER SITES

Without detailed engineering studies, it is difficult to pin point the exact location of all the towers that will be required for the system. Since the microwave network and the 800 MHz system will use the same towers, consideration must be given to the microwave paths between each tower as well as the general propagation coverage for the subscribers. For the purpose of this planning effort we have used 20 miles as a general rule for separation between towers. This mileage requirement is due in part to simulcast requirements and the distance 6GHz microwave signals can travel reliably. It has not been determined as of this writing if simulcast will be required throughout the entire state. This determination will be made after detailed discussions with potential state and political subdivision users. Using the 20 mile tower separation rule for the conceptual plan, an estimated 236 tower sites will be needed to complete the entire statewide system. It is generally believed that the tower locations represented in this plan will provide a reasonably accurate projection of tower requirements. An attempt was made to use as many of the existing state towers as possible. Refer to the map in **Exhibit 2**, for the anticipated location of new towers as well as the location of existing towers.

EXISTING TOWERS

The state currently has 80 existing towers that have been included for use in this plan. State fire lookout towers sites will also be used whenever possible. Existing towers are noted on the map in **Exhibit 2**.

NEW TOWERS

It has been estimated that a total of 156 new tower sites will be needed to augment the 80 existing towers. The term “new tower site”, as used in this plan, means that new land must be purchased. However, state land will be used when and where available. Additional existing towers may become available from other governmental entities that may chose to participate in the statewide system. Obtaining additional towers from local participation will contribute to

lowering the overall cost of the system while also helping to limit the proliferation of towers in the state. Based on current experience with leasing commercial tower space, planners have determined that in all probability leased tower space will not be adequate to accommodate the anticipated antenna loading that the new system will require at each transmitter/receiver location (site). Therefore, it is the consensus of those involved with this planning effort that the state should own all towers if at all possible. Construction of new towers will be on state owned land wherever possible. Purchase of privately owned land will be recommended only after a search for state land and a detailed microwave path analysis show that the technical requirements dictate the purchase of private land.

NETWORK CONTROL TERMINALS

Various control functions of a trunked radio system, such as the set up and break down of talk groups, or disabling a lost or stolen radio are controlled with a network control terminal.

Terminal equipment can also be used to obtain statistics on the performance and the usage of the network. More than one terminal can be used on the network. It is recommended that each state agency or public safety center dispatching for an agency subscribing to the trunked radio system be equipped with a terminal.

ANTENNA SYSTEM

A detail propagation study has not been completed for this phase of planning. However, general coverage maps have been completed using the following assumptions for the antenna system:

- All receivers will be equipped with tower top amplifiers
- All transmit and receiver antenna heights are between 300 and 350 feet
- All repeater station transmitter power is 75 watts output power
- All antennas will be omni directional, 7.5 dB gain collinear antennas
    - All coaxial cable will be 50-ohm, 7/8” form dielectric

A detailed propagation study will be completed for each transmitter site during the detailed design phase of this project. Specific technical parameters will be optimized to provide the best coverage from a specific location.

EQUIPMENT SHELTERS/GENERATORS

Each new site will require an equipment shelter. Shelters at some existing tower sites may also have to be replaced on an as needed basis. The approximate general shelter size will be 12’ x 26’.

Each new site will require a generator and battery package for backup power. The typical generator size for most sites will be 50 kW. Some existing sites may also require a new or larger generator and or battery package.

Backup power and shelter size will be evaluated during the detailed design phase. The cost for the shelters and generators are contained in **Exhibit 4**.

FREQUENCY ASSIGNMENTS

The National Public Safety Planning Advisory Committee (NPSPAC) for Region 22 has assigned specific frequencies (channels) in the 821-826 MHz band for use by the State of Minnesota as well as local units of government. The frequencies assigned to the local units of government were not assigned to a specific organization or agency, rather they were assigned to a geographic region, typically by county borders. These frequencies have a 25 KHz bandwidth, but can be used with a 12.5 KHz bandwidth such as in the metro radio project.

In addition to the NPSPAC frequencies, this planning committee has also selected frequencies from the FCC Public Safety Category – 806 MHz, for use in the statewide system. These frequencies are better suited to wide area applications such as those required in this plan. Please refer to **Exhibit 7** for a map indicating approximate assignment locations. Please note that each "Group Number" referenced on the map represents a total of five (5) 806 MHz channels. The term "channel" refers to the base transmit frequency and the mobile transmit frequency that is paired with the base frequency.

The FCC has also allocated 24MHz of spectrum in the 700 MHz band for Public Safety use. In accordance with FCC Docket No. 96-86 Regional Planning Committees (RPC) have been formed to develop local plans for the use of the new 700 MHz spectrum. Planning efforts are currently underway in Minnesota to develop a plan that pre-coordinates the frequency assignments in the 764-776 MHz and 794-806 MHz bands similar to the method used in the NPSPAC Plan noted above.

And finally, the State of Minnesota has applied for and received a license for 2.4 MHz of narrowband 700 MHz spectrum. This spectrum is available statewide to all eligible public safety services. The frequencies assigned under this license will be administered by the State of Minnesota rather than the Regional Planning Committee. No further FCC authorization will be required to construct and operate transmitter sites within the state unless they raise specific environmental, aviation safety, quiet zone, or international issues. Please refer to **Exhibit 7**

COST

Refer to **Exhibit 5** for a cost estimate to implement the 800 MHz Digital Trunked Radio System described in this plan. The estimates provided are an aggregate sum of the equipment and installation costs for each site. The costs include the following:

- Land
- Towers
- Shelters/generators
- 800 MHz fixed equipment
- Controllers
- Interop equipment
- Microwave equipment
- Installation
- Engineering

A summary of the total system cost estimates are provided in **Exhibit 6.** These figures are the compilation of the totals provided in Exhibits 4 and 5.

MICROWAVE

TOPOLOGY OF SYSTEM

The proposed design topology of the microwave system will provide the necessary DS1 connectivity needed to support the applications being considered for interconnection to this system. The tower spacing was kept at 20 miles or less depending on the terrain, existing tower sites, and availability of new tower sites. The network is routed to most cities with state government offices, State Patrol dispatch centers, and all Mn/DOT owned or leased radio towers. The routing is shown on the maps contained in **Exhibit 2**. The solid lines indicate high capacity loop paths using 1DS3 to 3DS3 digital radios at each site. The dotted lines indicate low capacity paths that will use 1DS1 to 28DS1 digital radios at each site. All microwave paths will be engineered for optimum performance after field survey information is obtained. Final antenna types and sizes will depend on frequency coordination results.

NETWORK DESIGN

The state will be divided into nine (9) regions using the existing State Patrol districts (Metro not included). The tower sites within the district will be connected to the Transportation Operations Communication Centers (TOCC) that are under construction during 2000 thru 2003 using digital microwave. At least one DS1 is proposed to every radio site. Channel banks at each radio site will interconnect all 800 MHz radio sites and at the central network controller site(s). The management and alarm information channels from the radio sites will be routed back to the network control center using dedicated 64 kBps data channels in the channel banks.

The proposed design includes DS1 to DS3 multiplexers at each loop microwave site. The actual connectivity will be determined during the detailed design process. The high capacity microwave will be designed in a loop configuration. The loop configuration will create a redundant path for communications within the district in the event of a point of failure to one of the communication sites.

The required antenna heights and fade margins were planned for 99.9995% path availability for a faded Bit Error Rate (BER) of 10-6. The primary microwave link performance objective is the system availability. The System availability with an objective of 99.999% consists of the propagation availability and equipment availability. Each of these are designed for 99.9995%. Each site has battery backup. If commercial power fails, batteries initially assume the load. The sites also have generators that automatically assume the load for long-term power outages.

COMPUTER CONTROLLED NETWORK

This equipment allows more efficient use of digital facilities and reduces equipment costs associated with traditional means of digital channel cross connections and test access. It allows the flexibility of channel cross connection, network hubbing, digital voice conferencing and data bridging.

MICROWAVE NETWORK COST ESTIMATE

Refer to **Exhibit 5** for a cost estimate to implement the digital microwave network described in this plan. The estimate includes itemized equipment and installation costs for each network site.

SECTION III

NETWORK MANAGEMENT

STANDARDS

&

EXCESS SPACE POLICY

&

LOCAL INVOLVEMENT

SECTION III

NETWORK MANAGEMENT STANDARDS

STANDARDS

There are two types of standards that are needed to implement a shared statewide trunked radio system. The first is the "network architecture" standards. For the purpose of this document this standard is defined as Project 25, described later in this section. The second required standard involves the operation and administration of the system. These standards will establish the protocols, and procedures for users of the system. The topics covered by the standards manual will include, but not limited to, the areas listed below. While most standards have already been written, they are too lengthily to include in this document.

PROTOCOL & PROCEDURES STANDARDS

1. Management
    a. Agency roles in operational management of system
    b. Network management
    c. Database management
    d. Maintenance of names and naming standards
    e. Changing policy & standards
    f. Security
    g. Equipment standards
    h. Moves, additions and changes
    i. Managing participation issues
    j. Training standards
2. Configuration and Allocation
    a. Naming conventions
    b. Talk-group and radio ID allocations
    c. Fleet-mapping standards
    d. Use of shared Talk-groups
    e. Talk-group & radio user priorities
    f. Telephone interconnect
    g. Subsystem roaming
    h. Scanning
    i. Recording/Logger ports
    j. Private call
    k. Status & message transmission/warning signals/AVL/text messaging
    l. Emergency button
    m. Multi-group announcement
3. Interoperability Guidelines
    a. MINSEF
    b. Statewide Fire Mutual Aid
    c. MIMS
    d. Statewide EMS
    e. Recording common interagency Talk-groups
4. Guidelines for Project 25 Trunked Users
    a. Talk-group and Multi-group ownership
    b. Interoperability between statewide 800 MHz system and other 800 MHz systems

    c. Statewide tactical Talk-groups
    d. Interoperability between statewide 800 MHz and federal agencies
5. Guidelines for Conventional Users
    a. Connecting into the Interop System
    b. RF control stations and portables
    c. Radio to radio cross band repeaters
6. Maintenance
    a. Agency maintenance plans
    b. Develop standards for preventive maintenance
    c. Record-keeping requirements
    d. Contact information & procedures
    e. Spare equipment
    f. Equipment configuration information
    g. Software location
    h. Notification of maintenance activities
    i. Outage responsibility/Time standards/Repair Standards
7. Media Policy
    a. Media access to Talk-groups
    b. Selling radios to the media
    c. Programming media radios
8. Agency Billing & Cost Allocation
    a. New Users
    b. Fees for service
    c. Operational costs
    d. Billing management
    e. Insurance
9. Compliance & Conflict Resolution
    a. Auditing and monitoring process
    b. Non-compliance
    c. Appeal process
10. Disaster recovery Plan
    a. Contingency procedures
    b. Procedures/responsibility for system restoration
    c. Levels of response

STANDARDS FOR OPERATIONAL MANAGEMENT

The purpose of these Standards is to define each agency's role in the operational management of the Statewide Shared Digital Trunking System.

Each User of the System will formally designate a Local System Administer (LSA) who will have the authority to represent their respective Agency(s) interests and make decisions on issues related to the day-to-day operation on their portion of the system and any urgent or emergency system operational or repair decisions. The MnDOT System Administrator will represent the statewide infrastructure portion of the system. Each LSA shall designate a backup who shall have the authority to represent their respective portion of the System in the absence of the primary LSA.
An urgent or emergency situation would be one where immediate decision authority is needed to

allow the System as a whole, or any of the Subsystem components, to continue supporting normal wide-area communications services. It is recognized that each Local Systems Administrator (LSA) may have to obtain authorizations from higher levels of their own organization to make longer-term or non-emergency capital or repair expenditure decisions.

Each LSA will be responsible for the day-to-day management, operation and oversight of the system components within their portion of the System. Specific duties will not be detailed in this document. However, the general duties will include, but are not limited to, the following:

1. Monitoring the system and its components for normal operations.
2. Participating in the diagnosis of system performance problems and the development of corrective action recommendations.
3. Dispatching appropriate repair services in the event of a malfunction in the system equipment.
4. Managing the database elements including Subscriber IDs, talk group IDs, and the various parameters that relate to their effective operation.

Due to the complexity and distributed administration & maintenance of the System, typical problems can appear when changes are made to hardware or software.
In order to keep all representatives informed of any updates, notifications will need to be sent to all primary & alternate Local System Administrator (LSA) representatives in the event of any of the following:

a. Any planned maintenance work being done on the Statewide or Local Systems that would affect the System performance for the other users would be preceded with reasonable notification of the maintenance work being done.
b. Any equipment malfunctions or failures that would affect system performance for the other users of the local systems or statewide system.
c. Any configuration changes in equipment or software by any one of the users that may affect system performance for the other users.

In addition to the responsibilities as a Statewide System Administrator, the MnDOT System Administrator will also be responsible for:

a. Arranging for System Administration meetings at least monthly to review operations of the System and share ideas or issues that have arisen in local subsystems that may be of interest to the other Local System Administrators.
b. Being available to work with any of the other Local System Administrators or the technical staff of any of the local systems to diagnose and resolve any system operational problem that involves parameter changes, maintenance or repair of the regional equipment.
c. Being the identified point of contact with the vendor for issues related to the statewide network equipment.
d. Providing timely information to the other Local System Administrators on any System issue that arises or repair/maintenance issue related to the system equipment.
e. Monitoring the performance of the entire network for normal operations, particularly the performance of the statewide infrastructure equipment.
f. Monitoring the configuration of the system database for normal operations, particularly the properties of the statewide equipment & database objects. And conducting the periodic database backups.

The Local System Administrators along with Mn/DOT's System Administrator will be the representatives forming the System Managers Group (SMG). The SMG is responsible for the operational management of the entire statewide system.

STANDARDS FOR NETWORK MANAGEMENT

The statewide network consists of, but not limited to, channel banks, hubs, switches, routers, servers, Local Area Networks at the equipment locations, and Wide Area Links connecting sites together consisting of the microwave & fiber optic equipment, and the network management tools provided by the equipment manufacturer.

The System architecture is primarily constructed around an Internet Protocol based network.
The network is composed of industry standard equipment, which also provides flexibility and a large variety of management & diagnostic tools.

The vendor will provide equipment configuration information as part of the system documentation.
The system network is complex and unusual problems may be difficult to identify and resolve. The system documentation will have to be kept up to date or will lose its value in supporting the system network.

The system network is protected from other agency data networks, and shall remain so. This is to protect the security and functionality of the system. If there is a connection to another data network, it shall be through an appropriately designed & maintained firewall.

The components of the network shall be considered as "owned" by the State of Minnesota, unless otherwise designated as a local component. In which case that component would be owned by the local unit of government. The individual owners will then be responsible for the maintenance of the sites & equipment that they own. Agreements between the Owners and/or Maintenance Contractors are at each agency's discretion, but the Owner is still ultimately responsible for their portion of the system.

The Backbone system is structured on an integrated network; any infrastructure hardware and software upgrades or changes that may impact the system network will need reasonable discussion and subsequent approval by the System Managers Group.
All maintenance work being scheduled that may affect the statewide system and/or a local system performance shall be preceded by reasonable and appropriate notification to the other Local System Managers.

The equipment configurations of the components of the network will need to be documented. This is primarily for the purpose of maintenance, but also affects future planning. The vendor will provide the original "as built" documentation.

The methods for performing detailed network operations will be defined in the technical resource manuals and training for the system. The technical resource manuals will be classified as "Security Information" and "General Non-Public Data" pursuant to Minn. Stats. §13.37 Subd. 1a.

The details on procedures not otherwise defined will be at the discretion of the System Managers Group.

The Mn/DOT System Administrator and Local System Administrators are responsible for managing the data attributes that they are individually responsible for. The MnDOT System Administrator shall be responsible for the statewide portion of the network.

PROJECT 25 STANDARDS

APCO Project 25 is a joint effort of U.S. federal, state, and local government, with support from the U.S. Telecommunications Industry Association (TIA). State government is represented by the National Association of State Telecommunications Directors (NASTD) and local government by APCO. The standards process is called “APCO Project 25” and the standards themselves are called “Project 25.” Of the three groups of users, APCO (i.e., local government) members are the largest group of users of Land Mobile Radios (LMR).

The primary objectives of the APCO Project 25 (P25) standards process are to provide digital, narrowband radios with the best performance possible, to meet all public safety user needs, and to permit maximum interoperability. Secondary objectives include obtaining maximum radio spectrum efficiency, ensuring competition throughout the life of systems, and ensuring that equipment is user-friendly. During the process, the needs of the user have been put first. Performance and meeting user needs were always placed higher in priority than spectrum efficiency or reducing technical complexity.

The Project 25 documents were developed by TIA, based on user needs, and then approved by the APCO Project 25 Steering Committee (representing federal, state, and local governments) before being published as TIA documents.

Project 25 Phase I (12.5 kHz bandwidth) is essentially complete, 30 of the 32 Phase I Project 25 documents have been published by TIA, containing more than 1,800 pages of technical information. The two remaining documents are on inter-sub-system interface conformance and network management conformance. These documents are expected to be published shortly.

The basic characteristics of Project 25 radios are these:

- a Phase I emission designator 8K10F1E (C4FM [compatible four-level frequency modulation]) for operation in a 12.5 kHz channel and a Phase II emission designator of 5K76G1E (CQPSK [compatible quadrature phase shift keying]) for operation in a 6.25 kHz channel.
- use of a common receiver for both C4FM and CQPSK to ensure full interoperability between the two signals.
- encryption defined for the U.S. Data Encryption Standard (DES) algorithms, but other techniques can also be employed.
- use of an IMBE (improved multiband excitation) vocoder with 4400 bits/s of digitized voice, 2800 bits/s of error correction on the voice, and 2400 bits/s of signaling overhead, for an aggregate bit rate of 9600 bits/s.

Project 25 Migration Strategy and Phase II Plans Project 25 has a well-planned migration strategy, both in the forward and backward direction. It was assumed in the basic planning that (1) no virgin spectrum was available and (2) users would need to effect a gradual phase-in and phase-out of equipment.

For the transition from 25-kHz to 12.5-kHz digital, all Project 25 Phase I radios will be capable

of both 25 kHz analog FM and 12.5-kHz digital C4FM operation. Radios can thus be procured gradually, and channels or talk-groups converted to P25 operation whenever all the radios on them are P25

The primary track of Project 25 Phase II has been announced to be 6.25-kHz CQPSK. The only difference between Phase I C4FM and Phase II CQPSK is the modulation method in the radio transmitter. A smooth transition is possible since Phase I radios can be gradually replaced by Phase II radios. The Project 25 Steering Committee is currently receiving proposals for a secondary TDMA [Time Division Multiple Access] track for Phase II. Here are two requirements for such.

A TDMA radio:

- to have a Phase I mode of operation (non-trunked mini mum), for operation with other P25 radios.
- to be able to patch digital audio (i.e., have a common vocoder) and signaling information to/from other P25 radios.

Other Standards Planned for Project 25 Phase II the U.S. Telecommunications Industry Association is pursuing standards for more than a basic radio air interface as a part of the APCO Project 25 Phase II standards process. One of these efforts is to develop a standard interface to consoles.

Another standard that TIA plans to develop as a part of Project 25 Phase II is a standard interface between repeaters and other subsystems (e.g., trunking system controller). This will allow users to purchase equipment from multiple manufacturers for a single site, rather than being locked into the offerings of any one company.

Users should consider their individual situation in making procurement decisions. Overall, the users in the United States have concluded that FDMA is the preferred solution for the vast majority of their needs.

Project 25 standards were designed primarily for the public safety user, with range and performance given high priority. Also, unique flexibility has been designed into the standards to enhance interoperability, privacy, gradual phase-in of new technologies, and the reliable

transmission of voice and data. Several other of the seven techniques provide greater spectrum efficiency, and several are less complex (with potentially lower costs). However, the Project 25 Steering Committee believes none of the others provides greater performance, at greater range, or has more public safety-oriented features.

REF: A complete copy of the Standards described in this document may be obtained from the MN/DOT-OEC library. Contact the Office of Electronic Communications at (651) 296-7421 for further information.

LICENSING EXCESS TOWER SPACE

Minnesota Statute 174.70 Subdivision 2 empowers the Department of Transportation to enter into agreements to permit privately owned communications equipment on Mn/DOT owned communications towers. The following process has been created to enable the Lease of excess space.

PROCESS

Following is the process that is followed to lease space on Mn/DOT towers to commercial wireless providers or other eligible private companies. At the recommendation of the Dept. of Administration, Real Estate Management Div. it was agreed upon that Mn/DOT will enter into License Agreements, rather than a Lease. This process is not necessary when dealing with local units of government, or federal government requests.

STEP 1 – The Department of Administration (DOA) publishes annual notice to potential lessees.

STEP 2 – Mn/DOT, Office of Electronic Communications will review each requests to License space on Mn/DOT towers. Criteria for selecting who will be granted a License are described below. Requests must be submitted to DOA in writing.

Criteria:

1. Licensing will be done on a first come, first served basis. The date of receipt at DOA will establish the receipt date. If more than one request is received on the same day, then the time indicated on the postmark will be the next criteria for establishing the date of receipt.
2. Technical compatibility of the requested system with existing or planned systems at the tower site.
3. Agreement by requesting company to accept published fee and all other terms of the License Agreement

Written request must include as a minimum, the following data:

a. A statement indicating the desire to install antennas, and house equipment, or construct a shelter (platform) at a MnDOT tower.
b. The request should include a site plan that describes the specific number, size, make and model of the antenna(s), the desired height and azimuth on the tower, type of coax cable, shelter, power, and other utility arrangements.

STEP 3 - Mn/DOT's Office of Electronic Communications will request an intermodulation (intermod) study from the commercial carrier. The intermod study will consider all existing and planned frequencies for the site, against the frequencies proposed to be used at the site by the carrier. This study must be submitted in a format that can be easily reviewed by the OEC engineering staff.

STEP 4 - If the intermod study is deemed satisfactory by the OEC engineering staff, then the requesting commercial carrier must submit a structural analysis of the MnDOT tower. The analysis must be completed and certified by a licensed engineering firm qualified to do structural analysis in the State of Minnesota. This report must be in a format that is easily read and interpreted by engineering staff.

STEP 5 – If the structural analysis is favorable, then the process to develop the License Agreement will begin.

a. If the structural analysis is not favorable, then a letter will be sent to the requesting carrier informing them that they cannot install their equipment as proposed. They would have the option to modify their request, or withdraw.

b. If withdrawn, the state would consider the next request as determined in STEP 2, and begin the process over again.

STEP 6 – Draft License Agreement Terms

a. License term for a five-year period, with the option to renew for three (3) additional five-year periods.
b. Fees – As published annually. Once an Agreement has been signed then the rate in effect at that time will remain for the entire License Term.

STEP 7 – Execute License documents as prescribed by policy/law.

REVENUE ISSUES

The revenue received as a result of Licensing Mn/DOT towers will be used to operate and maintain the communications systems of the State of Minnesota. This includes but is not limited to:

- Mn/DOT, State Patrol, and DNR two-way radio system equipment.
- Tower maintenance (reinforcement, painting, lighting, and new construction)
- ITS wireless applications (road signs, cameras, sensors, R/WIS etc.)
- Microwave system

Ref: A complete copy of the Policy and Licensing Package described in this document may be obtained from the MN/DOT-OEC library. Contact the Office of Electronic Communications at (651) 296-7421 for further information.

NON-STATE AGENCY USE OF RADIO SYSTEM

This discussion pertains specifically to Public Safety Agencies. Public Safety for the purpose of this plan is defined as: Law Enforcement, Fire, Emergency Medical Services, Highway Dept's. Public Works, Forestry Conservation, School Districts, and any other service provided for and funded by government agencies. Herein after referred to as: "local(s)", "local government" or "public safety agency".

As noted previously in this Plan, the Radio System will be planned and implemented to meet the needs of the State. However, attempts will be made to adjust the system design to meet local needs where and when feasible. This may involve moving a planned tower to an area that will meet local coverage needs while still meeting the needs of the state. However, it must be noted that this must be done at no additional cost to the state. If the local government needs exceed or expand the system beyond that needed by the state, then that portion of the system will be the fiscal responsibility of the locals. As a minimum this plan recommends the following:

- The expanded local portion of the system must meet the Network and Operational Standards as stated in this plan. This will ensure compatibility to the statewide system.

There may be times when the state system as planned and implemented may meet the local needs. As a minimum this plan recommends the following when and where this occurs:

- A policy be developed that prescribes the manner in which local units of government will be allowed access to use the system.

EXCESS CAPACITY OF RADIO SYSTEM

This discussion pertains specifically to Public Safety Agencies. Public Safety for the purpose of this plan is defined as: Law Enforcement, Fire, Emergency Medical Services, Highway Dept's. Public Works, Forestry Conservation, School Districts, and any other service provided for and funded by government agencies. Herein after refered to as: "local(s)", "local government" or "public safety agency".

As noted previously in this Plan, the Radio System will be planned and implemented to meet the needs of the State. However, attempts will be made to design the system to meet local needs where and when feasible. This may involve moving a planned tower to an area that will meet local coverage needs while still meeting the needs of the state. However, it must be noted that this must be done at no additional cost to the state. If the local government needs exceed or expand the system beyond that needed by the state, then that portion of the system will be the fiscal responsibility of the locals. As a minimum this plan recommends the following:

- the expanded local portion of the system must still meet the Network and Operational Standards as stated in this plan. This will ensure compatibility to the statewide system.

There may be times when the state system as planned and implemented may meet the local needs. As a minimum this plan recommends the following when and where this occurs:

- a policy be developed that prescribes the manner in which local units of government will be allowed to use the excess capacity of the system.

LOCAL INVOLVEMENT

Early on in the Planning Process for each phase as described in Section I, local government agencies will be involved in the planning process through information exchange meetings. These meetings will assist planners in determining where local resources can be used in the system. It will also identify local agency radio requirements that may be resolved by the proper placement of the state infrastructure. The infrastructure of the statewide system will be available to local government agencies that chose to use the system. Locals may accept the system performance as provided by the state, or add enhancements to the system to meet their specific needs. This plan recommends the following:

- Local use should be on a voluntary basis.
- Enhancements will be the fiscal responsibility of the affected local unit of government.
- Locals will be responsible for purchasing and maintaining their subscriber units (mobiles and portables).
- Locals using the system will pay an annual subscriber fee. The fee will be based on the previous year cost to maintain the system. The total number of mobiles and portables on the statewide system would then divide this cost. Each agency would then be charged this amount based on the number of mobile and portable radios used by that agency.

Other tasks of the Planning Team working with locals:

- Explain project goals and benefits of system to local representatives
- Determine local interest in system participation
- Review Plan to determine if local needs can be met, and or what changes could be made to meet local needs while still satisfying state needs at no additional expense.
- Inform local representatives of how state will proceed and how the plan may or may not fulfill local requirements.

TYPICAL PROCESS WITH LOCAL ENTITIES

- State Engineers target area

- State arrange meeting with local officials of targeted area(s)

    - Meeting
        - Discuss local communication status
        - Discuss what state is proposing
        - Look for common areas

- State engineers develop detail design for targeted area

    - Meeting
        - Present plan to locals
        - Adjust plan if necessary
        - Work out details of shared resources (if any)

- State begins process to acquire land (if necessary)
- Modifications to existing facilities if necessary
    - Work with locals if involves their facility

- State Bid letting for tower(s) shelter(s) etc
- Site construction
    - Meet with locals to keep informed of progress

- Specifications for radio equipment developed
- Bid letting
- Negotiate contract
- Award contract
- Negotiate Service Agreements with Locals for use of system
    - What system will do for locals State responsibilities
    - Local responsibilities
    - Rates
    - Maintenance
    - Training
    - Administration

SECTION IV

EXHIBITS – DOWNLOAD SEPARATELY

Exhibit 1..2001 Report to the Legislature

Exhibit 2..Tower Locations, Microwave Paths & Implementations Phases

Exhibit 3..Time Line

Exhibit 4..Land/Tower/Shelter/Generator Costs

Exhibit 5..800 MHz & Microwave Component Costs

Exhibit 6..Summary of all Fixed Component Costs

Exhibit 7..Frequency Assignments