
ENHANCED SPECIALIZED MOBILE RADIO

This document describes various aspects of enhanced specialized mobile radio (ESMR). It provides only a “snapshot” of ESMR services today, recognizing that technology is evolving, and industry is introducing new services and capabilities at a rapid pace. This document is not intended to reflect a government position or endorse a particular service provider or service. Rather, it is provided to offer broad industry information on ESMR. We invite comments to ensure that the most current information is included in our analyses.

If you have comments regarding the information contained in this document, please contact the Public Safety Wireless Network (PSWN) Program Management Office (PMO) at 800-565-PSWN or access the PSWN Program home page at: <http://www.pswn.gov>

Public safety agencies rely heavily on their land mobile radio (LMR) networks for communications and coordination within and among organizations. In the past few years, commercial wireless services such as cellular, paging, and specialized mobile radio (SMR) have provided powerful capabilities that complement existing public safety networks. It is important that public safety communities carefully evaluate, assess, and maintain current information on the expanding commercial wireless marketplace. This allows informed, objective assessments that will ultimately meet mission requirements.

The Increasing Importance of Integrated Wireless Services

As the growth of commercial wireless services continues, consumers are increasingly looking for technologies that enhance efficiency for a mobile work force. One way to achieve efficiencies is by delivering several types of wireless services (e.g., alphanumeric text messaging and cellular interconnect) through one end-user handset.

Specialized Mobile Radio (SMR) is a commercial wireless service that primarily provides mobile workgroups with internal dispatch and data communication services. Dispatch service allows users to communicate with a single radio or simultaneously with all radios, or with a subgroup of radios in a group. Traditional SMR service is similar to private LMR because it offers primarily voice dispatch service within a local area. SMR handsets operate in a push-to-talk (PTT) manner similar to LMR handsets.

A number of SMR providers have been upgrading their infrastructure with advanced digital technologies enabling them to offer a more comprehensive and integrated suite of wireless services, such as paging and cellular telephony.

The upgraded infrastructure is commonly referred to as enhanced SMR (ESMR). ESMR services are becoming an increasingly important communications tool for government, business, and private users. This report describes ESMR services, discusses some key ESMR performance

characteristics, provides sample costs, lists some considerations in selecting ESMR services, and provides a checklist to assist in determining whether ESMR meets user needs.

What Is ESMR?

ESMR is a commercial service that provides digital dispatch, cellular, and paging services through a single network. ESMR relies on advanced proprietary technology; there is no common, industry-wide standard. The technology allows subscribers three forms of communication from a single handset:

- Digital Dispatch - allows groups of users called talk groups to communicate with each other in a push-to-talk manner across the ESMR provider’s service area.
- Cellular-like telephone communications via the Public Switched Network (PSN)

- Alphanumeric short message services.

ESMR subscribers can also choose from a variety of optional digital cellular service features, such as call waiting, call hold, voice mail, and caller identification (ID).

In February 1999, the largest ESMR service provider announced plans to offer wireless Internet access by mid-1999. Customers will be able to access the company’s site from a personal computer or via an enhanced wireless subscriber device. The handset will support mobile Internet protocol (IP) and wireless modem dial-up functionality. This service will support a variety of applications, including electronic mail (e-mail).

Important ESMR considerations are summarized in Exhibit 1.

Availability	<ul style="list-style-type: none"> • Identifies whether ESMR services can be acquired from a carrier in a given region
Coverage	<ul style="list-style-type: none"> • Identifies whether ESMR call can reach users in a given service area
Accessibility	<ul style="list-style-type: none"> • Identifies whether ESMR users can access and use services during congestion or network disruption
Security and Privacy	<ul style="list-style-type: none"> • Describes the level of inherent security of the service and the capability to add security measures
Cost	<ul style="list-style-type: none"> • Characterizes the costs of typical ESMR services

Exhibit 1
Key ESMR Characteristics

Availability

ESMR is available in at least 92 of the largest 100 metropolitan areas of the United States and several international markets [1]. There is no standard ESMR technology, so unlike cellular and personal communication service (PCS) providers, it is uncommon for ESMR carriers to have “roaming” agreements with other ESMR providers to extend their services outside their own regions. One provider that is currently implementing a nationwide digital network dominates the ESMR market, and several ESMR providers have a regional market presence. ESMR providers have already deployed or will soon be deploying their networks in territories now served by analog SMR systems. In fact, many SMR customers are now migrating to the more advanced ESMR networks.

Coverage

ESMR is a relatively new service; therefore, there is less coverage than cellular networks. ESMR networks are typically deployed first in areas with high population density, such as in metropolitan areas and along major roadways. Consequently, ESMR networks may not provide full coverage beyond these roadways or in rural areas. This is a key consideration for users who expect and need contiguous service that extends beyond densely populated areas.

Like other wireless services, ESMR networks have coverage gaps. Coverage gaps are due to “dead spots” within the region, where the carrier’s signal is non-existent or too weak to communicate. Terrain or buildings can also interfere with the

signal and interrupt coverage. Users should match operational requirements against ESMR coverage to ensure that the service is available where they need it.

Accessibility

Accessibility addresses whether users can access and use ESMR services during congestion or network disruption. Users of ESMR networks compete for a limited number of available channels. Therefore, users may experience congestion if demand exceeds network capacity. Congestion may increase significantly during peak periods or emergencies, when voice traffic on commercial wireless networks increases sharply. Congestion in ESMR networks will cause delays in setting up connections and transmitting voice or data communications.

The likelihood and effect of congestion depends, in part, on the number of channels available to a network and the number of users of that network. If the carrier owns the rights to a sufficient amount of spectrum and deploys an appropriate number of channels, congestion then becomes a function of the efficiency in which the network processes and manages calls. ESMR is one of the fastest growing wireless commercial services in the United States, and users should be aware that no ESMR provider offers any priority access capability during congestion periods.

Security and Privacy

ESMR technology has several safeguards that address security and privacy. First, whenever a

subscriber turns on a handset, the unit's International Mobile Subscriber ID is sent to the network and a temporary mobile subscriber ID (TMSI) is assigned to the unit. The TMSI changes several times during each session, making it difficult to scan or clone the unit, and thus "impersonate" it on the network. For dispatch communications, a similar set of temporary IDs is used to define a subscriber unit's individual and talk group IDs.

Unauthorized access to the network is also prevented through an authentication process between the subscriber unit and the network. In short, the network sends a random number to the subscriber unit and the unit processes this number, using a proprietary authentication algorithm and an authentication key, to generate a response to the network. Only the network and the subscriber unit have the authentication key, and therefore, only the network and the subscriber unit can determine the correct response. Only if the response is valid is the call allowed to continue. This process is invisible to the user.

ESMR systems do not support encryption but there are attributes that foster limited privacy. The most common ESMR technology employs a time division multiplexing technology for voice transmission. In short, the technology divides each voice channel into timeslots, each milliseconds long. This makes interception of an ESMR call relatively more difficult than an unencrypted analog cellular phone call. A person trying to intercept an ESMR call would need to

consistently identify the timeslot of a particular communication. In addition, a compression algorithm is used for digitally encoding/decoding speech, so a person that managed to intercept a call would still have to decode the actual voice component of the communication.

Users with robust security requirements should understand the attributes of their particular provider's ESMR technology. Users should also consider the practices of the service provider, with respect to physical, operational, and information security.

User Equipment

ESMR subscriber units provide access to digital dispatch, cellular interconnect, and short text message services through one handset the size of a typical cellular or personal communication service (PCS) phone. Key factors for mobile users to consider when buying ESMR handsets include functionality, device ruggedness, ease of use, battery life, voice quality, warranty, available accessories, and purchase and maintenance costs.

ESMR handset prices generally range between \$190 and \$500, depending on the unit's functionality and performance. Users can buy handsets from ESMR providers or authorized ESMR dealers. Although there are a variety of handset models, there is only one company that manufactures handsets for the most widely deployed ESMR technology [2].

ESMR From a Network-Level Perspective

ESMR integrates the functionality of digital cellular and dispatch networks. All ESMR communications are carried through the ESMR network. There is no talk-around capability (i.e., the ability for two or more subscriber devices to directly communicate without the assistance of network infrastructure).

Exhibit 2 illustrates the transmission of a cellular call from an ESMR subscriber to a user on the PSN. First, a subscriber dials a telephone number and presses the “Send” key. The call request is sent via a control channel to the

nearest ESMR site. The ESMR network switching and control components then

authenticate the subscriber device, process the dialed digits, communicate with the PSN, provide call routing instructions, and assign a radio channel pair to complete the call. The call is then conducted and terminated in a manner similar to any cellular or PCS call.

ESMR subscribers can also make push-to-talk dispatch calls to a predefined group of users that make up a talk group. Exhibit 3 illustrates a dispatch call made within a talk group of three ESMR subscribers.

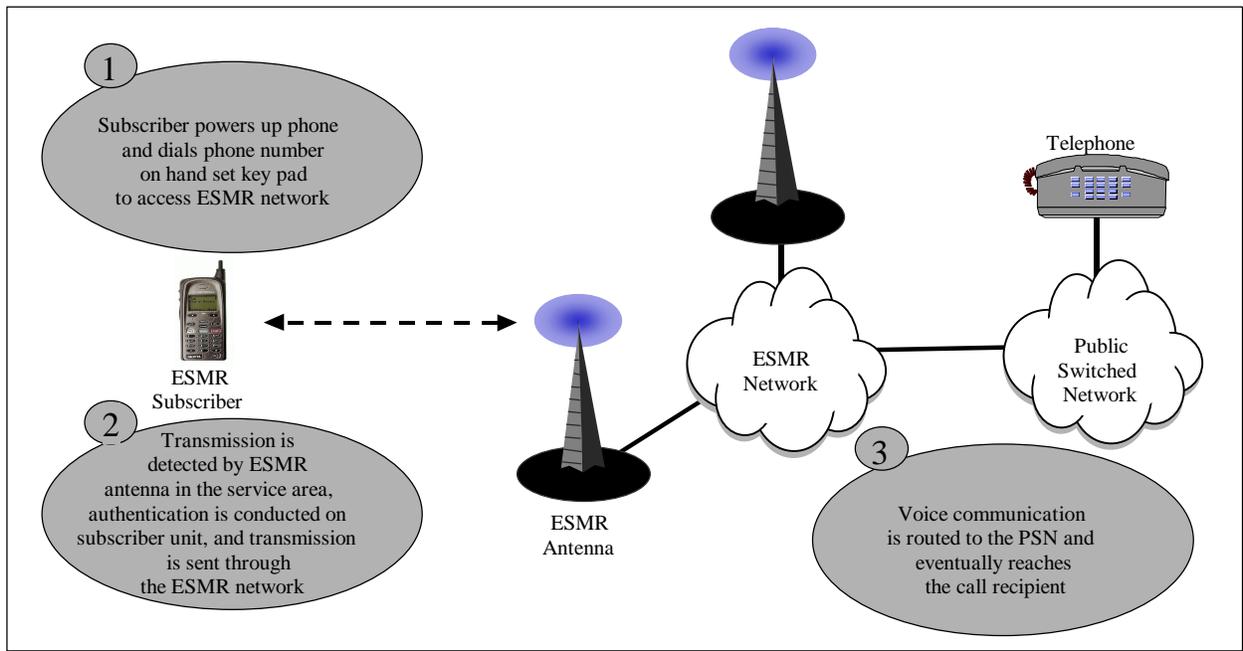


Exhibit 2
ESMR Digital Cellular Call from a Network Perspective

The dispatch function of ESMR emulates traditional LMR more than any other available commercial wireless service. A dispatch call is initiated when any user depresses the PTT button on the side of the subscriber handset. This transmission is received at an ESMR site and an authentication process is executed. The network then determines and validates the caller's talk group and identifies the locations of the members of the talk group. Location registers within the network continuously track the location of any powered-on subscriber unit as the user moves throughout a network. A radio channel is

assigned and then routing information is developed for the caller's voice transmission. The network also assigns radio channels for the destination sites serving the other members of the talk group. If a radio channel is not available for a particular user, that member is included in the call when a channel becomes available at the site serving that user. A hang timer allows users to have a series of PTT transmissions without having to set up a channel each time the PTT is released. ESMR dispatch calls are conducted without any interaction with the PSN.

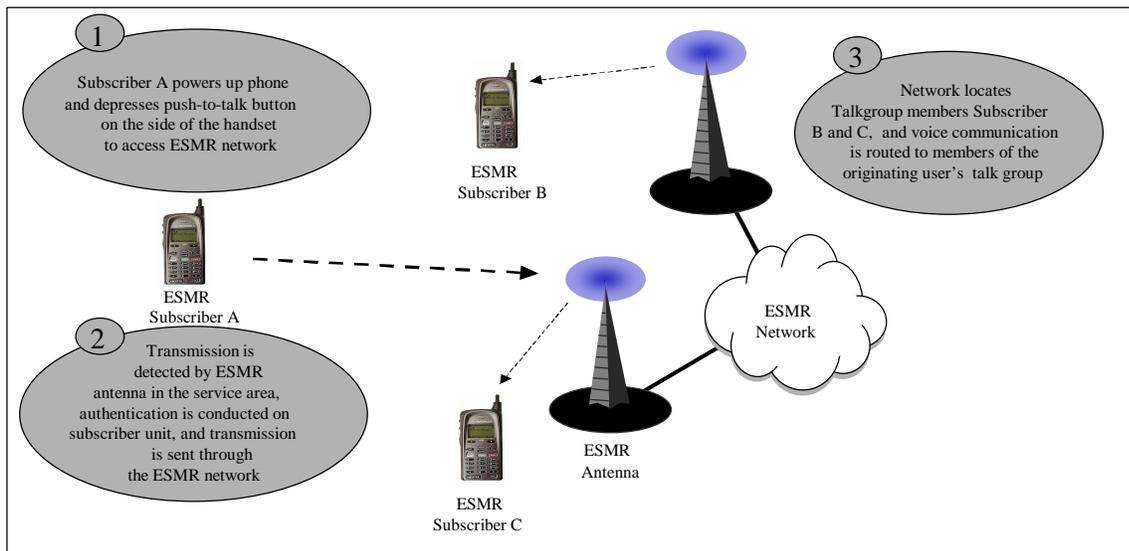


Exhibit 3
ESMR Digital Dispatch Call from a Network Perspective

ESMR Costs

ESMR customers pay equipment and service costs. Service pricing structures and service rates vary by carrier and pricing plan. In general, vendors “bundle” cellular and dispatch call minutes and alphanumeric messages on a monthly basis. Once a user surpasses these allotted minutes, they are billed on a per minute basis. Long distance charges are billed on a per minute basis. ESMR subscribers usually have a choice of several plans. The price and structure of these service plans can vary widely depending on the competition provided by cellular and PCS carriers within the ESMR’s operating area. Exhibit 4 illustrates an example of three different ESMR service plans offered by one provider.

It is important to note that there are aspects of the billing structure of ESMR services that may add to a subscriber’s monthly service cost. For example, billing for dispatch service is usually a

function of call duration multiplied by the total number of members of a talk group. The liberal use of talk groups can result in excessive service charges if a large volume of dispatch service is not included in the service plan.

ESMR Considerations

Users must carefully consider what operational requirements they have and whether commercial services may satisfy those requirements. Exhibit 5 highlights several factors to consider when evaluating ESMR services. ESMR service and feature packages and billing structures are likely to vary among carriers and even between different areas served by the same carrier. Before acquiring ESMR services, potential users may choose to ask questions such as those listed in Exhibit 6 to better understand the attributes and costs of specific services. These questions should assist planners in determining whether ESMR meets user requirements.

Integrated Service and Features	Plan A	Plan B	Plan C
Monthly Access	\$69	\$89	\$109
Digital Cellular Minutes Included	60	150	300
Additional Digital Cellular Minutes	\$.30	\$.25	\$.23
Dispatch Minutes Included	150	150	150
Additional Dispatch Minutes	\$.10	\$.10	\$.10
Long Distance, per minute	\$.15	\$.15	\$.15
Numeric Pages	Unlimited	Unlimited	Unlimited
Text Messages	25	25	25
Basic Voice Mail	Included	Included	Included
Enhanced Voice Mail	\$5	\$5	\$5
Caller ID	\$3	\$3	\$3
Additional Line	\$10	\$10	\$10

Exhibit 4
Example of Three ESMR Monthly Service Pricing Plans

ESMR Considerations

- **Cost:** ESMR services are priced as “fee for services” and largely depend on the number of bundled cellular and dispatch minutes included in a month. Users should be aware that during a call, all talk group members are billed for the call. This has the potential to lead to some very high additional service costs. Users are also responsible for long distance charges for cellular calls.
- **Compatibility:** There is no standard ESMR technology, so users of one ESMR network are unable to operate on another ESMR network.
- **Flexibility:** ESMR has the potential to eliminate the need to build a private LMR network, which reduces costs considerably. Users can quickly adopt new services and expand.
- **Dispatch:** Dispatch services usually require a customer to identify the users group. Also, dispatch services will usually only be provided in limited areas (e.g., though the carrier may have coverage in a number of cities, the customer can only use the dispatch feature in select areas). This may cause problems for those customers with multi-city requirements.
- **Coverage:** ESMR is available or will be available in most metropolitan areas. Coverage in rural areas will be sparse. ESMR is a relatively new technology, so carriers are still building out networks and expanding coverage.
- **Coverage Gaps:** Some ESMR networks may have significant coverage gaps, depending on geographic terrain, shadowing from buildings, and network build-out.
- **Roaming:** It is uncommon for ESMR providers to have roaming agreements, which underscores the importance of knowing where a particular ESMR provider has coverage.
- **Accessibility:** If the ESMR provider’s network becomes congested, it is likely that call setup and transmission may be delayed or blocked.

Exhibit 5 Considerations in Adopting ESMR Services

ESMR CHECKLIST

- Do I need integrated cellular and dispatch service?
- Where do I need these services? Locally? Regionally? Nationally?
- What ESMR services are available to meet my needs? Will this work in my current operational environment?
- Will it support mission-critical requirements?
- What is the coverage of the carrier's ESMR network?
- Is there priority access available for public safety users?
- Is the ESMR network susceptible to congestion? How often?
- Do known coverage gaps exist? Where?
- Will the provider address my coverage gaps in areas where I know I will need ESMR services?
- Are there regional or nationwide roaming agreements? With whom?
- What maximum delay in accessing the network will the carrier guarantee?
- What type of service and pricing plans are offered?
- How do the service plans rate against my needs?
- Are volume discounts or flat-rate pricing plans available?

Exhibit 6

User Checklist of Questions to Better Understand the ESMR Service

**APPENDIX A
LIST OF ACRONYMS**

ESMR	Enhanced Specialized Mobile Radio
LMR	Land Mobile Radio
PMO	Program Management Office
PSWN	Public Safety Wireless Network
PTT	Push-to-talk
SMR	Specialized Mobile Radio
TMSI	Temporary Mobile Subscriber Identification

APPENDIX B REFERENCES

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