TIA COMMITTEE TR-8
PRIVATE LAND MOBILE RADIO SYSTEMS STANDARDS
TR-8.5 Signaling and Data Transmission

TITLE:	Proposal for TIA-PN-102.BAJA-B
DOCUMENT NUMBER:	17-TBD
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DATE:	May 17, 2017
DISTRIBUTION TO:	TR-8.5 Subcommittee Members
INTENDED PURPOSE:	___ For Information _x_ For Incorporation into a TIA Publication ___ Other (description)
ABSTRACT:	This document contains a contribution on the Location Services Overview and is intended to be reviewed and ultimately considered for publication as TSB-102.BAJA-B
RECOMMENDATION:	Review and comment

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DRAFT PROPOSAL (Revision B – v1)

Location Services Overview

TR-8.5 Subcommittee

TIA-PN-102.BAJA-B

(To be published as TSB-102.BAJA-B)

May 17, 2017

TELECOMMUNICATIONS INDUSTRY ASSOCIATION

Foreword

(This foreword is not part of this document.)

This document has been created in response to a request by the Project 25 Steering Committee as provided for in a Memorandum of Understanding (MOU) dated April 1992 and amended December 1993. The MOU states that the Project 25 Steering Committee shall devise a Common System Standard for digital public safety communications (the Standard) commonly referred to as Project 25 or P25, and that TIA, as agreed to by the membership of the appropriate TIA Engineering Committee, will provide technical assistance in the development of documentation for the Standard. If the abbreviation “P25” or the wording “Project 25” appears on the cover sheet of this document when published that indicates the Project 25 Steering Committee has adopted this document as part of the Standard. The appearance of the abbreviation “P25” or the wording “Project 25” on the cover sheet of this document or in the title of any document referenced herein should not be interpreted as limiting the applicability of the information contained in any document to “P25” or “Project 25” implementations exclusively.

This document was developed by the TIA TR-8.5 Signaling and Data Transmission Subcommittee and provides an overview of TIA-102 Location Services. The 3rd edition (Revision B) updated the 2nd edition (Revision A) to address errata comments. This document cancels and replaces TSB-102.BAJA-A.

There are no annexes in this document.

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- No patents have been identified

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Revision History

Version	Date	Description
Original	2/17/2009	Initial release of Location Services Overview
Revision A	2/15/2010	Incorporated revisions to reference the Tier 2 Location Service Specification for the compression method
Revision B	TBD	Revision to align with the latest revisions of the Tier 1 and Tier 2 Location Service specifications and to align with the latest TR-8 practices
Draft B-v1	5/17/2017	Incorporated proposed resolutions recorded in combined comment matrix 17-007

Editor's Note: *This note and rows that begin with "Draft" will be deleted when this document is approved for publication*.

1. Introduction

The objective of the Location Services Overview is to describe how TIA-102 series standards and other industry standards are used to provide a location reporting service for land mobile radio (LMR) systems.

Knowing the location of subscriber unit and, by implication the user, could be extremely important, especially in situations where the user might be in harm's way or lost. Some illustrative examples are:

Resource Tracking

- Monitor locations and movements of the user community
- Automatic Reporting on the users voice channel:
  - Transmit location on a timed programmable interval
  - Transmit location on each PTT

Emergency Mode Reporting

- Activated when Emergency mode is entered, typically by pressing an "Emergency" button
- Set to automatically transmit on emergency PTT
- Repeats whenever the emergency message is sent; no manual PTT required

Perimeter and Target (Waypoint) Mapping

- Walk desired perimeter to map its location:
  - Set to transmit automatically on a short interval (e.g. 3 seconds)
  - Set unit identifier to perimeter name
- Mark designated targets:
  - Set to transmit automatically on PTT
  - Set unit identifier to target name
  - Transmit (could also have someone at base monitoring)
- Same technique used for Search and Rescue Missions and Grid Searches

The specifications in the TIA-102 Location Services document suite provide a means for subscriber units and infrastructure elements from various manufacturers to interoperate when providing location services.

1.1 Scope

This document describes LMR Location Services including a brief summary of the solution (section 2 below), document suite (section 3 below), and its architecture (section 4 below):

The document describes a two-tiered approach to providing location services. See section 2 below for a summary of the two tiers.

The functional scope of the location service as described herein covers functionality described in [4].

Group-oriented Location Services are not supported at this time.

1.2 References

The appearance of “Project 25” in references below indicates the TIA document has been adopted by the Project 25 Steering Committee as part of its Project 25 standard, i.e. “the Standard.”

[1] TIA-102.BAEA-C, Project 25 Data Overview and Specification, ANSI/TIA, December 2015

[2] TIA-102.BAJB-A, Project 25 Tier 1 Location Services Specification, ANSI/TIA, November 2014

[3] TIA-102.BAJC-A, Project 25 Tier 2 Location Services Specification, ANSI/TIA, April 2015

[4] TSB-102-C, Project 25 TIA-102 Documentation Suite Overview, TIA, March 2016

1.3 Acronyms and Abbreviations

ANSI	American National Standards Institute
CAI	Common Air Interface
COTS	Commercial Off-The-Shelf
FDH	Fixed Data Host
FDN	Fixed Data Network
FNE	Fixed Network Equipment
FS_R	Fixed Station Repeater
GPS	Global Positioning System
GPSR	GPS Receiver
IP	Internet Protocol
LIS	Location Information System
LORAN	Long Range Navigation
LRRP	Location Request/Response Protocol
LSHS	Location Service Host System
LMR	Land Mobile Radio
MDP	Mobile Data Peripheral
NMEA	National Marine Electronics Association
PTT	Push-To-Talk
SU	Subscriber Unit
TIA	Telecommunications Industry Association
UDP	User Datagram Protocol
XML	Extensible Markup Language

1.4 Definitions

CAI	see definition in [4]
FDH	see Data Host (DH) definition in [1]
FDN	see Data Host Network (DHN) definition in [1]
FNE	see definition in [1]
FS_R	see definition in [1]
SU	see definition in [4]

2. Location Services Summary

LMR Location Services provide a means to supply a Location Service Host System (mapping software for example) with the location of subscriber units moving throughout the coverage area of LMR systems. There are two tiers of service provided, with varying capabilities.

2.1 Tier 1 Location Service

The first tier supports a simple SU to SU interface for the Direct Data or Repeated Data configurations described in [1], without providing IP addressing, fixed host routing, or more advanced configuration of triggering and reporting. This approach is appropriate for real-time field incident applications where the Location Service Host System is resident on a portable device. It does not provide a mechanism to provide location information to a host device on a fixed network.

The Tier 1 approach utilizes a dedicated Service Access Point on the CAI Data Bearer Service described in [1] to transport location information formatted as described in NMEA 0183, a commonly used location protocol.

2.2 Tier 2 Location Service

The second tier, for the Direct Data, Repeated Data, Conventional FNE Data, or Trunked FNE Data configurations described in [1], utilizes a more complex application protocol to configure triggering and reporting in the SU from a fixed host, and uses UDP/IP to allow routing and transport in a fixed network for communication to/from a fixed host or SU. This approach is appropriate for applications in areas that contain the necessary infrastructure. It has the additional capabilities of being able to provide location information to a host device on a fixed network.

The Tier 2 approach utilizes the LRRP protocol across the IP Data Bearer Service described in [1] to transport requests from the Location Service Host System to the SU, and to transport location information from the SU to the Location Service Host System. LRRP is an XML-based protocol, which requires compression in order to efficiently use the IP Data Bearer Service, so a compression method is also necessary.

3. Location Service Document Suite

The LMR Location Service is specified in a suite of TIA-102 documents. This overview document describes the architectural framework that the LMR Location Service works within. The remaining documents specify detailed portions of the LMR Location Service in a normative fashion.

The TIA-102 Location Service document suite also includes the following documents:

- Tier 1 Location Service Specification [2] – this document is the detailed specification of messages and procedures for the Tier 1 Location Service.
- Tier 2 Location Service Specification [3] – this document is the detailed specification of messages, compression method, and procedures for the Tier 2 Location Service.

4. Location Services System Architecture

TIA-102 Location Services take place in a variety of system architectures:

- Trunked
  - SU to Fixed Data Host
  - SU to SU[1]
- Conventional
  - SU direct to SU
  - SU repeated to SU
  - SU to Fixed Data Host

In this section, architectural entities involved in Location Services are defined, the system architectures noted above are described, interfaces between architectural entities are discussed, and protocols used are briefly described.

4.1 Architectural Entities

This clause defines architectural entities that are involved in Location Services. These entities are participants in the Location Services architectures described in 4.2 below. Figure 1 below shows the entities involved in Location Services, and the possible paths for location information through the system.

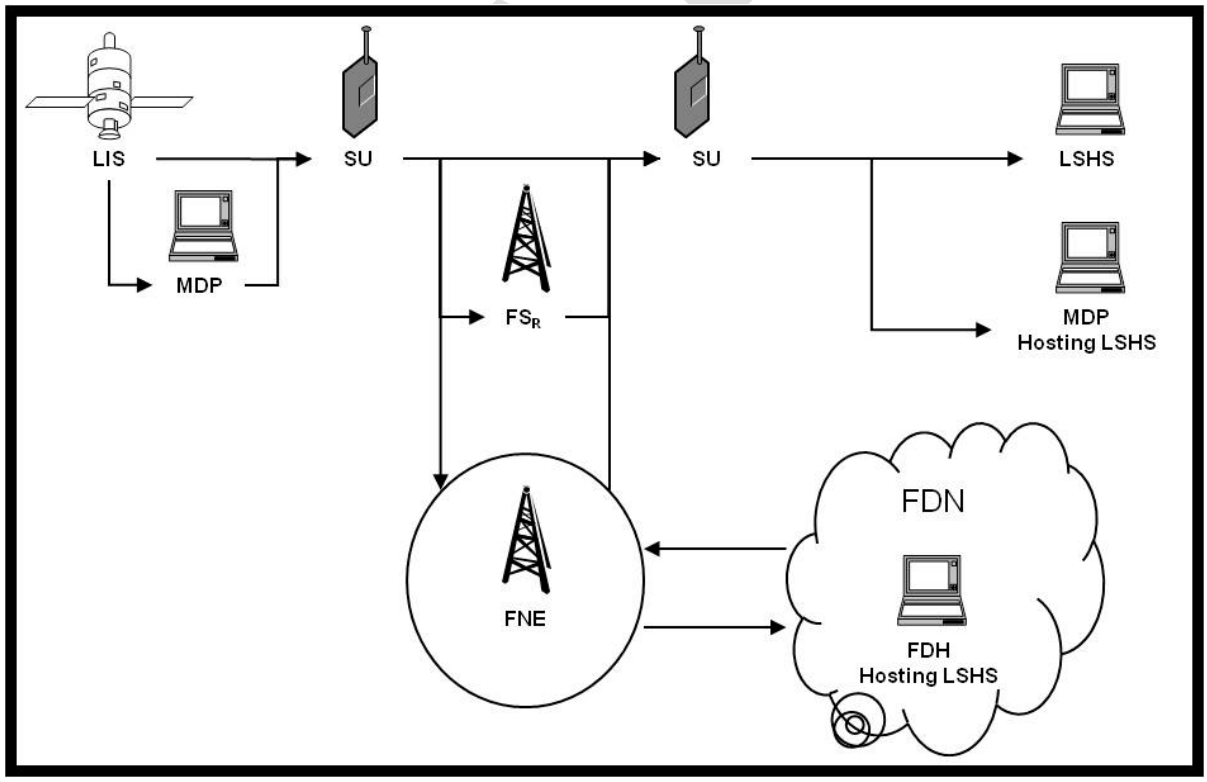

Figure 1 – Architectural Entities

[1] Note that in trunking, an SU might send to another SU in fixed host mode, with an IP packet routed by the FNE back to the destination SU, see 4.2.3 below.

4.1.1 Location Information System (LIS)

This is a system, outside of the LMR system, that provides location information to the SU so that the SU knows its location. It might be a GPS, a LORAN system, or some other location system.

Note that, depending on SU hardware design, some components might be internalized into the actual physical SU. For example, an SU might contain a GPSR chipset that receives GPS signaling.

The exact definition of the functionality of this system is outside of the scope of the TIA-102 Location Service document suite. See 4.3.1 below for a description of the interface between the LIS and the SU.

4.1.2 Location Service Host System (LSHS)

This is a system, outside of the LMR system, that operates on the SU location information. For example, it might provide mapping functionality that shows the location of various SUs on a map. This might typically be a COTS product.

Another function that this system has is to provide the ability to issue commands to the SU to obtain location information, or to provide configuration to the SU regarding when to send location information, if a bi-directional request/response protocol is used.

Note that this entity might reside as part of the FDH described in 4.1.3 below, or as part of the MDP described in 4.1.4 below.

Note also that, depending on SU hardware design, some components might be internalized into the actual physical SU. For example, an SU might have the capability to display a map showing the location of other SUs.

The exact definition of the functionality of this system is outside the scope of the TIA-102 Location Service document suite. See 4.3.3 below for a description of the interface between the LSHS and the SU, and see 4.3.6 below for a description of the interface between the LSHS and the FDH or MDP.

4.1.3 Fixed Data Host (FDH)

The FDH has an IP address. For Location Services, the FDH might contain or communicate with an application embodying a LSHS (see 4.1.2 above). The responsibility of the FDH for Location Services is to receive Location Information from an SU (on a given UDP port), uncompress it, and provide it to the LSHS through an interface (see 4.3.6 below), and to compress and provide any commands received from the LSHS to the SU when a bi-directional request/response protocol is used.

4.1.4 Mobile Data Peripheral (MDP)

The MDP has an IP address. For Location Services, the MDP might contain or communicate with an application embodying a LSHS (see 4.1.2 above), and it might provide an interface between the SU and the LIS, or contain part of the LIS. The responsibility of the MDP is to receive location information from the LIS (see 4.3.1 below) and forward it to the SU, encapsulated in UDP/IP over the A interface, or to receive location information from the SU, uncompress it, and provide it to the LSHS (see 4.3.6 below) and to compress and provide any commands received from the LSHS to the SU when a bi-directional request/response protocol is used.

4.1.5 LMR System

The LMR system is a radio network providing a variety of services, and is described in [4]. It has defined subsystems and interfaces that are used to carry location information between the LIS and the LSHS.

There are four packet data configurations specified in [1]: Direct Data, Repeated Data, Conventional FNE Data, and Trunked FNE Data. Tier 1 Location Services are supported on the Direct Data and Repeated Data configurations. Tier 2 Location Services are supported on all of these configurations.

The following subclauses describe component entities of the LMR System involved in Location Services:

- SU
- FS_R
- FNE

4.1.5.1 SU

The SU provides communication services on the LMR system to a user. For Location Services, the SU obtains location information from the LIS and provides it to the LSHS through its interfaces.

4.1.5.1.1 Obtaining Location Information

The SU obtains location information from the LIS via the interface described in 4.3.1 below. In this case, the SU could display the received location information locally to its user.

The SU could also obtain location information from the LIS via the MDP on the A interface, using UDP/IP addressing. The destination address of the information might be another data host, or it might be the SU itself, in which case the SU could display the received location information locally to its user. If delivery to both a data host and location display at the SU are needed, the MDP could send copies of the location information to both destinations.

4.1.5.1.2 Triggering Conditions

There are a variety of triggering conditions that might cause the SU to send the location information it receives to a LSHS. Many of these triggers are associated with actions performed by the user of the SU that is sending the information. The TIA-102 Location Services support configuration and use of these triggers. The triggers for Tier 1 Location Service are specified in [2] and the triggers for Tier 2 Location Service are specified in [3]. It is intended that all supported triggering options be enabled or disabled at the discretion of the agency that is using the service.

4.1.5.1.3 Reporting Conditions

The following are some conditions on reporting location information:

1) **Batch Reporting** – The SU buffers several Location Information Messages and reports them only on request.
2) **Freshness** – The SU verifies that the data in its buffer has changed prior to transmitting on a trigger.

4.1.5.1.4 Providing Location Information

In Direct Data or Repeated Data configurations, an SU receives location information from another SU, and provides it to the LSHS on the interface described in 4.3.3 below. The SU could instead provide the location information over the interface to an MDP described in 4.3.4 below that hosts the LSHS.

4.1.5.2 FS_R

For Location Services, the FS_R behavior is the same as it is for any other service that utilizes CAI Data Bearer Service or IP Data Bearer Service.

4.1.5.3 FNE

For Location Services, the FNE behavior is the same as it is for any other service that utilizes CAI Data Bearer Service or IP Data Bearer Service.

4.2 Architectures

There are four packet data configurations defined in [1]: Direct Data, Repeated Data, Conventional FNE Data, and Trunked FNE Data. Tier 1 Location Service supports the Direct Data and Repeated Data configurations. Tier 2 Location Service supports all four packet data configurations. Details regarding information flow for these configurations are described in [2] for Tier 1 Location Service and in [3] for Tier 2 Location Service.

The interfaces shown in the diagrams in this clause are numbered to reference the corresponding interface description in 4.3 below. Subsystems are represented as circles or ovals. Entities are represented as rectangular objects.

4.2.1 Direct Data Configuration

Figure 2 below shows a Direct Data configuration architecture.

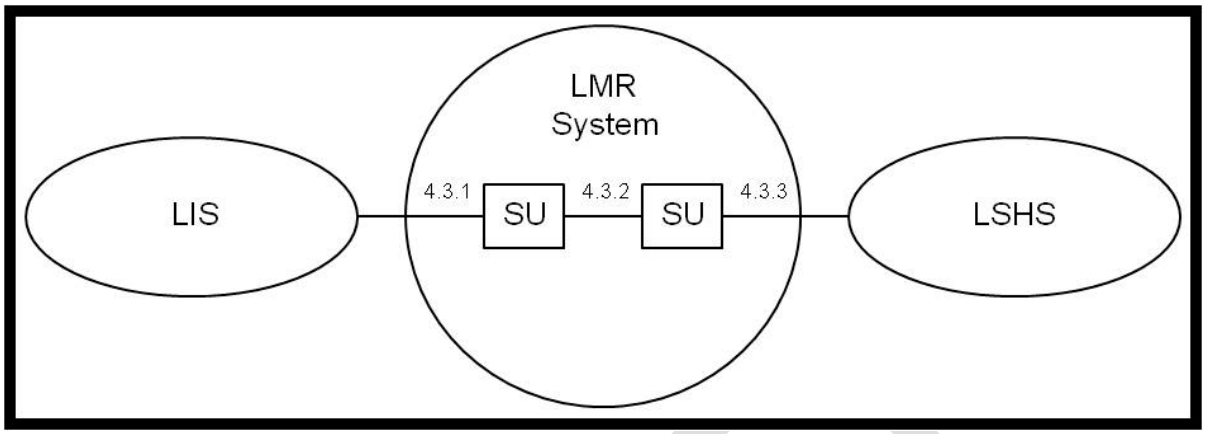

Figure 2 – SU to SU Direct Data Configuration

4.2.2 Conventional SU Repeated to SU

Figure 3 below shows a Conventional SU repeated to SU architecture.

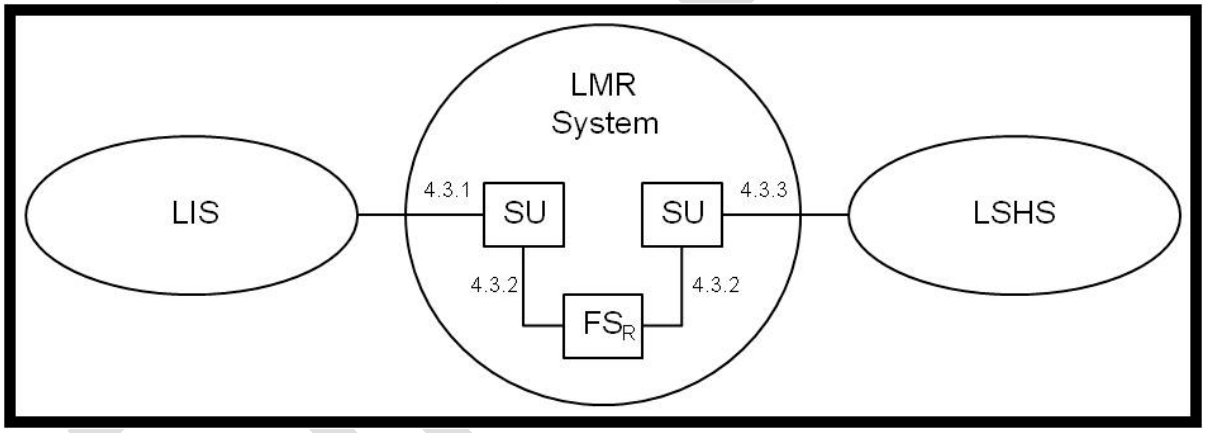

Figure 3 – SU to SU Repeated Data Configuration

4.2.3 Conventional or Trunked FNE Data Configuration

Figure 4 below shows an SU to FDH Conventional FNE Data or Trunked FNE Data configuration architecture.

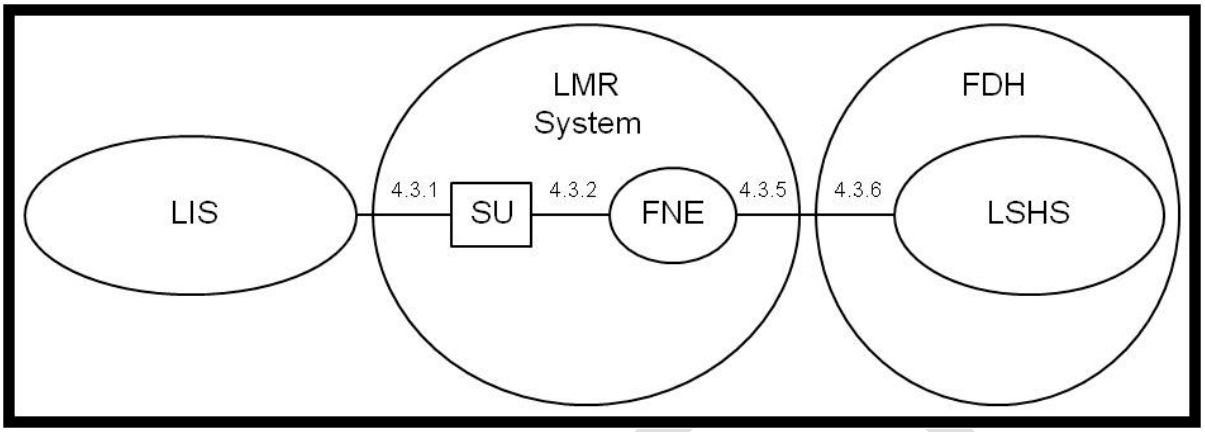

Figure 4 – SU to FDH Conventional or Trunked FNE Data Configuration

Figure 5 below shows an SU to SU Conventional FNE Data or Trunked FNE Data configuration architecture.

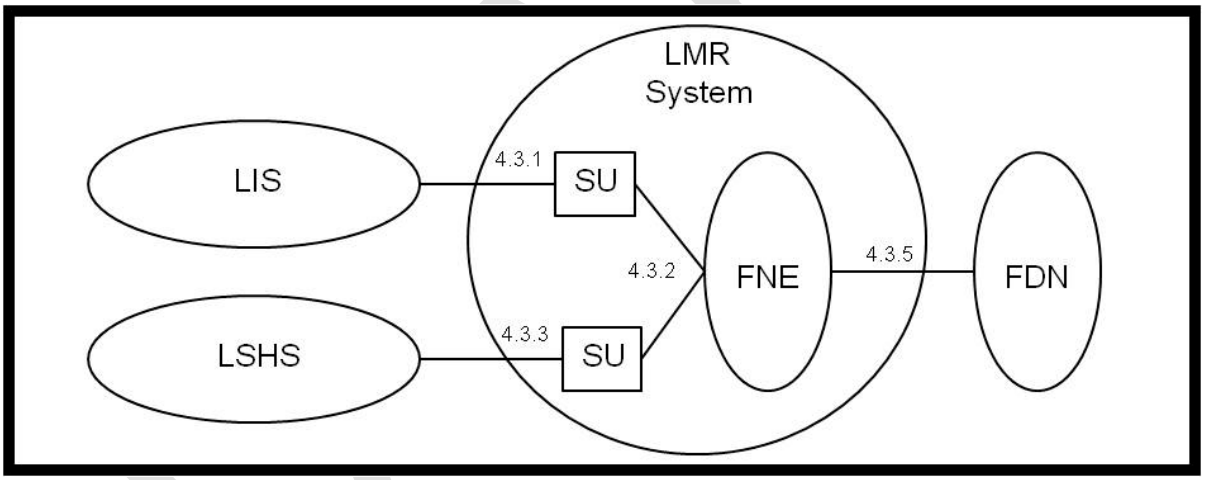

Figure 5 – SU to SU Conventional or Trunked FNE Data Configuration

4.2.4 MDP Used for Location Services

An MDP could be inserted in the system, connected to the SU.

Figure 6 below shows connection of the LIS to an SU through an MDP.

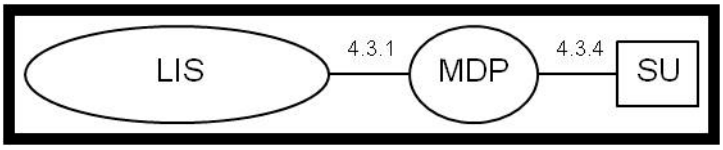

Figure 6 – LIS to MDP

Note that the LIS could also be partially incorporated into the MDP.

Figure 7 below shows connection of the LIS to an SU through an MDP, when the LSHS is an application that is hosted on the MDP.

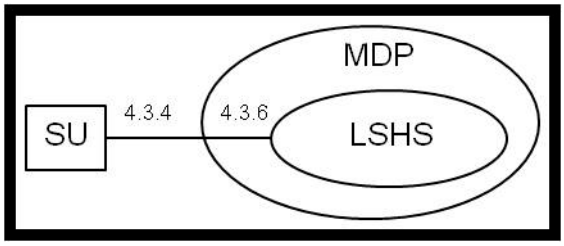

Figure 7 – MDP to LSHS

4.3 Interfaces

This clause discusses the interfaces between architectural entities.

4.3.1 LIS to SU or MDP

This interface is not standardized, for several reasons:

- A portion of the LIS could be contained in the same hardware as the SU (if the SU contains a GPS receiver, for example) or the MDP (if the MDP is a GPS receiver, for example). This makes it difficult to describe an interface that works in all situations without restricting the SU implementation options unnecessarily.
- It is anticipated that an SU from any given manufacturer is certified with and has implemented the appropriate protocols and connectors to communicate with the LIS chosen by that manufacturer to meet the needs of its customers. This makes it unnecessary to provide interoperability between different LIS components and the various manufacturers' SUs.
- The LIS industry is separate from the LMR industry and so is outside of the scope of this formulating group. This makes it difficult to specify an interface protocol that all Location industry manufacturers consistently agree with and manufacture to.
- Finally, this leaves open the possibility of innovation and change on this interface to provide better services in the future.

Manufacturers need to be prepared to specify what equipment or protocol is supported by their SUs for this interface. It is necessary to emphasize that no new physical interface is specified for the SU to communicate with the LIS.

4.3.2 SU to SU, SU to FS_R, and SU to FNE

For the Tier 1 Location Service, the SU to SU and SU to FS_R interfaces are specified in [2]. For the Tier 2 Location Service, the SU to SU, SU to FS_R, and SU to FNE interfaces are specified in [3].

4.3.3 SU to LSHS

This interface is not standardized, for several reasons:

- A portion of the LSHS could be contained in the same hardware as the SU (if the SU implements a mapping application, for example). This makes it difficult to describe an interface that works in all situations without restricting the SU implementation options unnecessarily.
- It is anticipated that an SU from any given manufacturer is certified with and has implemented the appropriate protocols and connectors to communicate with the LSHS chosen by that manufacturer to meet the needs of its customers. This makes it unnecessary to provide interoperability between different LSHS components and the various manufacturers' SUs.
- The LSHS industry is separate from the LMR industry and so is outside of the scope of this formulating group. This makes it difficult to specify an interface protocol that all LSHS manufacturers consistently agree with and manufacture to.
- Finally, this leaves open the possibility of innovation and change on this interface to provide better services in the future.

Manufacturers need to be prepared to specify what equipment or protocol is supported by their SUs for this interface. It is necessary to emphasize that no new physical interface is specified for the SU to communicate with the LSHS.

4.3.4 SU to MDP

For the Tier 2 Location Service, the SU to MDP interface is specified in [3]. This interface is not defined for Tier 1 Location Service.

4.3.5 FNE to FDH

For the Tier 2 Location Service, the FNE to FDH interface is specified in [3]. This interface is not defined for Tier 1 Location Service.

4.3.6 FDH to MDP or LSHS

For the Tier 2 Location Service, the FDH to MDP or LSHS interface is specified in [3]. This interface is not defined for Tier 1 Location Service.

4.4 Location Service Protocols

For the Tier 1 Location Service, the protocol stacks and protocol layers are specified in [2]. For the Tier 2 Location Service, the protocol stacks and protocol layers are specified in [3].