MOTOTRBO™

Application Development Kit Overview

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Section 1

1.0 What is MOTOTRBO™?

MOTOTRBO™ is Motorola's next generation of Professional Radio that is capable of analog and digital two-way communications. In addition to the standard features available with Motorola's other analog-based products, MOTOTRBO™ brings digital enhancement to the voice quality as well as an expanded feature set to this product tier.

While operating in digital mode, MOTOTRBO™ uses a two-slot Time Division Multiple Access (TDMA) air interface to transmit and receive digitized voice and air protocol control messages simultaneously. This leads to a higher quality of service (QoS) and a richer user experience with the product.

With the digital mode operation of the MOTOTRBO™ system, customers can expect end-to-end operation of advanced features and integrated applications such as text messaging, Location-Based Services (LBS), and telemetry as well as customized capabilities provided through an internal option board.

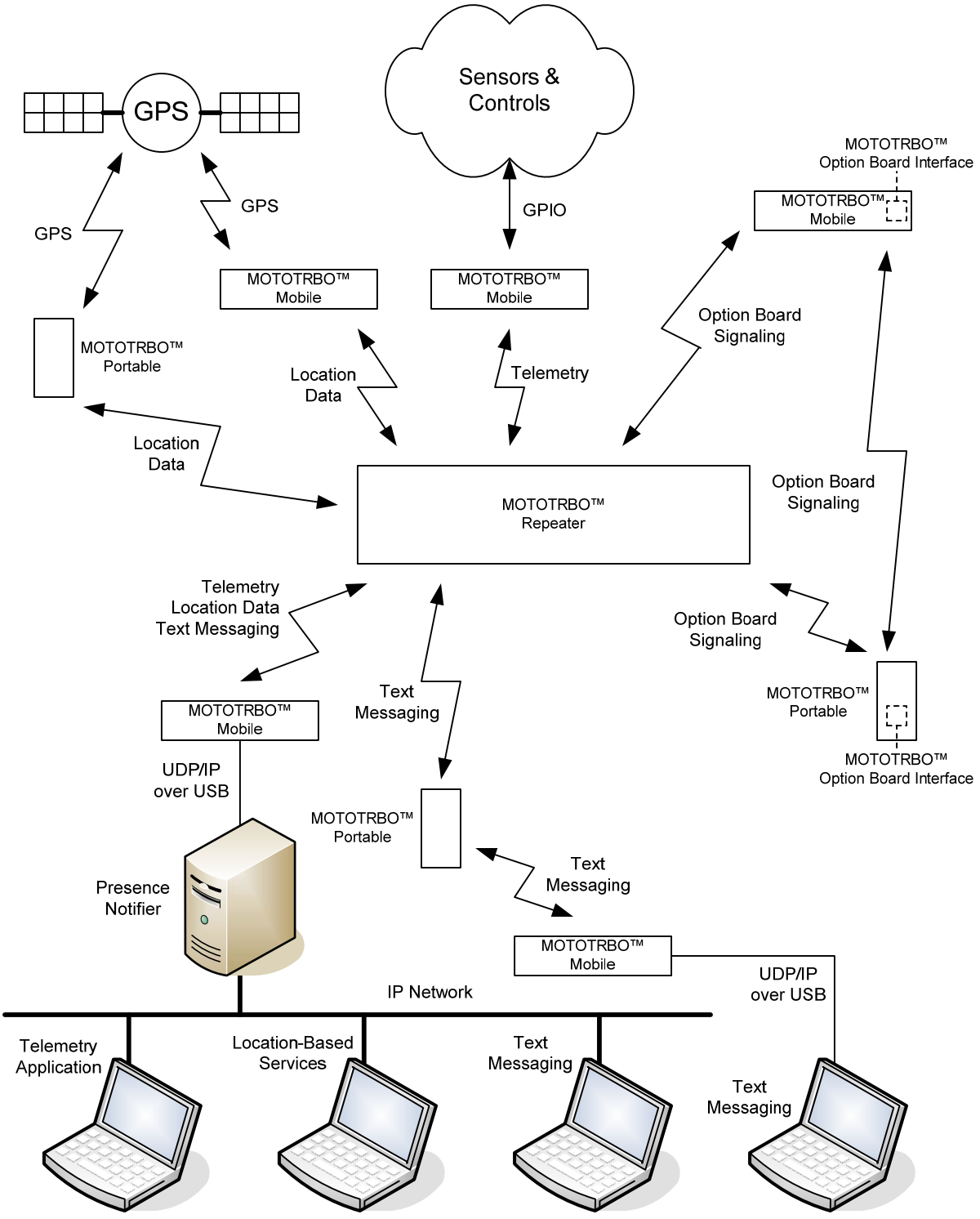

Figure 1 - MOTOTRBO™ System Example

Section 2

2.0 Extending the MOTOTRBO™ Product

Aside from the functionality embedded in the radio, the MOTOTRBO™ subscriber's capabilities can be extended through defined application programming interfaces for 3rd party developer use. The MOTOTRBO™ Application Development Kits (ADKs) offer an opportunity to customize a solution specifically to a customer's need.

The MOTOTRBO™ ADKs are comprised of protocol specifications and development guidelines that are intended as technical references for the external vendor. These ADKs not only include software specifications, but also include electrical and mechanical specifications, where applicable. Each interface's set of technical references also detail the specific domain knowledge required to successfully implement a 3rd party application for the MOTOTRBO™ product.

These are the primary ADKs for developer use:

- MOTOTRBO™ Option Board ADK
- MOTOTRBO™ XCMP-Based IP Peripheral ADK
- MOTOTRBO™ Telemetry ADK
- MOTOTRBO™ Location Data ADK
- MOTOTRBO™ Text Messaging ADK
- MOTOTRBO™ Non-IP Capable Peripheral ADK

Please refer to the individual ADK sections for more information on the interface. Refer also to the Appendix: ADK Document Map for more information on document components for each ADK.

2.1 MOTOTRBO™Option Board ADK

The MOTOTRBO™ portable and mobile radios provide a physical and logical interface to accommodate an internal option board with an onboard processor and embedded logic. This option board interface is the means by which an option board, executing its own software application, interoperates with the main board firmware to create the custom end-user solution.

The option board interface of the MOTOTRBO™ product uses the Extended Command and Management Protocol (XCMP) to establish a communication mechanism between the option board device and the radio. Through this protocol, the option board can request notification of ergonomic events such as button presses or signals (i.e. carrier detect, PL detect, etc.) in order to take further action to process a customized feature. The option board can also request the radio to execute certain actions such as display text or route audio in order to present a specific ergonomic experience to the user. In addition, the

option board can activate or de-activate specific functionality, such as scan, the menu system, or an over-the-air data session, to execute the behavior of a new feature.

The option board interface uses a Synchronous Serial Interface (SSI) to transport the XCMP control and data messages within XCMP Network Layer (XNL) packets to and from the radio and its available services. The SSI is comprised of four logic lines: clock, sync, data in, and data out. The option board uses the SSI to transport logical and audio data to and from the radio. There are no dedicated analog audio lines on the option board interface. Whether the MOTOTRBO™ radio is operating in analog or digital mode, all audio is encoded into digital format and transported on the SSI bus.

The SSI bus is a multi-slotted Time Division Multiplexed (TDM) communication channel that is shared with other chips and devices contained within or attached to the Radio Host.

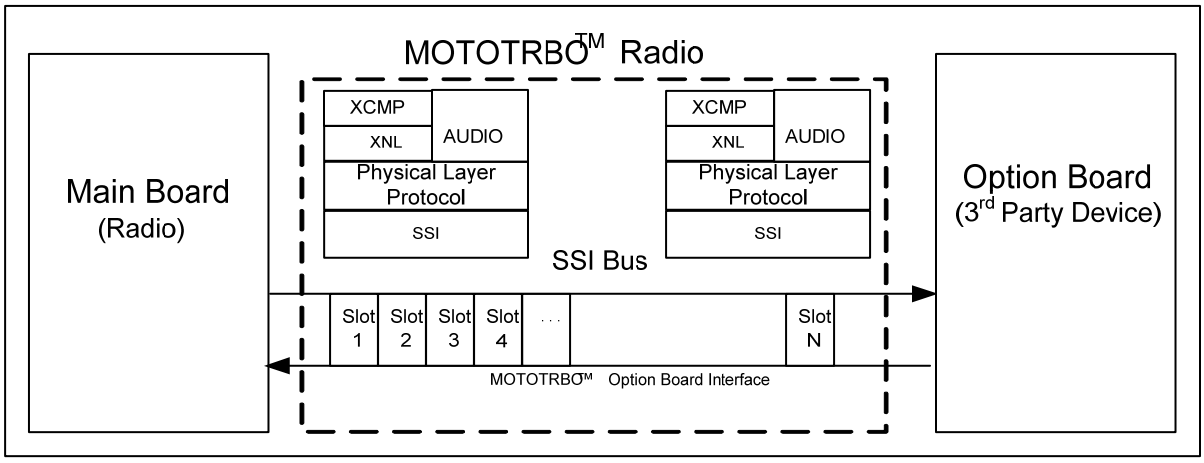

Figure 2 - MOTOTRBO™ Option Board Interface Architecture

Through the MOTOTRBO™ Option Board interface, custom applications can be created to achieve a desired user operation while the MOTOTRBO™ radio is operating in either analog or digital mode. The extended functionality provided by an option board can be a basic ergonomic feature, such as a “Man-Down” lone worker application, or an advanced signal processing feature, such as a custom signaling system format.

The MOTOTRBO™ Option Board interface also has the extended capability to communicate with other devices within the radio system. This includes Data Applications which are integrated into the Radio Network through a PC environment. These Data Applications communicate using User Datagram Protocol over Internet Protocol (UDP/IP) sent over the Common Air Interface (CAI) of the MOTOTRBO™ Radio. Interoperation with Data Applications is only available while MOTOTRBO™ is operating in digital mode.

For more information about the MOTOTRBO™ Option Board interface, please see the following references:

- MOTOTRBO™ Option Board ADK Guide
- MOTOTRBO™ Option Board PROIS Cross-reference
- MOTOTRBO™ XCMP / XNL Development Guide
- MOTOTRBO™ XCMP / XNL Development Specification

For more information about the other interfaces, please refer to the appropriate sections contained within this overview.

2.2 MOTOTRBO™XCMP-Based IP Capable Peripheral ADK

To expand the capability of the MOTOTRBO™ portable and mobile radios, an accessory connector is available as a means to provide external physical and logical interface. This interface allows the radio to function as a USB device attached to an IP capable peripheral.

The MOTOTRBO™ radio is able to send/receive XCMP/XNL message from an external IP capable device via a unique TCP port. The radio attached to the external IP capable device executes the XCMP commands from the external application and reports the status change.

Although it operates as a USB device when an external IP capable device connects through the radio accessory connector, the MOTOTRBO™ subscriber is still considered a master device within the XCMP/XNL architecture.

When communicating with the radio's XCMP/XNL interface, the external IP capable device becomes an XCMP device. Therefore it can even directly communicate with other XCMP devices connected to the radio, for example, the Option Board through XCMP/XNL message.

As an example, Figure 3 illustrates the interface architecture for the MOTOTRBO™ IP capable peripheral with an XCMP-based application.

For more information about the XCMP IP capable peripheral and also its operation with other applications offered by the MOTOTRBO™ radio, please see the following references:

- MOTOTRBO™ XCMP Development Guide
- MOTOTRBO™ XCMP Developer Specification
- MOTOTRBO™ ADK Data Services Overview
- MOTOTRBO™ Third Party Peripheral Cable ADK

For more information about the other interfaces, please refer to the appropriate sections contained within this overview.

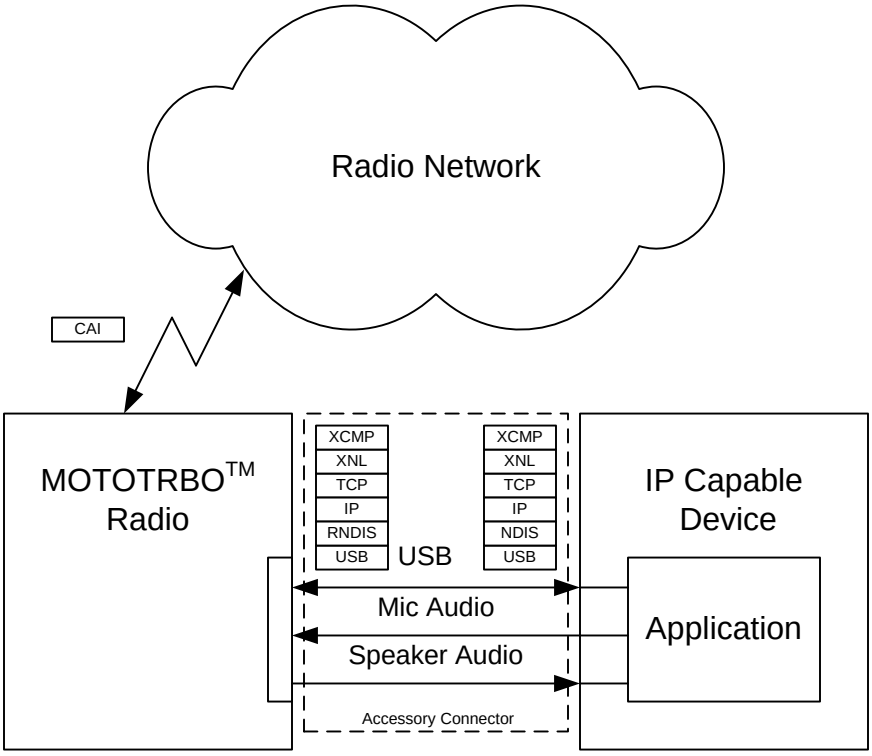

Figure 3: MOTOTRBO™ IP Capable Peripheral Application Interface Architecture

2.3 MOTOTRBO™ Non- IP Capable Peripheral ADK

The Non-IP Capable Peripheral is a self-powered device that attaches to the portable or mobile radio through its accessory connector. It does not use an IP stack to communicate with the radio. The peripheral acts as the USB-Host and uses XCMP commands to communicate with the MOTOTRBO™ radio. The MOTOTRBO™ radio acts as the USB device in the USB connection.

Below are some examples of possible non-IP Peripheral applications that could be developed by third parties:

- Bar code reader – e.g. inventory management to send bar code info
- RFID reader – e.g. to send customer specific data
- Printer – mobile printer connected to a radio
- VoIP Gateway –e.g. used as telephone interconnect solution
- Voice Recorder – e.g. to record and store of voice calls and caller information

Universal Serial Bus (USB, version 1.1) is used for the physical layer communication.

The CDC/ACM class driver is used as the USB device stack to communicate with the Non-IP Capable Peripheral USB system driver.

XCMP/XNL is used as the application communication protocol between the Non-IP Capable Peripheral and the MOTOTRBO™ radio. The Non-IP Capable Peripheral is considered a non-master device within the XCMP/XNL architecture. The XCMP/XNL protocol provides a set of commands for an external device to control and manage the MOTOTRBO™ radios.

The USB and XNL connections are independent of the analog/digital RF modes of operation. The Non-IP Capable peripheral does not need to re-establish the USB or XNL connections after mode change.

As an example, Figure 4 illustrates the interface architecture for the MOTOTRBO™ Non-IP capable peripheral.

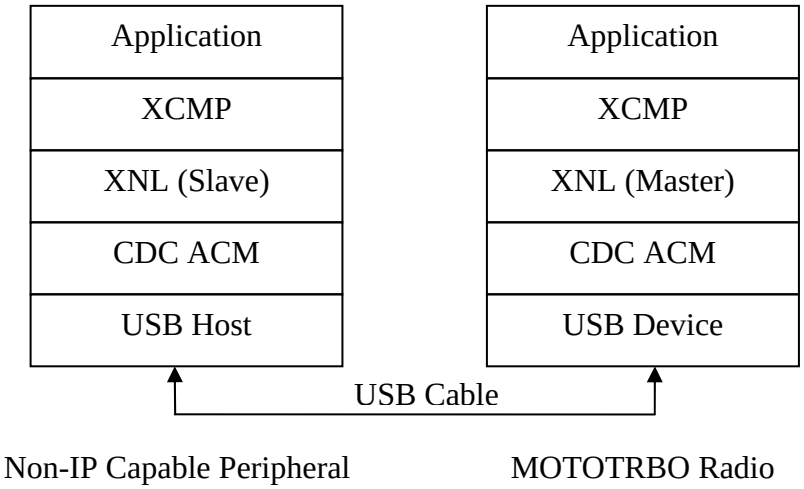

Figure 4: MOTOTRBO™ Non-IP Capable Peripheral Application Interface Architecture

For more information about the Non-IP capable peripheral and also its operation with other applications offered by the MOTOTRBO™ radio, please see the following references:

- MOTOTRBO™ XCMP Development Guide
- MOTOTRBO™ XCMP Developer Specification
- MOTOTRBO™ Third Party Peripheral Cable ADK
- MOTOTRBO™ ADK Data Services Overview

For more information about the other interfaces, please refer to the appropriate sections contained within this overview.

2.4 MOTOTRBO™ Telemetry ADK

The MOTOTRBO™ product can be customized for telemetry operation by developing a PC-based application using the MOTOTRBO™ Telemetry interface. A Telemetry Services PC application interoperates with a MOTOTRBO™ radio via direct USB connection and can monitor or control the general purpose inputs and outputs (GPIOs) of a radio. Telemetry operation is available while the MOTOTRBO™ product is operating in digital mode only.

Telemetry operation is available on 3 GPIOs for the MOTOTRBO™ portable and on 5 GPIOs for the MOTOTRBO™ mobile. The status of telemetry events can be queried for inputs or outputs. The state transition of telemetry inputs can also be announced and shown on a display-capable MOTOTRBO™ radio.

Routing of telemetry information in the radio network is accomplished using UDP/IP. The destination of the telemetry data can be either to a Telemetry Services PC application or to another device such as an option board. The Telemetry interface can also broadcast telemetry status over-the-air to specific MOTOTRBO™ subscribers within the radio network.

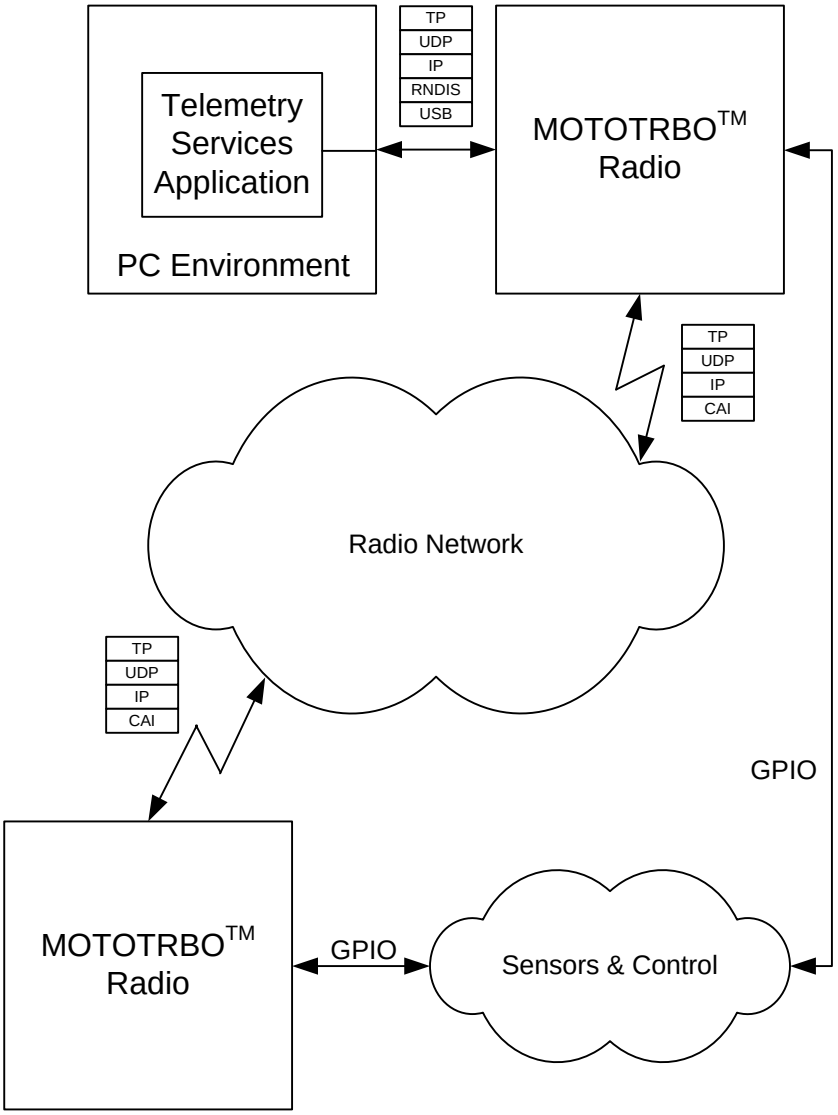

Figure 5 – MOTOTRBO™ Telemetry Interface Architecture

The Telemetry interface enables remote detection or activation of events through the MOTOTRBO™ system. An example of a telemetry-based solution is an irrigation system that is automatically activated based on average moisture level.

For more information about the MOTOTRBO™ Telemetry interface, please see the following references:

- MOTOTRBO™ Telemetry ADK Guide
- MOTOTRBO™ Telemetry Protocol Specification
- MOTOTRBO™ Data Services Overview

- MOTOTRBO™ Third Party Peripheral Cable ADK

For more information about the other interfaces, please refer to the appropriate sections contained within this overview.

2.5 MOTOTRBO™Location Data ADK

The MOTOTRBO™ product features optional embedded GPS capability for Location-Based Services (LBS) with the portable and mobile radio. The location function provides latitude, longitude, altitude, velocity, and heading data for the radio. A LBS PC application can also interoperate with the MOTOTRBO™ product to record a timestamp of reported location data for any specified radio. The Location Data interface is available while the MOTOTRBO™ product is operating in digital mode only.

Location status can be configured for periodic or on-request reporting during normal operation. During emergency operation, the MOTOTRBO™ radio can be configured for more frequent reporting of location data.

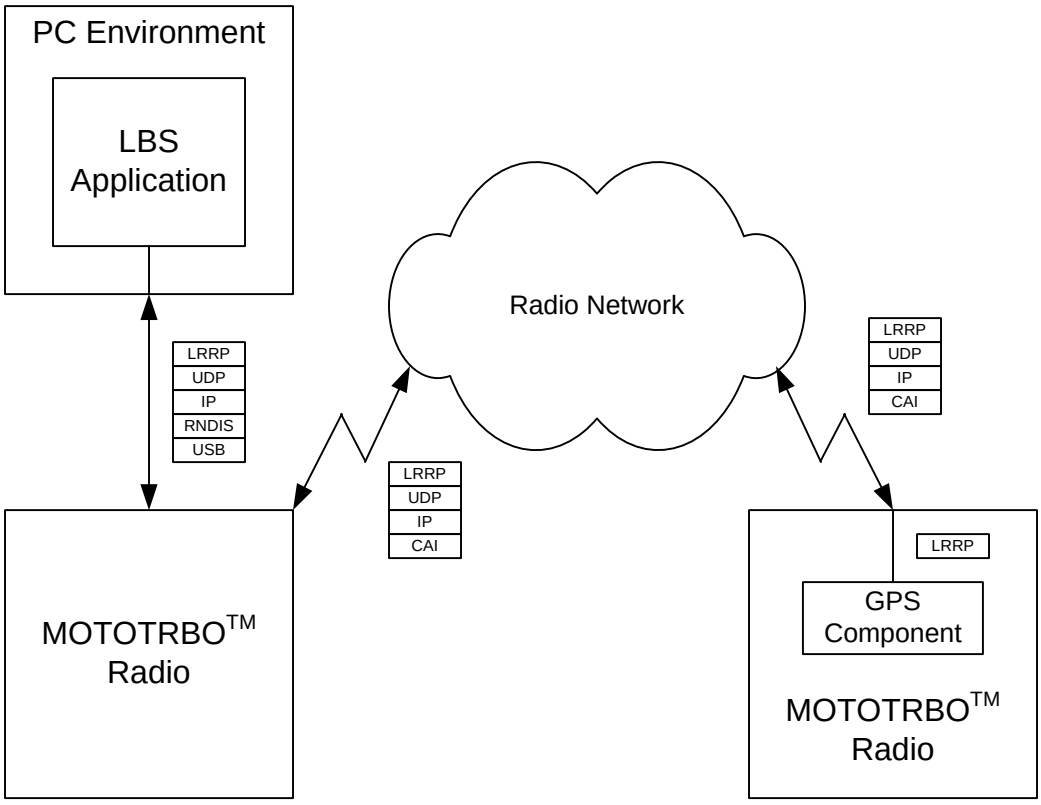

Figure 6 – MOTOTRBO™ Location Data Interface Architecture

Messages for requests and responses for location data are handled through the Location Request and Response Protocol (LRRP). LRRP is a location data reporting protocol that is optimized for use within the MOTOTRBO™ Radio Network. LRRP control and data messages are sent via the Radio Network within UDP/IP packets that are transported over the Common Air Interface (CAI). The LRRP messages are processed directly by the embedded GPS components inside the MOTOTRBO™ radio as well as within the LBS PC application. The Location Data interface can also interoperate with the MOTOTRBO™ Option Board interface to route location data directly to a custom option board device.

The Location Data interface facilitates asset tracking via location-based services. For example, a LBS application can provide an Automated Vehicle Location (AVL) capability to track the position of delivery trucks in the coverage area of the MOTOTRBO™ system.

For more information about the MOTOTRBO™ Location Data interface, please see the following references:

- MOTOTRBO™ Location Data ADK Guide
- MOTOTRBO™ Location Request and Response Protocol (LRRP) Specification
- Motorola Binary XML Encoding Specification
- MOTOTRBO™ Data Services Overview

For more information about the other interfaces, please refer to the appropriate sections contained within this overview.

2.6 MOTOTRBO™Text Messaging ADK

The MOTOTRBO™ product includes embedded text messaging capability for one-to-one or one-to-many device destinations. This capability can be extended to interoperate with a PC-based application to provide enhanced Text Messaging Services (TMS) using the Text Messaging interface of the MOTOTRBO™ radio. The TMS feature is available while the MOTOTRBO™ product is operating in digital mode only.

A text message containing up to 140 characters can be sent between a subscriber, talkgroup, subscriber with an attached PC (via USB), dispatcher client, or external network (i.e. the Internet). These messages can be pre-canned or composed along with a received message inbox for later viewing.

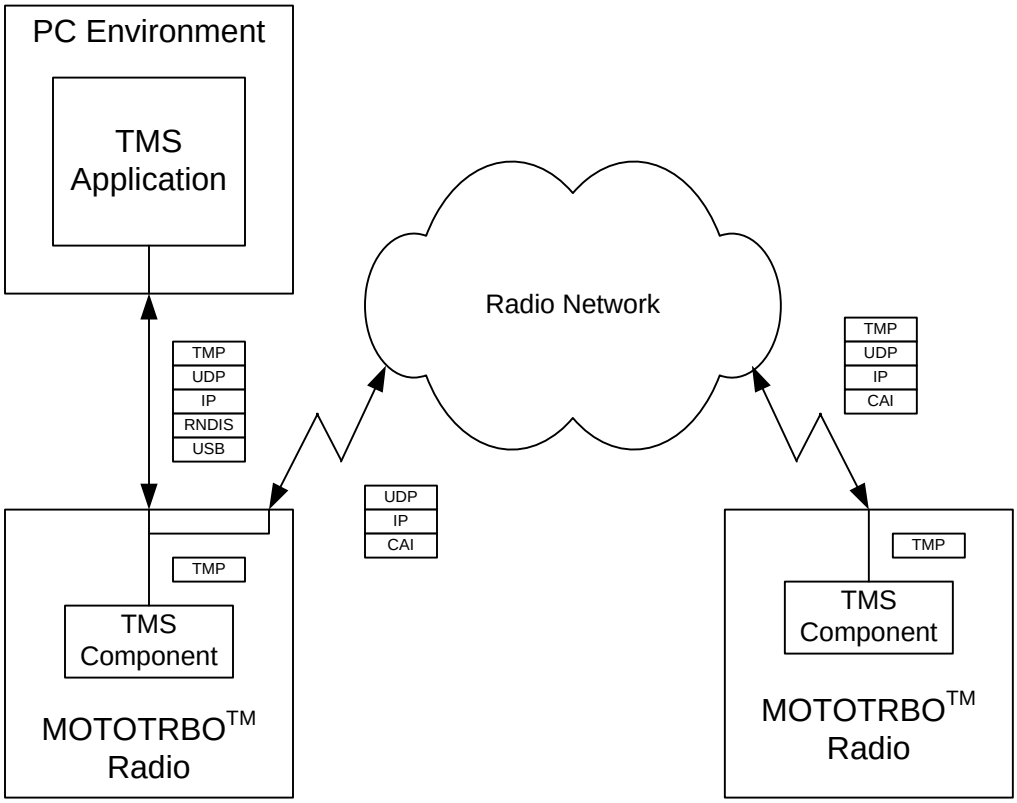

Figure 7 – MOTOTRBO™ Text Messaging Services Interface Architecture

Text messages are routed within the Radio Network as UDP/IP packets transported over the MOTOTRBO™ Common Air Interface (CAI). The destination of text messages is determined by the target IP address and port number. This enables the routing of text messages to two logically different devices that are physically connected together (e.g. PC attached to MOTOTRBO™ radio via USB). In addition, the Text Message interface interoperates with the MOTOTRBO™ Option Board interface to route text messages directly to the option board for processing.

The Text Messaging Services interface provides alternate methods for sending and receiving text messages within the MOTOTRBO™ system. A model implementation of this interface would be a PC-based dispatch messaging center. The messaging center contains a user interface for typing text messages to be sent to an individual radio or a group of radios as well as an output screen for displaying received messages.

For more information about the MOTOTRBO™ Text Messaging Services Interface, please see the following references:

- MOTOTRBO™ Text Messaging ADK Guide
- MOTOTRBO™ Text Messaging Protocol Specification
- MOTOTRBO™ Data Services Overview

For more information about the other interfaces, please refer to the appropriate sections contained within this overview.

2.7 MOTOTRBO™Automatic Registration Service (ARS) ADK

The MOTOTRBO™ subscriber has a number of data applications, such as Text Message, Telemetry and Location, which require the sending of data messages asynchronously to a Subscriber Unit (SU). The ARS provides a common registration service that accepts, stores and distributes subscriber presence information to interested data applications. The ARS can be used by all data applications and helps to reduce the complexity of handling message transmissions, as well as promotes the efficient use of air interface bandwidth.

The ARS consists of two components, which are the Registration Application in MOTOTRBO™ radio and the ARS Server in customer network. The ARS server is running on a device that is IP capable and is connected to what is called an ARS radio, via USB connection. The ARS Radio is responsible for routing the IP messages sent to and from the ARS Server. The transport layer between the MOTOTRBO™ radio and the ARS Server is UDP/IP.

The Figure 8 shows an example of the architecture diagram for a simple ARS configuration. Note, in this diagram, a MOTOTRBO™ radio acts as an ARS Radio.

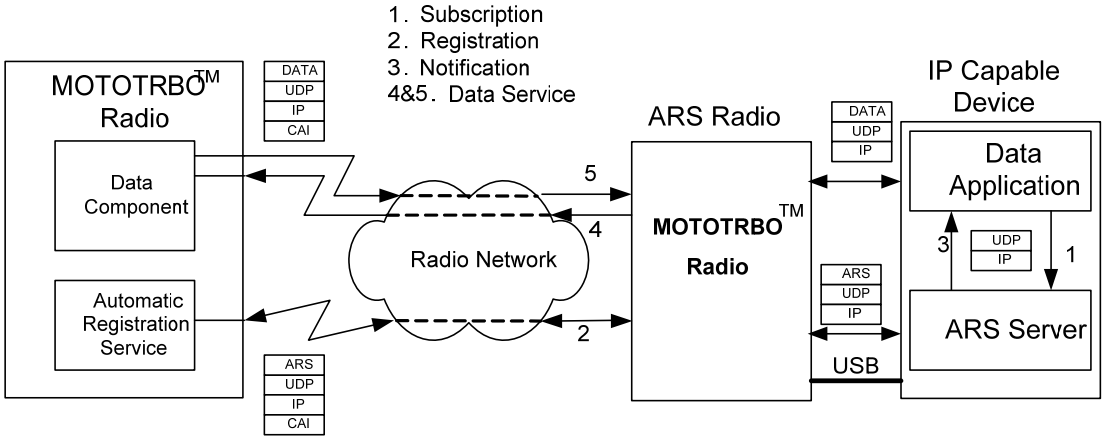

Figure 8: Example Architecture Diagram of ARS

For more information on the application of the ARS interface and its protocol, please see the following references:

- MOTOTRBO™ Automatic Registration Service (ARS) ADK Guide
- MOTOTRBO™ Text Messaging ADK Guide
- MOTOTRBO™ Location Data ADK Guide
- MOTOTRBO™ Telemetry ADK Guide
- MOTOTRBO™ Data Services Overview

For more information about the other interfaces, please refer to the appropriate sections contained within this overview.

2.8 Presence Notifier

The Presence Notifier is used to notify a PC-based backend application, such as for telemetry, LBS, or text messaging, that a MOTOTRBO™ radio has powered on or off and has registered or de-registered with the system. This application allows for efficient bandwidth utilization of the Radio Network – messaging only occurs between the backend application and those MOTOTRBO™ subscribers that are available and that the application is interested in. The Presence Notifier component is for use in digital mode only.

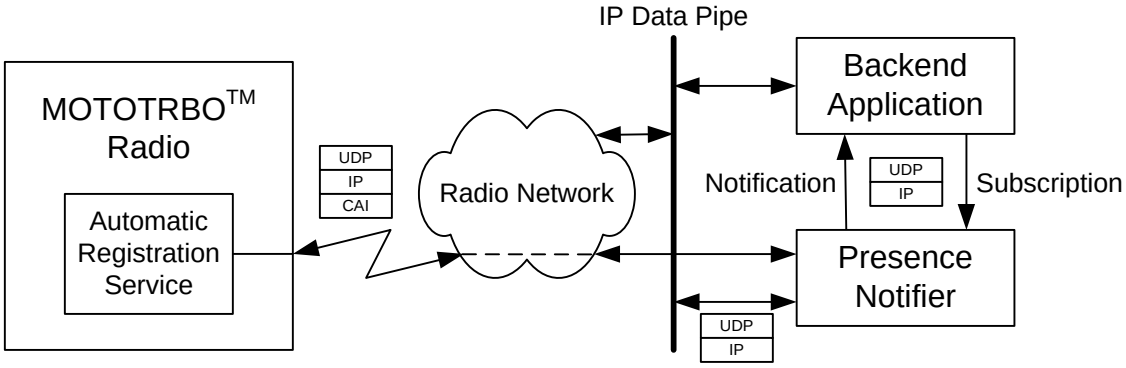

Figure 9 - Presence Services Architecture

The MOTOTRBO™ radio contains an Automatic Registration Service (ARS) that sends a registration message to the Presence Notifier within the Radio Network. When the MOTOTRBO™ radio is powered down, a de-registration message is sent. The registration and de-registration messages are sent as UDP/IP packets that are transported over the CAI. The Presence Notifier ultimately receives the UDP/IP packets and processes them for the registration state of each MOTOTRBO™ radio.

The Presence Notifier tracks the state of each MOTOTRBO™ radio on the Radio Network and reports each radio's state to each Backend Application. Each backend application must subscribe with the Presence Notifier in order to receive notifications of each MOTOTRBO™ radio of interest. Information between each Backend Application and the Presence Notifier is exchanged as UDP/IP packets.

For more information about the Presence Notifier, please see the following references:

- Presence Notifier Application User's Guide
- Presence Notifier-to-Watcher Interface Specification
- MOTOTRBO™ Data Services Overview

For more information about the other interfaces, please refer to the appropriate sections contained within this overview.

2.9 Data Services

Aside from the data application capability of the MOTOTRBO™ product for telemetry, location, and text messaging, the MOTOTRBO™ radios can also be used as a generic UDP/IP "pipe" for the transport of data between multiple IP-capable devices. These devices, such as laptop or desktop PCs, must be attached to subscriber units operating within the Radio Network. The Data Services capability is available while the MOTOTRBO™ product is operating in digital mode only.

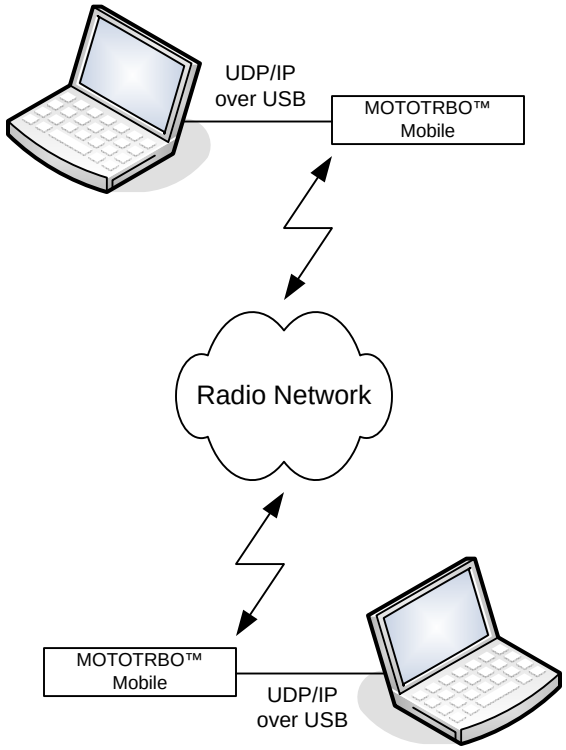

Figure 10 – Data Services Architecture

The attached PCs are mapped to an IP space that is separate from the MOTOTRBO™ radio IP address range. Therefore, data intended to the attached IP-capable device or the MOTOTRBO™ radio can be routed to the appropriate endpoint.

For more information about the Data Services capability, please see the following reference:

- MOTOTRBO™ Data Services Overview

For more information about the other interfaces, please refer to the appropriate sections contained in this overview.

Section 3

3.0 Professional Radio Application Developer Program

The Professional Radio Application Developer Program now includes MOTOTRBO™ and is comprised of three tiers of membership:

- Registered User
- Licensed Developer
- Application Partner / Application Provider

Each tier of membership brings greater accessibility to program information and development resources. Interested developers must be approved for Licensed Developer or Application Partner status in order to receive items such as:

- Application Development Kit (ADK) documentation
- Technical support, including developer forums and training
- Program affiliation media, including partner logo and application directory listing
- Motorola channel partner and customer information

Registered Users have access to general information and resources only.

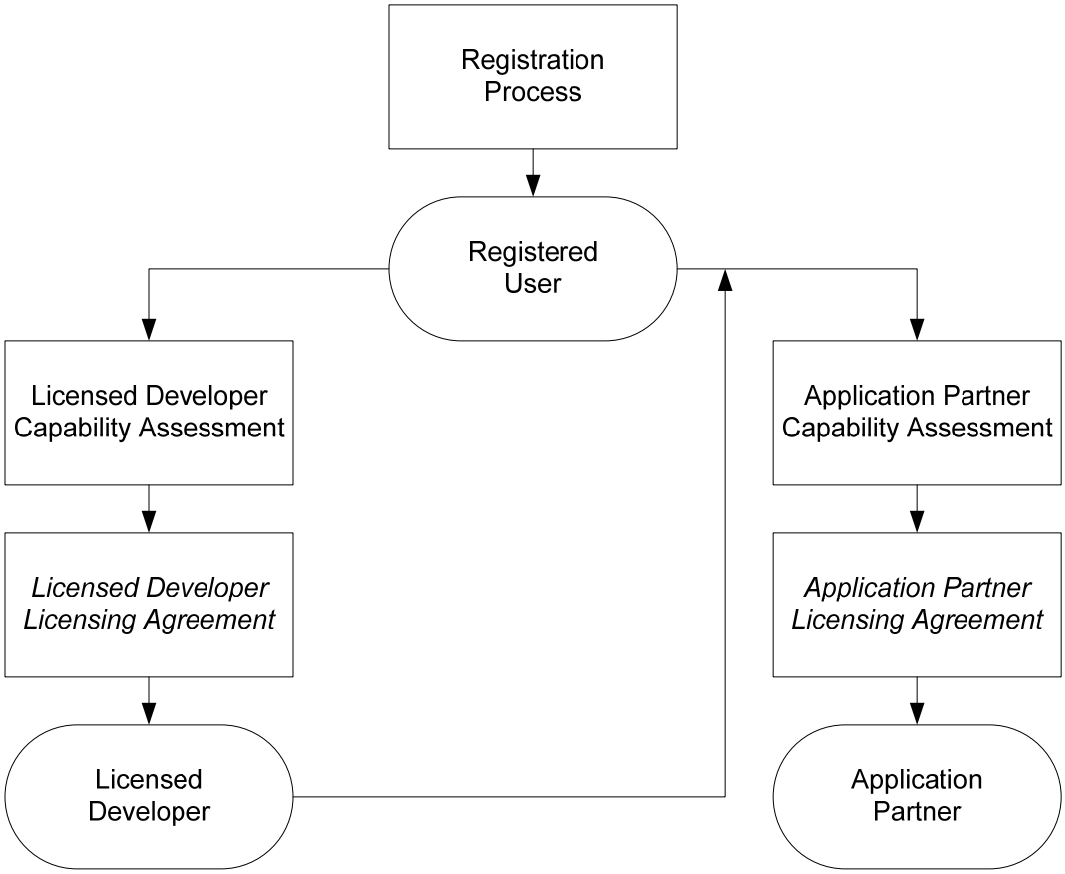

Figure 11 – Professional Radio Application Developer Program Membership Process Flow

The capability assessment is based on technical competency, commercial capability, and product portfolio. Characteristics that are considered include:

- Adequate commercial capability
- Expertise in two-way radio communications
- Expertise in hardware / software engineering development
- Adequate development and test environments
- Repeatable development and test processes
- Quality Assurance processes

Section 4

4.0 Service & Support for Application Development

The MOTOTRBO™ Application Development Kits (ADKs) are only one component of the service and support for 3rd party developers. The Professional Radio Application Developer Program for MOTOTRBO™ is staffed with full-time engineers whose primary responsibility is to support 3rd party application developers world-wide. Application developers have direct access to Motorola resources to assist in the development and certification of the 3rd party application.

This service and support includes, but is not limited to, the following items:

- Technical training on the use and capability of the developer interfaces on the MOTOTRBO™ radio
- Application notes and FAQs on relevant MOTOTRBO™ development topics
- Technical consultation service during the design and development phases of the 3rd party product
- Access to a MOTOTRBO™ system test environment with subscribers and infrastructure for 3rd party product verification (where supported by the local business region)

In order to ensure technical leadership and growth, the capabilities of the MOTOTRBO™ product and the developer interfaces will be continuously improved and enhanced for greater functionality and expansion. As a mechanism to support this process, Motorola will:

- Assist developers to define feature enhancements
- Document and submit change requests for prioritization
- Track and oversee defect repair of application interfaces

Through this process, the MOTOTRBO™ product will be ensured to have:

- Clear, concise, and accurate developer documentation
- Full compliance with published specifications and guides for each application interface
- Compatibility audit with older release versions of published specifications

Section 5

5.0 Further Information and Contact

For further information about MOTOTRBO™ and MOTODEV, please visit the following websites:

- Motorola MOTOTRBO™: http://www.motorola.com/mototrbo
- MOTODEV developer network – Professional Radio Application Developer Program: http://developer.motorola.com

As an alternative, please contact your region's business development manager for further information on how to develop applications for the MOTOTRBO™ platform.

- Asia Pacific Region (APAC)
  - APACAPP@motorola.com
- Europe, Middle East, and Africa (EMEA)
  - EMEAAPP@motorola.com
- Latin American Countries Region (LACR):
  - LACRADP@motorola.com
- North America (NA)
  - NAGADP@motorola.com

Section 6

6.0 Appendix: ADK Document Map

Document	MOTOTRBO™ Option Board	MOTOTRBO™ Telemetry	MOTOTRBO™ Location Data	MOTOTRBO™ Text Messaging	MOTOTRBO™ XCMP-Based Applications	MOTOTRBO™ Non- IP Applications
MOTOTRBO™ ADK Overview	X	X	X	X	X	X
MOTOTRBO™ ARS Protocol Specification		X	X	X		
MOTOTRBO™ XCMP-Based IP Capable Peripheral ADK Guide					X	
MOTOTRBO™ Option Board ADK Guide	X					
MOTOTRBO™ Option Board PROIS Cross-Reference	X					
MOTOTRBO™ XCMP / XNL Development Guide	X				X	X
MOTOTRBO™ XCMP / XNL Development Specification	X				X	X
MOTOTRBO™ Telemetry ADK Guide		X				
MOTOTRBO™ Telemetry Protocol Specification		X				
MOTOTRBO™ Location Data ADK Guide			X			
MOTOTRBO™ LRRP Specification			X			
Motorola Binary XML Encoding Specification			X			
MOTOTRBO™ Text Messaging ADK Guide				X		
MOTOTRBO™ Text Messaging Protocol Specification				X		
Presence Notifier Application User's Guide		X	X	X		
Presence Notifier-to-Watcher Interface Specification		X	X	X		
MOTOTRBO™ Data Services Overview	X	X	X	X	X	X
MOTOTRBO™ Third Party Peripheral Cable ADK		X			X	X
MOTOTRBO™ Non-IP Capable Peripheral ADK Guide						X

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