ATLAS®
P25 SYSTEMS

Modernizing the framework of LMR Systems

Technology That Makes Your System **Safe And Simple**

Making Safe, Simple™

There was a time, before IP networks and cloud computing, when land mobile radio (LMR) systems were complicated. They were deployed with special-use proprietary hardware and software. Their circuit-switched networks operated in a framework where functions were hierarchical. This created many points of failure and only provided a finite level redundancy. System managers had to worry about the end-of-life of their proprietary components, and were locked into support agreements with their existing vendor when upgrades became necessary.

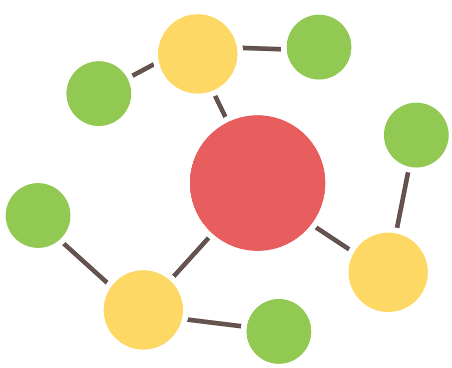
As the LMR industry migrated from circuit switched networks to IP networks, most manufacturers upgraded their legacy circuit-switched wiring to packet-switched networks. Unfortunately, the core problems remained: Multiple points of failure, finite-level redundancy, and dependence on proprietary equipment were not resolved by simply using an IP distributed transport network.

In today’s IT environment, this model doesn’t make sense. There’s no reason why you should be restricted to this old architecture when migrating to IP. EFJohnson’s ATLAS® network is the industry’s only P25 system designed entirely for an IT framework. Unlike competing P25 IP based networks, ATLAS is an IT system with an LMR overlay instead of an LMR system with an IP transport component.

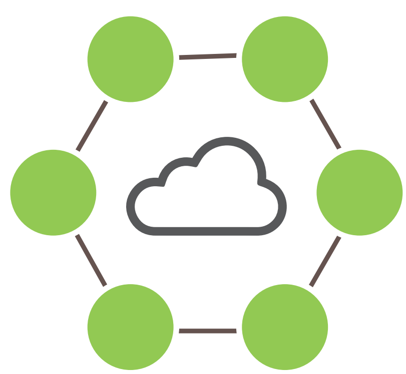
When other manufacturers talk about distributed architecture, they are referring specifically to the transport IP network that links each device. However, even in these "distributed" systems, the LMR application—which handles things like call routing and comparator functionality—operates hierarchically: All voice and data is routed to a centralized, single purpose server where it is then dispersed to other points in the system.

Breaking the LMR framework, EFJohnson engineers took IP standards and design principles and adapted them to accommodate the unique LMR Mission Critical Communications requirements so that even the LMR functionality is distributed to every node. This patented core technology is called Latitude™. Latitude enables ATLAS to be a fault tolerant, scalable, mission critical LMR application riding on commercial off-the-shelf (COTS) servers in a standard IP network.

Old Architecture



Latitude™



EFJohnson's Latitude technology is based on three principles:

1. ***Decoupling the radio side from the network side.***

The wireless technology is decoupled from the network technology. The entire system can evolve and integrate different wireless technologies, allowing new radio technologies such as DMR III, P25, and LTE to be enabled faster.

2. ***Decoupling the hardware from the software.***

The system controllers are software applications deployed on standard off-the-shelf hardware available from multiple vendors. System software is decoupled from the network hardware which:

- Prevents obsolescence
- Allows your IP system to evolve as the network hardware technology evolves

3. ***Distributing control throughout the network.***

EFJohnson's patented IP-based network architecture uses multicast technology to distribute network intelligence throughout the network. LMR functionality and control is distributed to each node providing fault-tolerance and scalability, while minimizing IP traffic loading.

- Virtualized software control points that run anywhere or everywhere in the network

Decoupling the Radio Side from the Network Side—IP Network Forms the Backbone of the System

EFJohnson's design approach allows you to operate and manage P25 LMR wide area network solutions in a way that decouples the LMR network's RF functionality from the network intelligence and call routing capabilities.

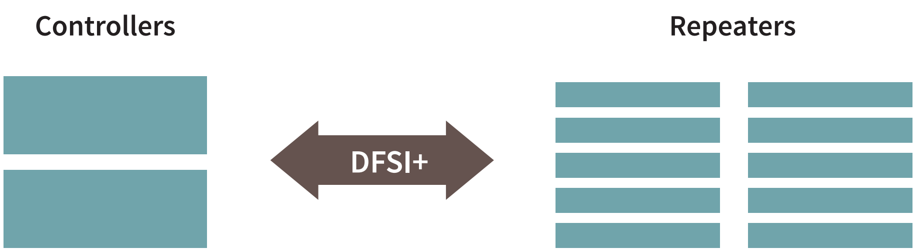
The APCO P25 standard envisioned this when it standardized the Digital Fixed Station Interface (DFSI) protocol where the:

- Transmitting, receiving, and encoding/decoding of communication is done at the repeater/base station logical entity, and
- The base station interfaces with the controller element, which manages the resource, network routing, and roaming intelligence

Transferring RF functionality to the radio and control intelligence into the network enables several technological enhancements:

- Control functions can be viewed, configured, and implemented as software
- Control functions can distributed anywhere
- Control functions are replicated at each node, providing inherent redundancy
- Control functions scale, expand, and accommodate new functionality with plug-and-play functionality

DFSI, as defined by P25, is inherently a non-distributed protocol. For a distributed control architecture, EFJohnson extended the DFSI protocol and licensed the extensions for open implementation of DFSI+. This approach is similar to Software-Defined Networking (SDN). Using SDN approaches, the control logic and the traffic logic are decoupled, allowing much greater flexibility and independence between these two elements of the system design.



Decoupling the Hardware from Software

Decoupling the logical functions of the network (implemented in software) from the hardware platform avoids reliance on proprietary hardware implementations. This creates a scalable deployment model that allows your network to evolve to take advantage of future enhancements in hardware memory, processor speed, and capacity.

With this approach, all application level switching and routing functions are "virtualized" and fully encapsulated in software. Thus, ATLAS virtual control points are not hardware devices that form crucial nodes in the system, subject to single points of failure. Instead, they are software services that can be hosted on any standard off-the-shelf hardware residing anywhere throughout the system.

Separating the application or service delivered from the underlying hardware enables system manufacturers to accelerate time-to-market for new services. It also allow system owners to use existing hardware efficiently and reduce the cost of their operations. The traditional approach of coupling software with specific hardware, has made hardware replacement and system upgrades extremely expensive. It has also stifled innovation, limited the introduction of new features, and made LMR technology enhancements cost-prohibitive. This perpetuates the status quo of static legacy-based system deployments.

EFJohnson is able to achieve this decoupling by leveraging and combining the benefits of several technology trends into a unique architecture and implementation approach:

- Using open source operating systems, primarily centered around Linux and Linux-based OS distributions, without proprietary hardware platform requirements
- Eliminating deep hardware dependencies such as custom silicon processors, specialized memory, and bus architectures
- Creating a platform service layer that abstracts the application from the underlying operating system and the hardware platform
- Establishing a modular application development environment that can host new services and applications as discrete software packages on readily available hardware platforms

Distributing Control Throughout the Network

In a traditional LMR system, each site is deployed with a site controller. Additionally, there is a central controller (core) that is used to connect these site controllers together to form a wide area communications network. When a call is received from a particular site:

1. The call request goes to the central controller.
2. The central controller keeps track of user registration within the system and sets up multiple instances of point-to-point (unicast) calls to each remote site controller that has expressed interest in a talkgroup.
3. Once the call is set up, the originating site sends the voice signal to the central controller. Then, the central controller forwards the voice signal to all interested sites.

Traditional LMR architecture does not provide any inherent fault tolerance or redundancy. To provide geographic redundancy, traditional LMR manufacturers typically sell two or three expensive, redundant cores.

In contrast, EFJohnson's patented approach uses an IP-based multicast[1] technology. This approach ensures that when a call is received at a site, the corresponding site controller has all of the logic and permissions to route the call. When sending out the voice packets, the originating site uses a multicast address (corresponding to the talkgroup rather than sending them out to each site). The interested sites join the corresponding multicast addresses and automatically receive the voice packets from the originating site controller. When the call ends, the site controller relinquishes the call control. Any subsequent call is handled by the site controller where the next call is originated.

[1]*Not to be confused with the LMR terminology of 'multicast,' in this context 'multicast' refers to the IT terminology - very efficient usage of network bandwidth.*

Network efficiencies of EFJohnson's multicast vs traditional LMR unicast IP distribution are realized because the number of concurrent multicast voice streams is roughly equal to the number of sites on a system. For example, for each channel in an EFJohnson eight-site system, only one multicast audio stream will be sent across the LMR network. Traditional LMR unicast systems may have eight times as many voice streams when accounting for site-to-core, core-to-site, and core-to-dispatch audio streams

EFJohnson's Latitude Technology

EFJohnson's patented Latitude distributed technology makes the ATLAS P25 application and transport network unique. This enables ATLAS systems to offer increased flexibility as compared with traditional LMR systems in various aspects of its operations:

Auto-Discovery & Self-Healing Sites

Any new site is automatically configured on the system once it is connected to the network. There is no need to manually reconfigure the existing sites. Each site on the system periodically broadcasts messages to the other sites, indicating its availability to participate in calls. When a new site gets deployed in the system, it immediately begins exchanging messages with the other sites. All sites in the system are aware of all the other sites in the system. Each site also knows which talkgroups every other site is interested in receiving.The inter-site communication leverages the power of IP multicast to provide one-to-many and many-to-many communication using a standard IP gateway router. Any site on the ATLAS-enabled IP network that is capable of listening or sending voice packets can participate in the talkgroup. Network packets are simultaneously received and processed by all participating sites.

Distributed Call Control

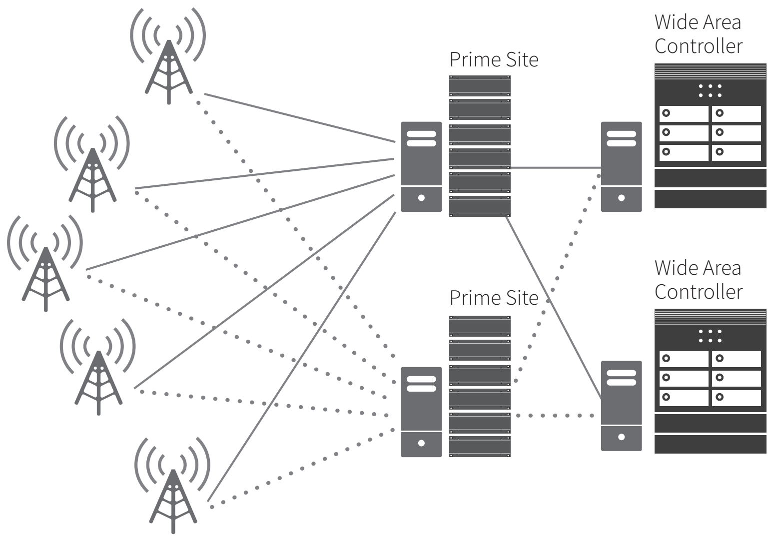
The site initiating a call is responsible for call setup. Once the call is established, the initiating site encodes voice messages with a standard audio CODEC and uses standard IP multicasting to send real-time transport protocol (RTP) voice packets across the network to the other sites. Thus,

- No central controller is necessary to initiate a call
- A failure at one site does not affect the operation and performance of the remaining sites

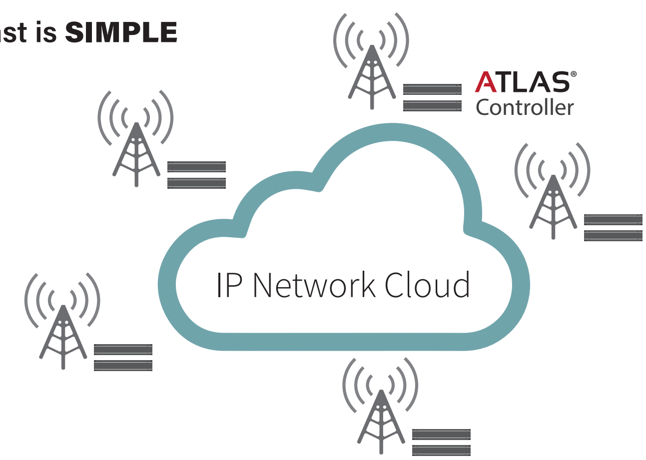
Simulcast Control

A prime example of making safe simple, EFJohnson's ATLAS simulcast solution has consolidated the traditional hardware elements of comparator, prime site controller, and wide area controller functionality into a software application. The ATLAS simulcast solution replicates this functionality at each site. Where traditional LMR systems may deploy a second instance of comparators and controllers, ATLAS provides redundancy equivalent to the number of sites times two, plus a hot standby controller installed at each site. Critical timing requirements for simulcast call launch are achieved using GPS-acquired time, which has unparalleled accuracy (on the order of nanoseconds).

Traditional Simulcast is **COMPLEX**



ATLAS Simulcast is **SIMPLE**



ATLAS®

Patents Associated with ATLAS Latitude™ Technology:

US Patent 8,483,114 – Method and System for Peer-to-Peer Communication Among Sites
US Patent 8,774,093 – System & Method for Providing Mobility Management & Out-of-Coverage Indication in a Conventional Land Mobile Radio System
US Patent 8,699,369 – Hybrid Land Mobile Radio System Incorporating Mobility Management and Out-of-Coverage Indication
US Patent 8,614,998 – Method and System for Integration of Trunking and Conventional Land Mobile Radio Systems
US Patent 8,712,368 – System and Method for Providing Radio Communication in a Land Mobile Radio System
US Patent App. 14/217,150 – Distributed Simulcast Architecture (pending)

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