ROHILL

System Manual

Part 2: TetraNode Architecture

TetraNode

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1. TetraNode Architecture

1.1 Design Philosophy

TetraNode has been developed as a solution for mission critical applications where clear and reliable voice and data communications are necessary because human lives, property, or corporate survival are at stake. It brings together several well-known networking concepts and technologies in order to produce a revolutionary approach to mission-critical communications based on the TETRA standard.

Recent developments in the information technology and mobile communications industries are converging to open standards. In this new environment, driven by increased computing power, a growing mobile workforce and the widespread presence of the internet, software applications are taking the place of hardware configurations, allowing similar services to be applied across a variety of platforms.

In developing TetraNode, Rohill's philosophy has been to adopt an architecture based on concepts which have been totally tested and proven in real networks and to produce solutions based on standardised components, open operating systems and open interfaces. These offer new approaches to network design and architecture to give the flexibility, scalability and security necessary to meet the current and future needs of military and public safety clients. Importantly the cost of network ownership is minimised without compromising the performance and reliability of the solution.

Key criteria for the development of the TetraNode solution are:

- Soft-switch technology
- Open system architecture
- Scalability
- Low cost of ownership
- Migration and interworking support
- Redundancy options
- Security
- Interoperability

1.1.1 Soft-switch technology

TetraNode applies soft-switch technology, which means that the switching of voice and data streams is performed in software. In a softswitch TETRA system

all functionality is implemented in software. This eliminates the need for expensive dedicated hardware and makes the system easy to install, configure and maintain as well as running faster than a hardware solution. Well-defined software architecture allows specific customer requirements to be catered for swiftly and efficiently when required.

The powerful, innovative software-based softswitch solution guarantees that TetraNode is able to provide the fullest range of digital mobile radio functionality.

1.1.2 Open System Architecture

TetraNode adheres strictly to the open standards philosophy. This philosophy asserts that open hardware and software components and standard interfaces make communications solutions easier to operate and maintain. At the same time open standards provide ample opportunities for future growth and allow new features to be incorporated without major modifications being required.

Continuous development of the standards is ensured through a number of initiatives and standardisation bodies to improve connectivity, functionality and reduce development and operational costs even further.

TetraNode has been designed to make the most of open, widely available, multiple source hardware and software. This leads to considerable cost savings, reduced vendor or component dependency and guarantees state of the art technology.

1.1.2.1 Open Hardware

TetraNode generally utilises Commercial off the Shelf components or modules and by doing so a number of key benefits are achieved:

- Hardware is available from multiple vendors, reducing vendor dependency and customer lock-in.
- Through economies of scale, costs are reduced.
- The risk of component obsolescence is addressed.
- Support is readily available by way of documentation, suitable operating systems, drivers, and evaluation kits.

1.1.2.2 Standard Software Protocols

TetraNode employs standard networking protocols to create a powerful, flexible environment for a wide range of applications. These include, amongst others:

- Internet Protocol (IPv4, IPv6)
- Extended Mark-Up Language

- Hyper Text Transport Protocol
- Simple Network Management Protocol
- File Transfer Protocol
- Point to Point Tunnelling Protocol
- Secure Socket Layer and Secure Shell
- Microsoft's Server Message Block

Open standards allow the customer to adapt existing solutions and add third-party applications without depending on the infrastructure supplier or incurring massive financial penalties. They also provide a risk-free environment for the continued development of even more powerful solutions in the future as standards evolve, new standards conceived and more applications become available.

1.1.3 Scalability

The TetraNode system has a flat, modular network architecture which is easily expandable from a single-site to nation-wide solution. A few standard building blocks are repeated to create larger sized networks without the need to discard expensive components.

A TetraNode network comprises a minimum of one TetraNode eXchange, and one Base Station System. Larger networks are created just by adding additional Base Station Systems and gateways to external Data and Telephone Systems. Base Station Systems can be expanded up to 16 TETRA carriers.

Multiple TetraNode eXchanges or networks can be interconnected in any combinations of mesh, star & ring topologies for optimum scalability, flexibility and redundancy.

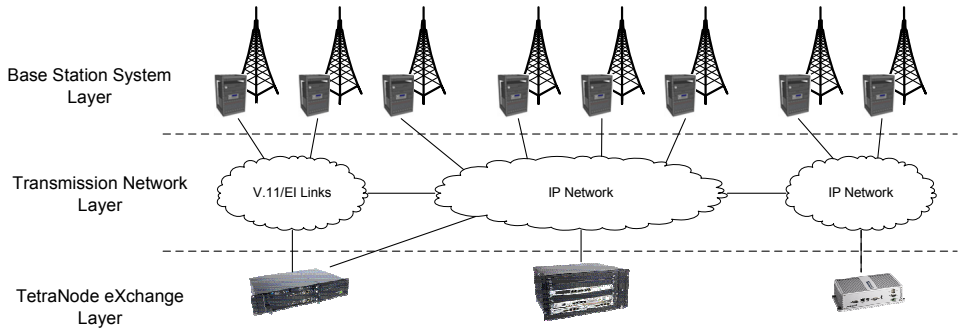


Figure 1 - Networking Networks for Scalability

1.1.4 Low cost of ownership

TetraNode has been designed to minimise the total cost of the system, which includes investment in equipment, installation and maintenance, radio spectrum

requirements and leased lines. There are three main areas where TetraNode offers specific cost savings:

- Minimise hardware costs

  Hardware costs are minimized by the use of soft-switch technology and the widespread adoption of commercial, off-the-shelf equipment that has been assessed and confirmed as compatible with TetraNode by Rohill.

- Low installation and maintenance costs

  Installation and maintenance costs are minimized as the system is easy and intuitive to install and configure – i.e. plug and play. Network components "hot-swap modules" can be replaced without losing valuable time while the network is unavailable. This ensures a rapid rollout of the network as well as minimum effort required for maintenance and upgrade tasks.

- Low operational costs

  Since TetraNode is IP-centric and based on open standards the IP backbone can be shared with other applications, such as voice, video and data. There is no need for a dedicated separate IP-network or landline based transmission network to interconnect the Base Station Sites to the switch site. Apart from avoiding unnecessary investment and efficiency losses, the use of a common backbone results in fewer staff and less training effort being required to operate and maintain the transport network.

- Various migration and integration options

  Migration costs from existing non-proprietary, open standard analogue systems are reduced through TetraNode's multi protocol capability providing interoperability with the legacy networks and allowing continued use of existing assets.

- Low Power Consumption

  The low power consumption of soft switch based infrastructure components and the high power efficiency offered by the third generation base station transceiver hardware, enables significant savings on electricity costs. These savings are typically doubled whilst less air-conditioning capacity is required

1.1.5 Migration and Interworking Options

When implementing new advanced solutions such as TETRA, a migration path is required to enable continuous business operation. Permanent or temporary

interworking functions have to be provided with existing infrastructures and applications to preserve the support of the operational processes.

For this reason TetraNode allows multiple protocols to be implemented in one seamless network (MPT1327 and TETRA), supports a wide range of telephony interfaces ranging from single line solutions to trunk line solutions, allows analogue radio channels to be integrated into the network and offers an open-standard based IP interface for interconnection with existing applications.

With multiple protocol support existing MPT networks can be upgraded or expanded with TETRA facilities. Analogue base station transceivers from different manufacturers can be interconnected to TetraNode by use of the Base Station Interface, with only the network elements needing to be replaced by a TetraNode system. Even the existing MPT terminals can still be used. Due to the overall integral multiprotocol support interoperability between MPT and TETRA terminals is guaranteed and continuous co-operation of people using different type of radios secured. Rather than rely upon routing through a PSTN, PABX or using analogue back-to-back interfacing solutions, the integrated TetraNode solution permits seamless operation of features such as Caller ID, Short Data Messages and Group Calls. Furthermore costs and complexity are reduced because of the integrated network management capabilities and the possibility to share dispatch and gateway resources between both types of radio terminals.

1.1.6 Redundancy

Mission critical communication networks which handle emergency situations demand network availability at all times. TetraNode has the capability to offer five nines (99.999%) availability and no single point of failure.

Key to the redundancy concept is the use of distributed databases, which speed up operation and reduce dependency on a single, centralized database. System components can be duplicated with a minimum of extra hardware and software support. Redundancy is provided on all system levels but customers can reduce the cost by only selecting those features which they feel are most important.

A number of measures are available in the event of a link failure that would switch to an alternative route around the network or to a dedicated or dial-up line. When all links fail, autonomous, independent operation remains possible as the Base Station Site may continue to operate in fallback or isolated mode to offer local trunking.

1.1.7 Security

Mission critical communications networks demand permanent availability for authorised users and prevent system access for unauthorised ones.

To facilitate this demand the TetraNode system offers the possibility to use standardized TETRA security features such as authentication, encryption and remote enabling and disabling of terminal units. Air interface encryption is available using static key or dynamic key encryption.

An open platform is provided to achieve end-to-end encryption solutions designed and controlled by the owner.

For network management and dispatch, standard IP encryption methods may be applied to protect fixed links, such as PPTP, SSL and IPSec.

1.1.8 Interoperability

TETRA-based communications systems are intended to meet customer expectations for interoperability as an industry standard, supported by multiple vendors. The TetraNode design ensures interoperability for any mix of terminals complying with the TETRA standard.

1.2 Introduction to TetraNode

TetraNode is a software-intensive network solution, which requires the minimum amount of hardware. Whenever possible, it is based on commercial, off-the-shelf hardware and software components. Internal and external system components are connected together via open interfaces based on industry standards in a modular, highly scalable and flexible architecture approach.

The TetraNode system consists of the following primary system blocks:

- TetraNode eXchange

  The TetraNode eXchange performs the switching of voice and data traffic and provides the signalling between subscribers in the system.

- TETRA Base Station System

  The Base Station System provides radio coverage in a defined geographic area also referred to as a cell. It provides the TETRA air-interface to the mobile station of the radio user.

- TetraNode Expansion Platform

  The TetraNode Expansion Platform rack allows a variety of interface cards to be fitted for interconnection to telephony or leased line infrastructures.

- Network Management System

  The Network Management System allows the network manager to access the Switching and Management infrastructure and the Base Station Systems for configuration and monitoring purposes.

- Line Dispatch System

  The Line Dispatch System provides the dispatcher access to advanced system features, which enable the dispatcher to efficiently communicate with radio users and management the mobile fleet.

- Gateways to External Networks

  The gateway or system interfaces to external networks allow the TetraNode network to be connected to other systems, equipment or applications.

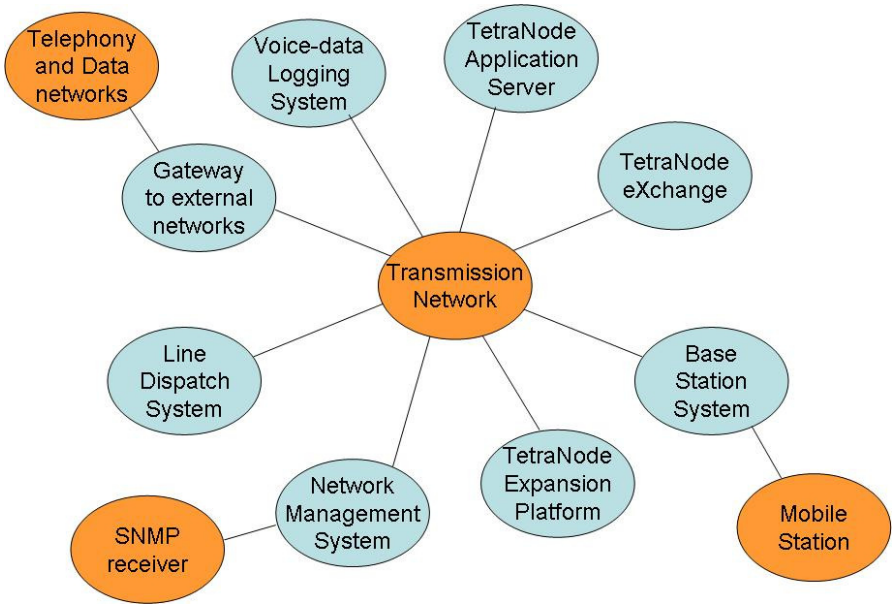
- Voice-data Logging System

  The Voice-data Logging System captures and retrieves voice and data communications within a TetraNode network.

- TetraNode Application Server

  The TetraNode Application Server provides a common server platform and services framework to run TetraNode server applications.

The system blocks can be located on geographically separated locations. Interconnection of the system blocks is then achieved through a transmission network using IP links and/or point-to-point leased or local lines. This part is referred to as ‘Transmission Network’. From a TetraNode system point of view the transmission network is a supporting subsystem to provide the service to the end-user, just as the mobile station is a supporting subsystem, required to provide the end-to-end communication functionality to the user. This is illustrated in Figure 2.



Blue: TetraNode System Block

Orange: Supporting Subsystem

Figure 2 - TetraNode Systems and Subsystems

The basic functionality for each subsystem is further detailed in Part 3, TetraNode Sub-Systems.