

Architecture of TETRA

The TETRA network structure comprises of multiple system components and interfaces. Its primary focus is on Switching and Management infrastructure (SwMI) within the TETRA system. It does not standardize the internal interface of TETRA networks and it is upon the manufacturers to customize it. This gives the manufacturers the freedom to customize the internal network interface to optimize the internal network according to their needs.

The SwMI system components are linked through six specified interfaces, essential for ensuring compatibility, interconnection, and network management among the various system elements and networks. It consists of six major components like -

- Individual TETRA network -

This is a standalone TETRA network system, consisting of a local switching center, mobile switching center (MSC), base transceiver station (BTS), gateways, switches, operations and management center (OMC) and the associated control and management facilities.

- Mobile station (MS)

The Mobile Station (MS) can be broken down into the mobile termination unit (MTU) and the related terminal equipment (TE). TETRA mobile devices can be classified based on their portability into two categories, hand-portable (or simply portable) and vehicle-mounted mobile (or simply mobile). Mobile stations are categorized into 4 classes based on attributes like power class and their capability. Regardless of their rated transmit power, they need to be capable of modifying their transmission power in accordance with the network's power control directives. The 4 classes are as follows -

- Vehicle mounted mobiles - Class 1: 30 watts, Class 2: 10 watts
- Hand-portable mobiles - Class 3 watts, Class 4: 1 watt

There are three receiver classes based on their operating environments:

- Class A is designed for effective performance in urban settings and regions featuring hilly or mountainous terrain.
- Class B is tailored for optimal operation in urban and densely populated areas.
- Class E is intended to fulfill the stricter demands of quasi-synchronous systems.

- Line station (LS)

The line station (LS) consists of the line termination unit (LTU) and the related terminal equipment (TE). This configuration is commonly found in a control room console in a control room console terminal or dispatcher unit that connects to a TETRA SwMI via an ISDN network. The main difference between mobile station (MS) and a line station (LS) is the transmission medium where the mobile termination unit (MTU) handles it for MS and line termination unit handles it for LS.

- Direct Mode Mobile Station (DM-MS)

This includes mobile devices that establish direct communication with one another without relying on the infrastructure, operating in a trunked mode. A mobile device configured for Direct Mode Operation (DMO) facilitates point-to-point or point-to-multipoint communication by utilizing the Direct Mode (DM) air interface. The TETRA standard outlines several options for expanding the fundamental mode of operation:

- Direct Mode Repeater MS: This extends the communication range beyond two DMO mobile devices.
- Dual Mode Switchable MS: This supports both TETRA DMO and trunked TETRA V+D (Voice + Data), enabling dual-watch mode.
- Direct Mode Gateway: This serves as a link between TETRA DMO and TETRA V+D modes.

The above options are utilized for different operating possibilities. These models are-

- Direct Mode Mobile Station (DM-MS) - This enables two mobile devices to communicate directly using the DM air interface. This communication occurs in a "walkie-talkie" style, with the initiating DM-MS providing air interface synchronization and taking on the role of the master DM-MS.
- Dual Watch Mobile Station (DW-MS) - This is an extension of the DM-MS, capable of operating in both DMO and trunked V+D modes. A DW-MS can communicate with DM-MS or TETRA SwMI while simultaneously monitoring V+D or DM channels. During idle periods, a DW-MS can monitor both V+D and DM channels.

- Direct Mode Repeater (DM-REP) - It receives information from one DMO mobile station and retransmits it to another DMO mobile station.
- Direct Mode Gateway - This model serves as the connection between TETRA DMO and TETRA V+D modes. A DM-GATE bridges the protocol differences between DM and trunked V+D air interfaces.
- Direct Mode Repeater/Gateway - This model is a combination of repeater and gateway functionality. It can be achieved with a vehicle-based DM repeater and additional gateway capabilities for establishing a link to a TETRA V+D network.

- Gateway

This facilitates the calls between TETRA network and networks outside of TETRA system, like a public switched telephone network (PSTN). There is a need for a gateway because the external networks connected to the TETRA network employ information formats and communication protocols that are incompatible, necessitating some form of translation or conversion.

- Network management unit

This unit offers local and remote network management capabilities, which are common in TETRA systems. They typically cover system management tasks related to fault monitoring, configuration, accounting, performance assessment, and planning. The TETRA network management specifications primarily focus on establishing a standard management interface and outlining general requirements for ensuring interoperability between various systems. The actual implementation of these management functions is the responsibility of network operators and equipment manufacturers.

TETRA utilizes a method of partitioning radio spectrum into multiple channels that are then shared among multiple users. This is called trunking and it allows people to talk to each other on the same radio without getting in each other's way. The channels used in TETRA range from voice channels to data channels and control channels, with voice channels providing voice communication and data channels providing data communication, while control channels are used to control and manage the system. The TETRA protocol offers a variety of additional features and services, including Group Calling, Emergency Calling, and Location-Based Services. Group Calling enables multiple users to communicate simultaneously, while Emergency Calling enables users to call a central control room in an emergency. Location-based Services enable users to locate their location through GPS or other location technologies. All in all, TETRA Protocol is intended to provide secure and dependable communication services to professional users who require top-notch communication services.