

Monitoring Stations

Spectrum Management Training Program

Elective Module EM1-Option 1 : Spectrum Monitoring

Outline

- Fixed Monitoring Stations
- Mobile Monitoring Stations
- Portable Monitoring Stations
- Remote Control and Automation
- Example of Network Architecture
- Siting of Fixed Monitoring Stations
- Maintenance, Calibration and Repair

Fixed Monitoring Stations

- The central element of any monitoring system.
- Carry out all measurements without any limitations. (Working place – place for antenna setup – power supply -)
- Equipment could cover all frequency ranges (HF – VHF – UHF)
- HF long-distance international transmissions with large arrays
- Automatic monitoring and remote control facility.

Fixed Monitoring Stations

- Monitoring and Recording capability around the clock.
 - Can't be established in sufficient numbers (Cost , Location)
 - Not suitable for microwave detection (Narrow beam transmitting antenna).
 - At least two stations are required to determine the location of the transmitter and may be one station in HF only (SSL station).
 - Must be supported by mobile stations for accurate location determination and homing functions.

Fixed Monitoring Stations



Fixed Monitoring Stations



Mobile Monitoring Stations

- Carry out all functions of fixed monitoring stations.
- Carry out all those monitoring operations where the low power of the transmitters, the high directivity of the antennas and the particular propagation characteristics make it impossible for measurements to be made by fixed stations.
- The design varies considerably according to their purpose, scope and operating conditions.
- The limitation on the antennas concerns the size and the number.

Mobile Monitoring Stations

- Mainly covers the frequency range 20 MHz – 6 GHz and may be extended up to 40 GHz.
- Equipped with GPS and digital compass for bearing and location determination.
- One mobile equipment is sufficient for location determination.
- Limited coverage with respect to fixed monitoring stations.

Mobile Monitoring Stations

- Suitable for microwave detection (high gain transmitting antenna)
- Each 2 – 3 fixed monitoring stations should be supported by one mobile monitoring station for location determination.
- Suitable vehicle and power supply are necessary for mobile equipment.
- Carry additional portable equipment to complete the monitoring cycle.
- Ideal tools for DF, location and homing functions.

Mobile Monitoring Stations



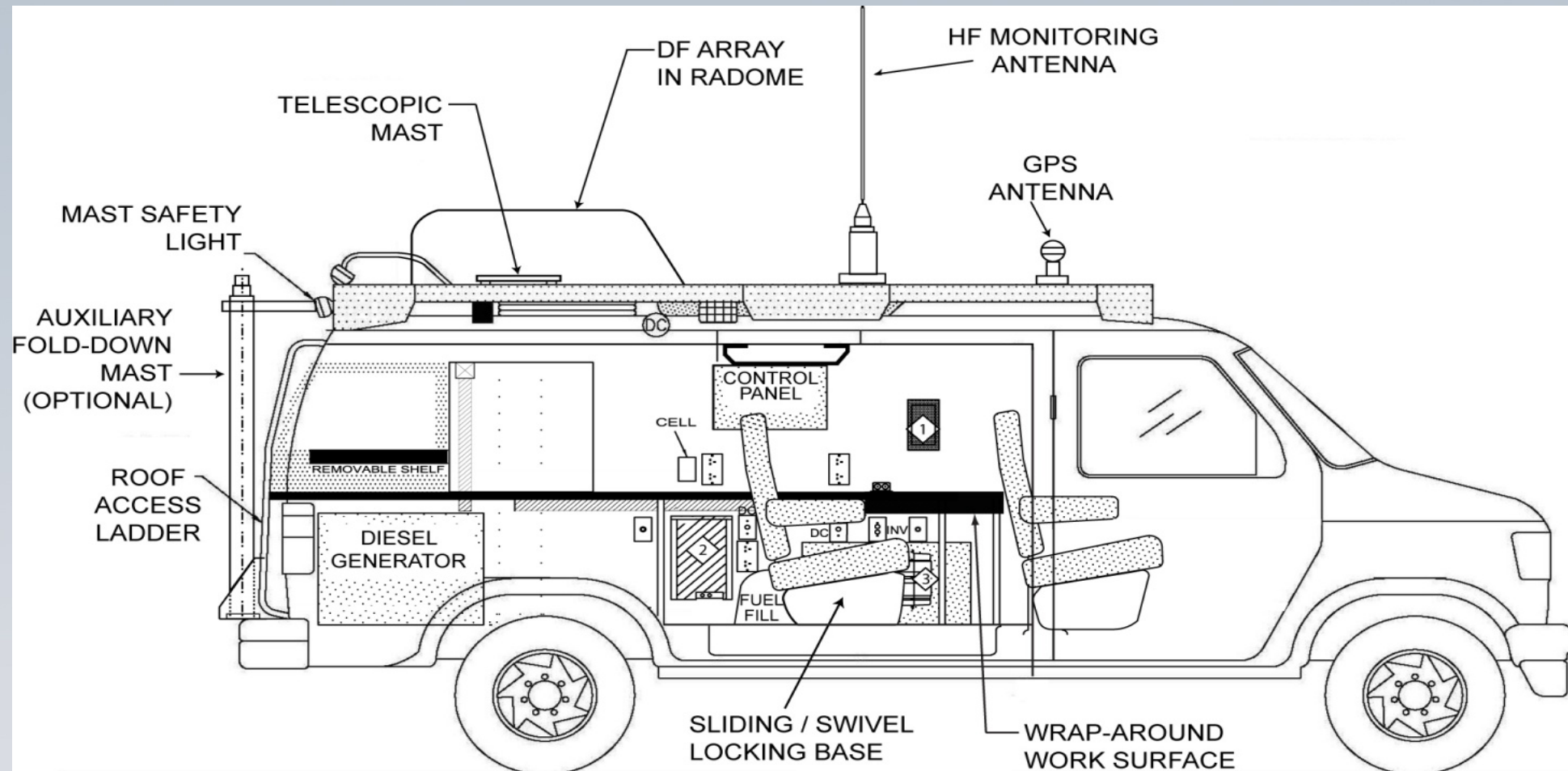
Mobile Monitoring Stations



Mobile Monitoring Stations



Mobile Monitoring Stations



Portable Monitoring Stations

- Complete the mobile monitoring systems.
- Reaching locations un-accessible to vehicles.
 - (Interior of a building – roof of a house)
- Their moderate weight makes it possible to carry them walking to locations inaccessible to vehicles.

Portable Monitoring Stations

- Used to determine exact locations of interference sources or verifies compliance of radio equipment with relevant technical parameters on site.
- Frequency range (20 MHz – 8 GHz) or more.

Portable Monitoring Stations



Portable Monitoring Stations



Portable Monitoring Stations



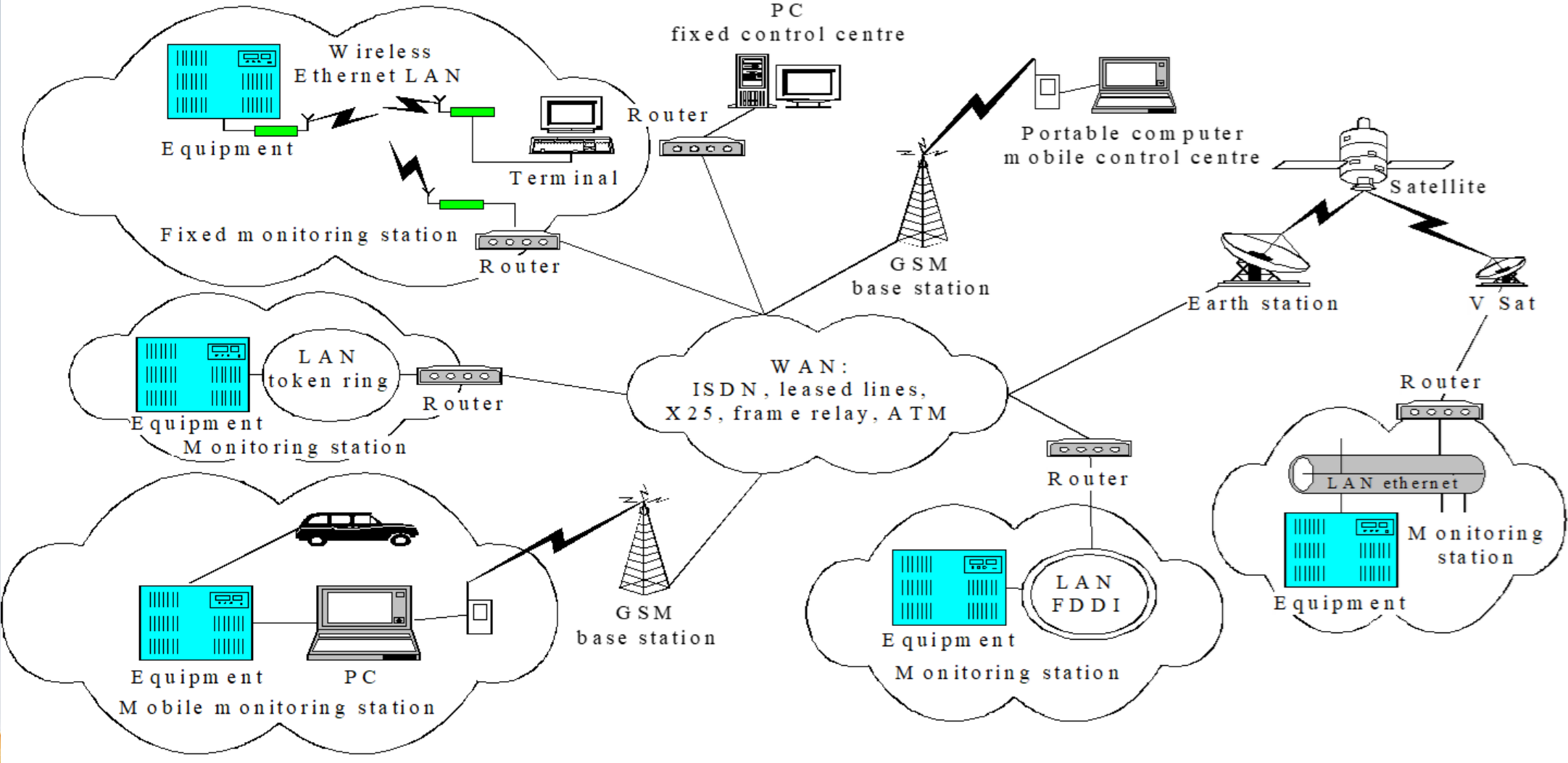
Remote control and Automation

- Modern spectrum monitoring system consists of several fixed monitoring stations and mobile monitoring stations.
- All fixed and mobile monitoring stations are connected to the control center mainly for location determination.
- The control center is equipped by suitable software programs required to control the monitoring stations.

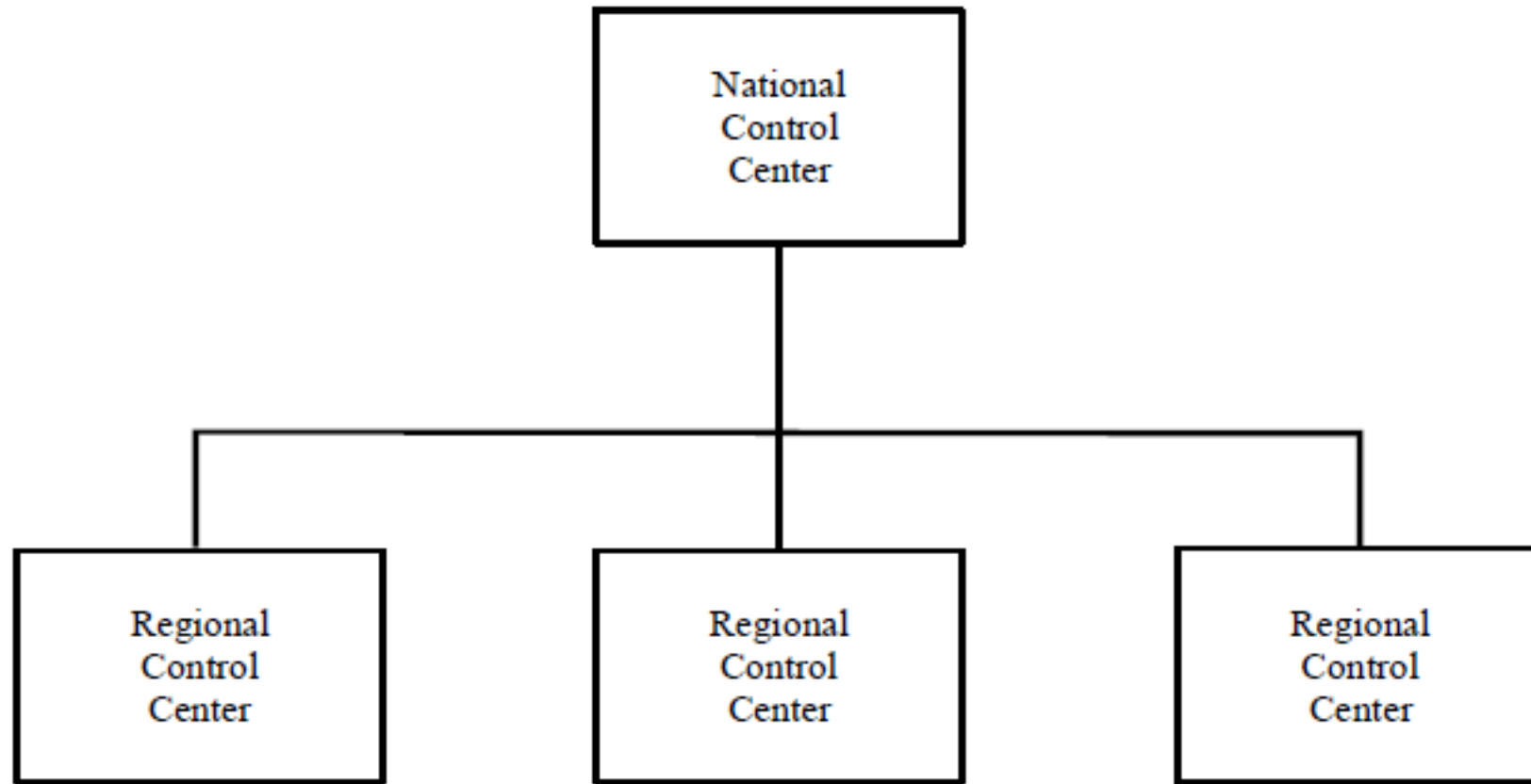
Remote control and Automation

- The control center is equipped by GIS system with the required maps for different areas and with different scales suitable for location determination.
- According to the geographic coverage area, there may be some regional control centers which are connected to the main control center.
- The main control center must be connected to spectrum data base to exchange the data and validate the compliance with license conditions.

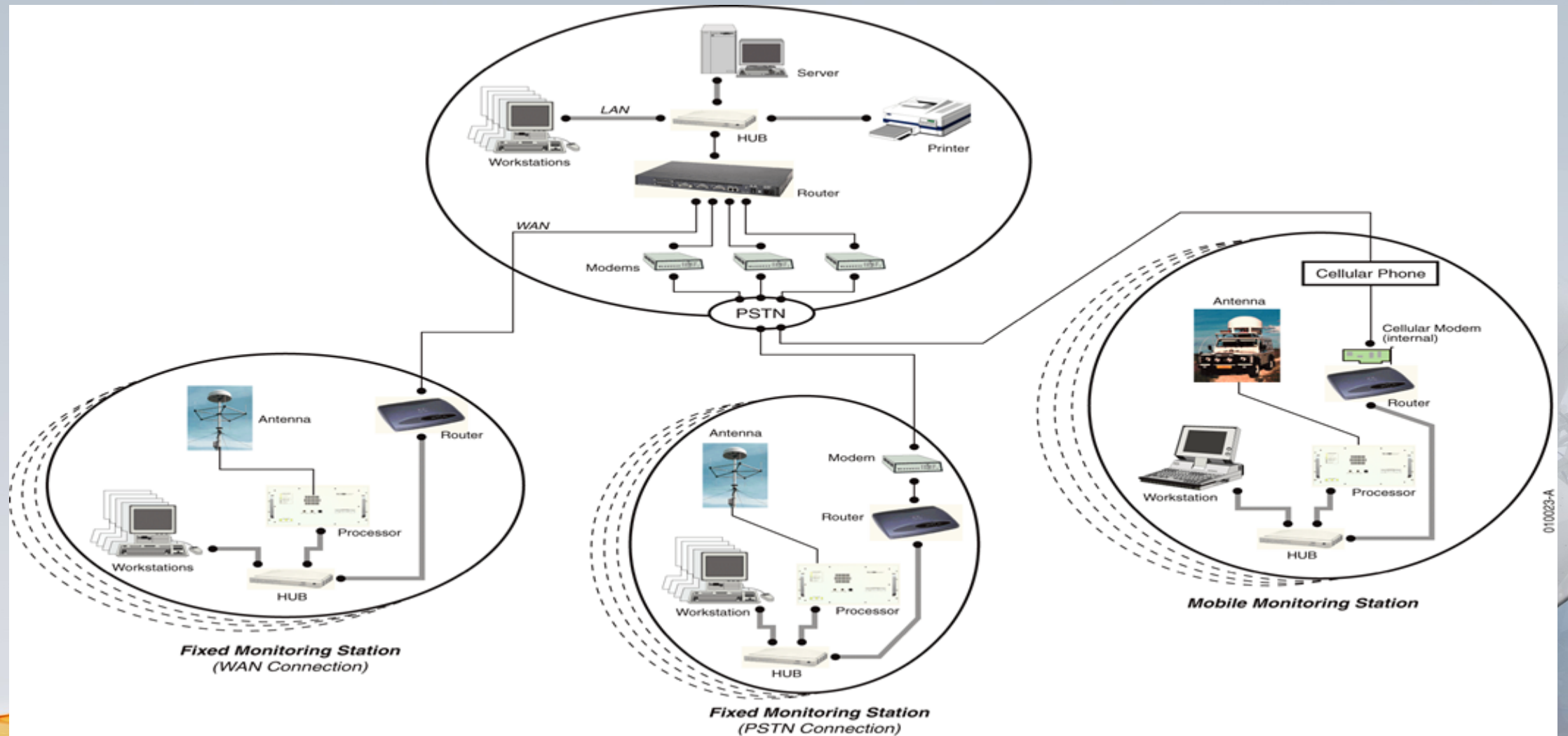
Example of a Network Architecture



Example of a Network Architecture



Example of a Network Architecture



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Siting of Fixed Monitoring Stations

- Minimum siting criteria for fixed stations without HF DF
 - Premises (buildings, power, protection, etc.)
 - Towers and antennas
 - Communications
- Additional siting criteria for stations with HF DF
 - Distances from obstacles affecting propagation
 - Zoning for protection from interference

Siting of Fixed Monitoring Stations

- Minimum Distances between Obstacles and an HF DF Antenna

Obstacle	Minimum Distance (m)
Non-metallic, one-story building	100
Small building with metal roof	250
Metal structures (small sheds, etc.)	800
Open-wire telephone lines, low-tension lines	300
High-tension lines with pylons 20m high	1000
Wind turbines	2000
Wind farms	5000
Isolated trees	100
Small groups of trees	200
Forests	800
Metal fences	200
Small antennas	200
Large antennas	400
Lakes, ponds, rivers	1000

Siting of Fixed Monitoring Stations

- Selection of the area: the location of the Fixed Monitoring Stations must

Satisfy three main conditions:

- The location must be suited to the zone to be monitored.
- The station must be protected against radio and electromagnetic spurious signals .
- The environment must be protected against obstacles.

Siting of Fixed Monitoring Stations

- Power Sources and Communication Networks:
 - The site should be remote from existing or potential industry or congest residential district ,at least 1 Km.
 - At least 1Km clearance from lines exceeding 100KV is suitable, and up to 10 Km may be required for extremely high voltage or where extensive monitoring or very weak signals is planned.
 - Airports should be more than 8 Km distant in the direction of runway approaches or 3 to 4 Km in the other directions.

Siting of Fixed Monitoring Stations

- For the Monitoring Stations with HF, the location of the HF Direction Finder must respect the following conditions:
 - The soil must be flat and of uniformly high conductivity.
 - It must be sufficiently distant from all metallic obstacles and elements even those which are buried.
 - It must be sufficiently distant from infrastructure such as building, tree , highwaysetc.
 - It should be easily accessible and has available power supplies (UPS, general electric distribution..etc)

Siting of Fixed Monitoring Stations

- For the Monitoring Stations with VHF / UHF:
 - The transmissions present in the covered zone should be well known.
 - In the frequency range up to several GHz , many powerful Transmissions can disturb the operation of the DF.
 - These powerful transmissions could cause troubles:
 - Spurious Lines.
 - Desensitization
 - Blocking.

Siting of Fixed Monitoring Stations

- Concerning Protections introduced by radioelectric requirements, consider 2 zones:
 1. PROTECTION zone of 1500 m radius, where all transmissions higher than a defined threshold in the range of waves received by the monitoring stations.
 2. GUARD zone of 1000m radius (rural environment) or 500m (Urban environment) , where it is forbidden to operate electric equipment without authorization.

Siting of Fixed Monitoring Stations

- The requirements against obstacles need to be consider two protection zones:
 - PRIMARY zone is completely free from disturbing elements.
 - SECONDARY is determined by the antenna height within a 2000m radius.

Siting of Fixed Monitoring Stations

- Protection against strong Transmitters Fields:
 - The site should be free from any significant emission source within a 0.5 to 2 Km radius.
 - The tower supporting the Direction Finding antennas should be built at least 1 Km away from the potential emissions capable of disturbing the monitoring tasks.

Siting of Fixed Monitoring Stations

- Protection against electromagnetic radiation of local Computer Systems:
 - Double shielded coaxial cables must be used to connect antenna to receivers.
 - Shielded cables has to be used for the computers system.
 - Computer equipment and components must be installed far from Receiving elements.

Fixed Monitoring Stations Site Survey

- Comprehensive evaluation should be made before installation
- Site Survey – checklist
- Comprehensive report

Maintenance, Calibration and Repair

- Importance of maintenance and calibration
- Establish file on each system or major piece of equipment
- Perform scheduled maintenance
- Certain equipment requires calibration
- Central workshop may be more efficient than repair stations at all sites
- Essential spare parts and supplies should be available
- Scope of yearly maintenance, repairs and support may be on the order of 10% of the original system cost