Disaster Communications

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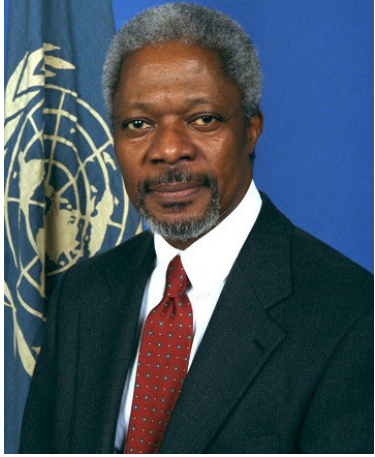
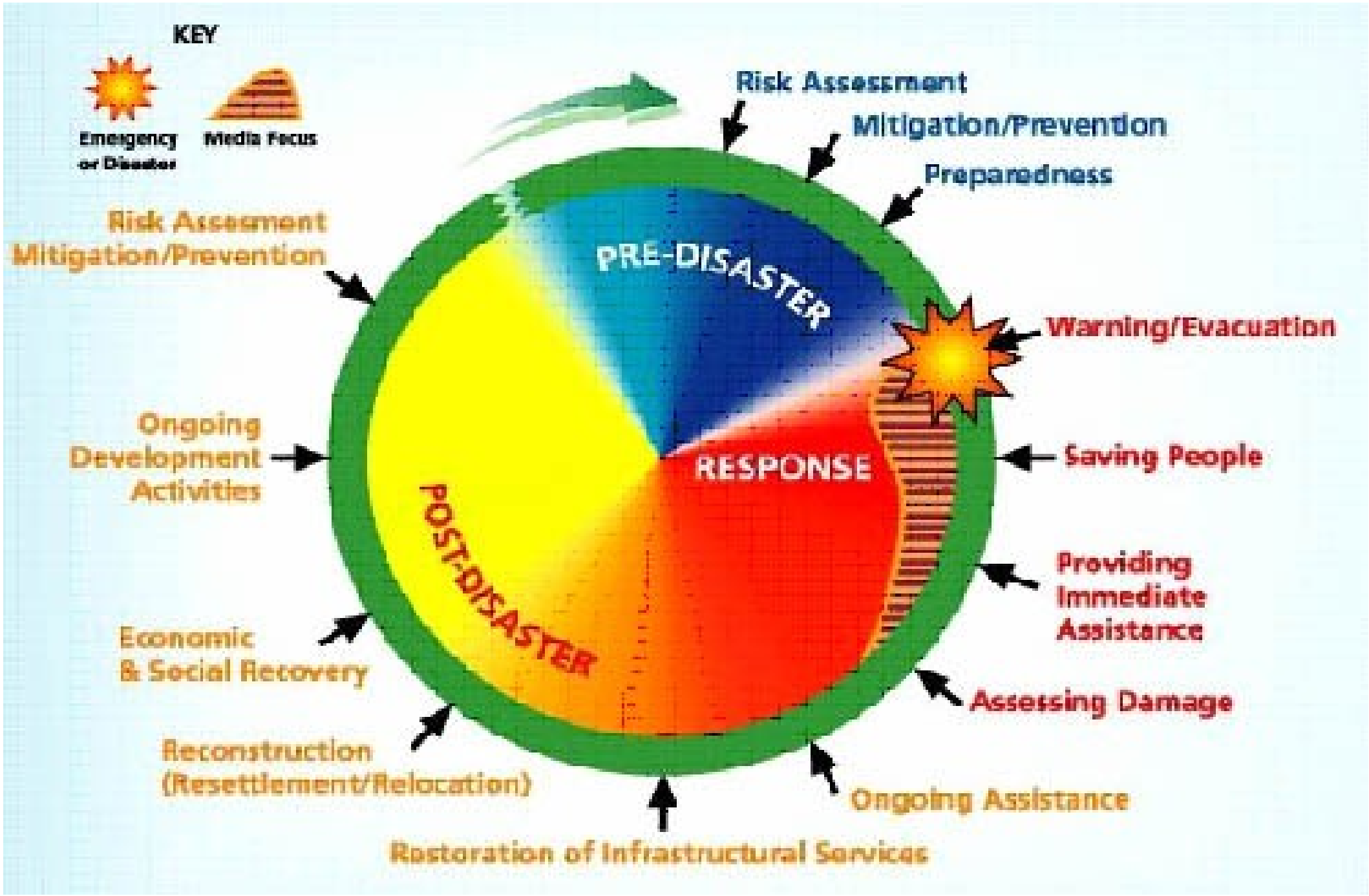
Highlighting the role of Telecommunications for humanitarian assistance, United Nations Secretary General, Kofi Annan said:



Humanitarian work is one of the most important, but also one of the most difficult tasks of the United Nations. Human suffering cannot be measured in figures.....An appropriate response depends upon the timely availability of accurate data from the often remote and inaccessible sites of crises. From the mobilization of assistance to the logistics chain, which will carry assistance to the intended beneficiaries, reliable telecommunication links are indispensable (ICET-98).


KEY
Emergency or Disaster
Media Focus
Risk Assessment
Mitigation/Prevention
Preparedness
Warning/Evacuation
Saving People
Providing Immediate Assistance
Assessing Damage
Ongoing Assistance
Restoration of Infrastructural Services
Reconstruction (Resettlement/Relocation)
Economic & Social Recovery
Ongoing Development Activities
Risk Assesment Mitigation/Prevention
PRE-DISASTER
RESPONSE
POST-DISASTER

Communications Requirements

First 1-24 hours

Rescue
Command & Control
Disaster Inventory

24-48 hours

Rescue
Humanitarian Calling
Recovery
News

3-30+ Days

Recovery Operations
Restoration

Bandwidth requirements increase as response extends over time

Emergency Communicators' Motto

PICON ---

Plan It Carefully Or Nothing

A Tornado and Lessons Learned by a Communications Manager

- While I was unharmed and under no serious threat, trees were down; Power, Cable TV, and the Internet off
- Tried my iPhone - No luck: *Data services not available*. The voice telephone of the iPhone worked, but sporadically
- Lesson: *Cell phones are not reliable, even "smart" phones.*

- To reply to an inquiry about conditions, I decided send an email via HF radio since the antennas were intact.
- I decided that I would not only respond to the inquiry, but copy it to my supervisor and colleagues. Their e-mail addresses are not in the address book for the HF radio program, and I could not access my on-line e-mail account to get their addresses.
- Lesson learned: *Have a hard copy list of important e-mail addresses.*

I decided to send the single e-mail via RMS Express and WINMOR. I boot the modem only to receive a message informing me that it failed to initialize. Despite several attempts, I was never able to initiate a connection. Since the Internet was down, I could not simply telnet. There is also no VHF nor UHF packet node within simplex distance, so, I gave up.

The failure was not due to the program, but it was my failure. In two years of regular use, I had never made a connection with the Internet down. The problem was due to a port conflict, possibly in my router or PC firewall.

The problem disappeared as soon as the Internet came back.

Lesson learned: *Test capabilities without the Internet.*

There is an voice net on the local wide-area UHF repeater system. The repeater was working well and my leaning antenna was still indicating an strong signal back. The net was called and not a single station checked in. Despite a good group for drills, during this tornado emergency, no one checked in.

I considered PSKmail. I immediately connected and executed the *send e-mail* command.

The e-mail began to transfer but an old unsent e-mail in my outbox was sent first. I waited 20 minutes and my new e-mail failed to transfer.

I tried another other server, connected immediately and, again after twenty minutes I gave up, with my new message failing to transfer.

A few weeks earlier, I had discovered some issues with PSKmail and had noted that an updated version of the software was available. I failed to install new version when it was released, thinking I would do it *when I get time*. Too late, I had no Internet to download it.

Lessons learned:

First, I failed to check the outbox and remove unimportant e-mail. In a emergency, where power sources are scarce, wasting time and power due to an old unsent e-mail is not good.

Second, I failed to update a software release that eliminated known communication problems.

Eventually, I received a text message and was able to reply via cell phone.

I switched to HF where several stations were clearly audible using digital modes.

I could have attempted to send email to one of the stations via Fldigi. The receiving station can relay the message on or pop it in to the Internet, an easy solution.

By this time I did not need to send an e-mail, so I did not try. I had simply forgot about this option.

I also remembered that I had missed two voice HF nets that were easily within range.

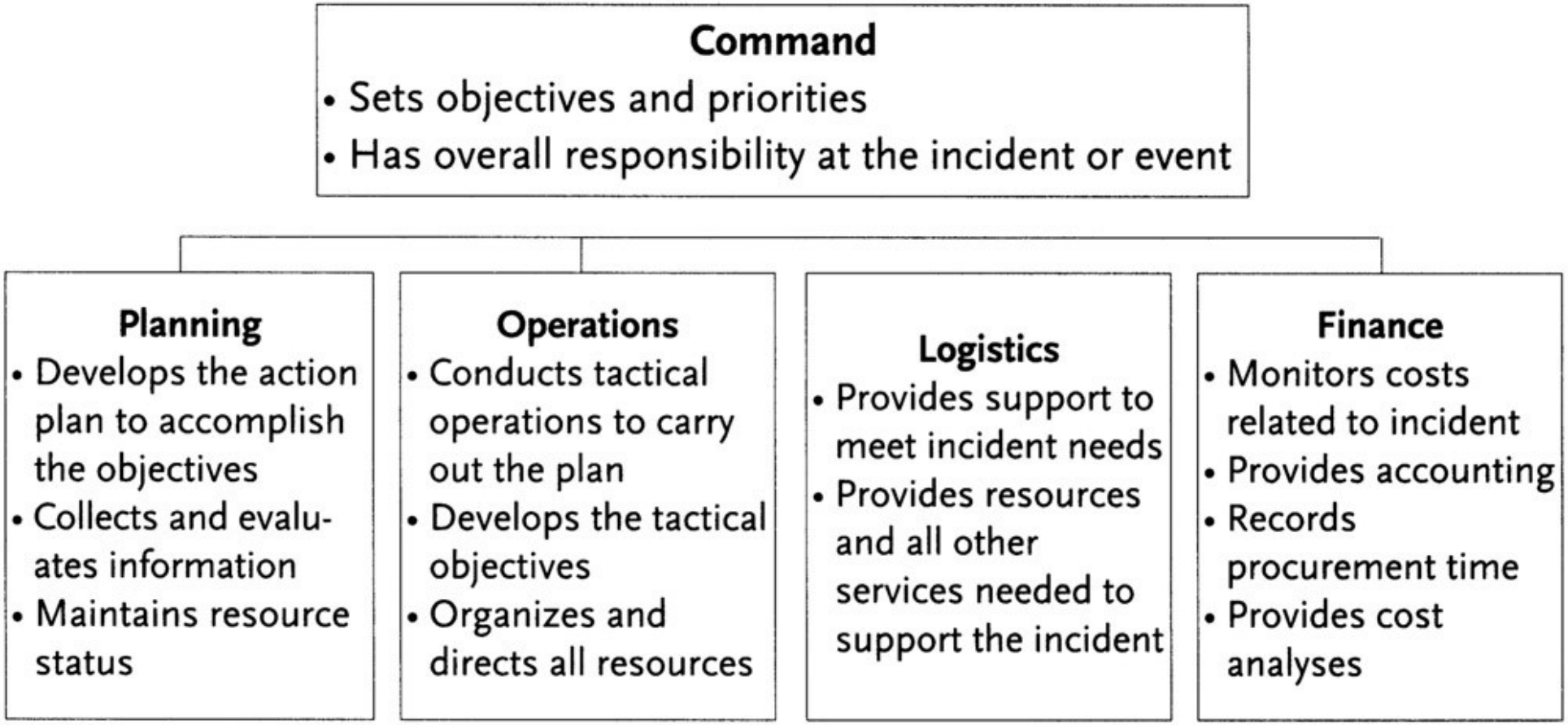
Bottom Lines

- I failed to fully test the station under exact conditions that would be encountered without the Internet.
- I failed to program the emergency communications e-mail software with important e-mail addresses.
- I failed to have a hard copy of important e-mail addresses.
- I failed to realize that important information in a Gmail account (or other Web-based services) is not available when the Internet is down.
- I failed to perform critical software updates in a timely manner.
- I failed to write out communications plans. Such a plan would not have caused me to forget two other methods that I could have easily used.

Outline

- Technology for Communications
- Internal Communications
- Communications with other agencies/stakeholders
- External Communication

Incident Command System



POTS

Plain Old Telephone Service

Has great security.

In developed countries, it is almost universally available.

Slow, but efficient.

However, it is

- Dependent on wires being connected.
- Dependent on Central Office operation.
- Subject to restrictions from host country.

2-Way Radio – Conventional - LMR

Simplex

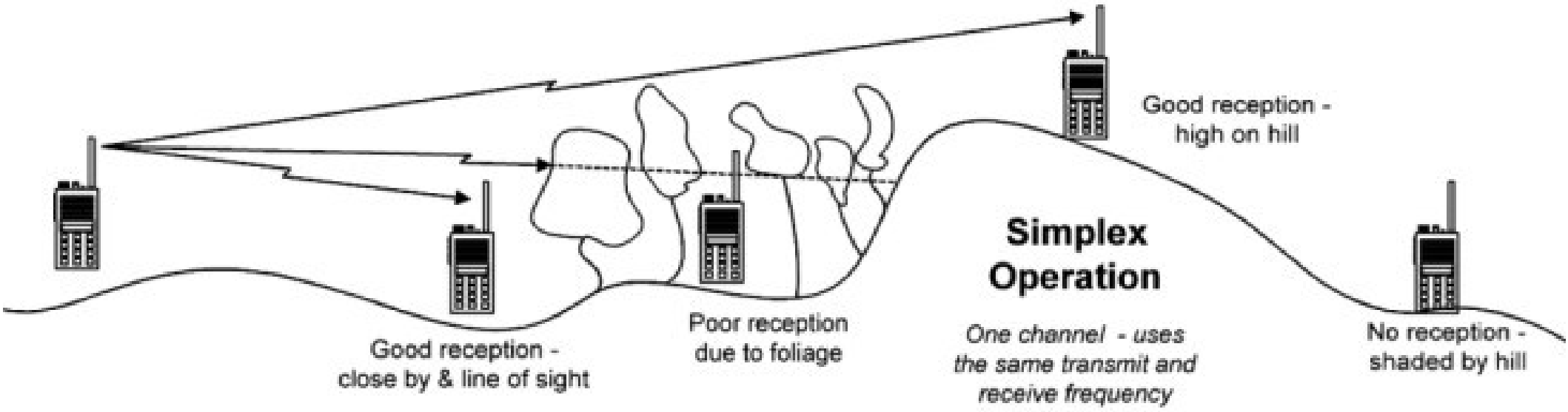
Repeated

Trunked

Simplex Radio Systems

One radio talks to another with no intermediaries.

In general, requires Line-of-Sight between radios.

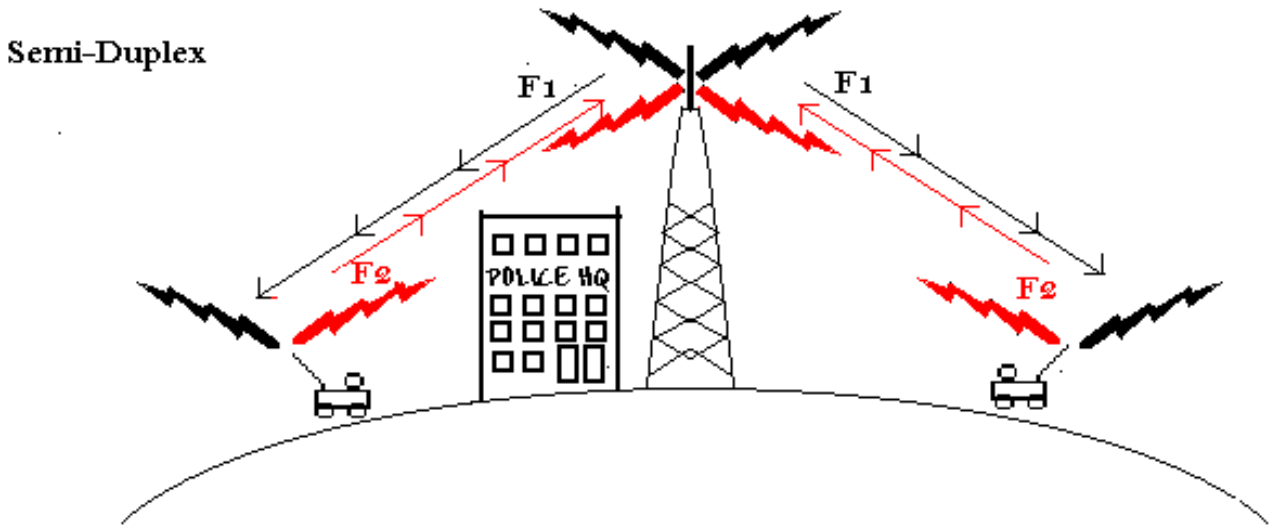


Repeater Radio Systems

All radios receive on frequency F1

All radios transmit on frequency F2

A repeater at a high location, received the transmission on frequency F2 and retransmits it (repeats) on frequency F1



Repeater Radio Systems

Advantages

All Users hear all transmissions

Line-of-sight problem is almost eliminated

Portable radios may use lower power

(= longer battery life)

Disadvantages

Repeater must be operational.

If repeater fails, radios cannot communicate with each other.

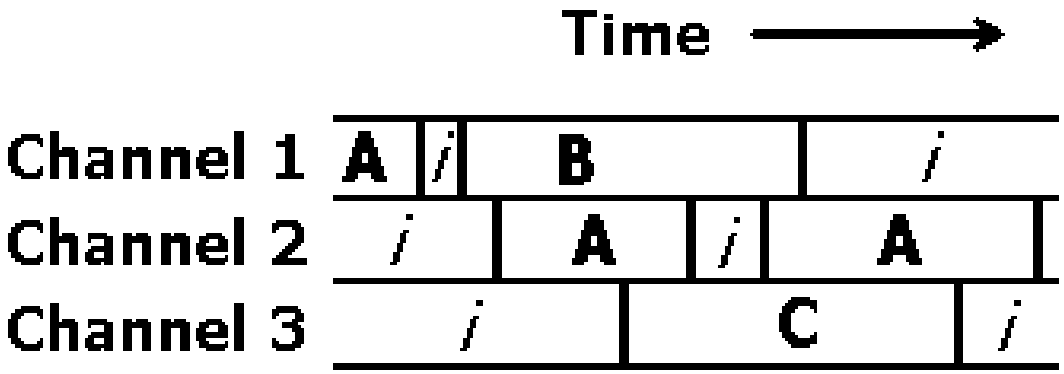
Solution: Talkaround

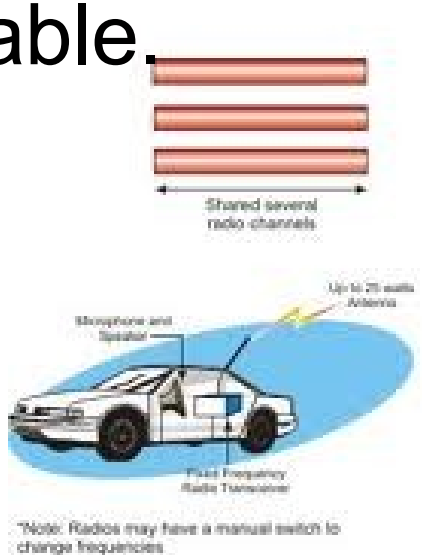
Trunked Radio Systems

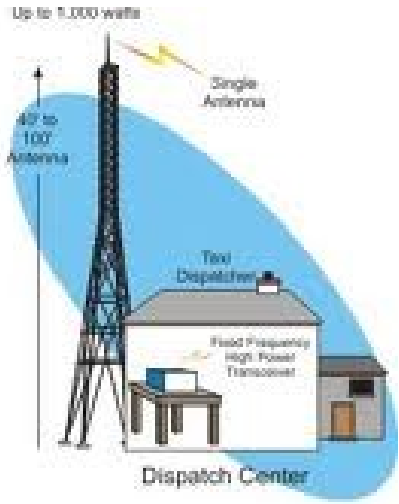
Since every group of users does not need continuous use of a channel, using a intelligent controller, a pool of several channels can be used by many users.

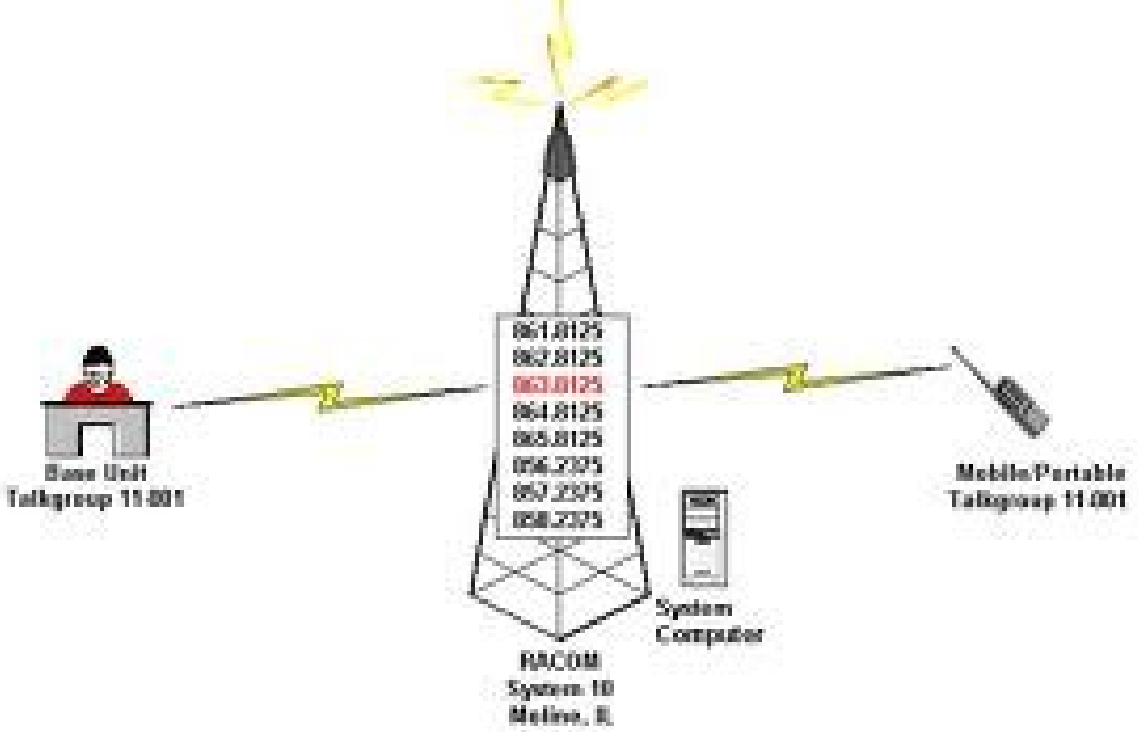
Requires sophisticated hardware at the repeater site.

Unless the system is designed properly, it will not work if the repeater is inoperable.



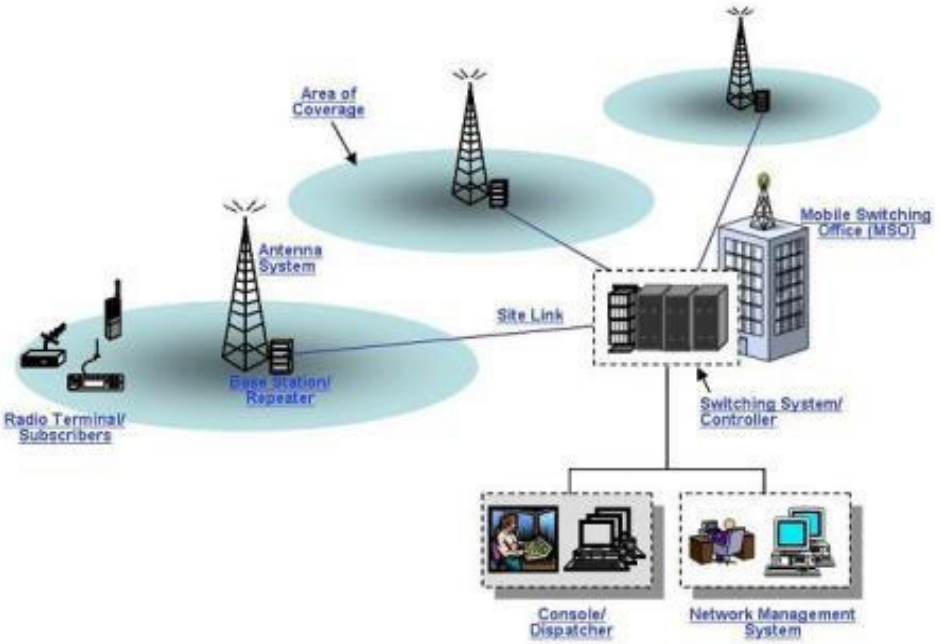




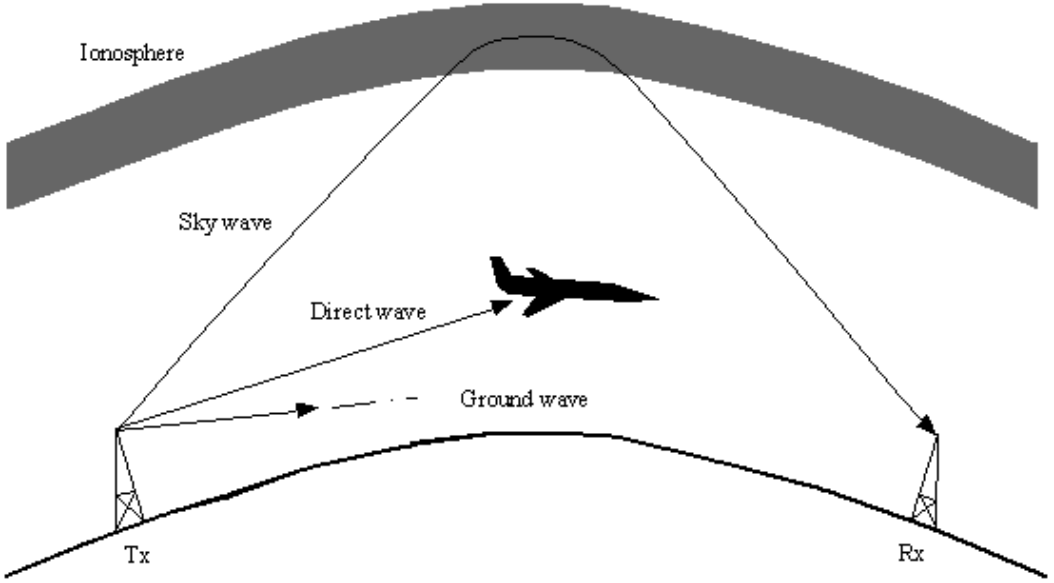


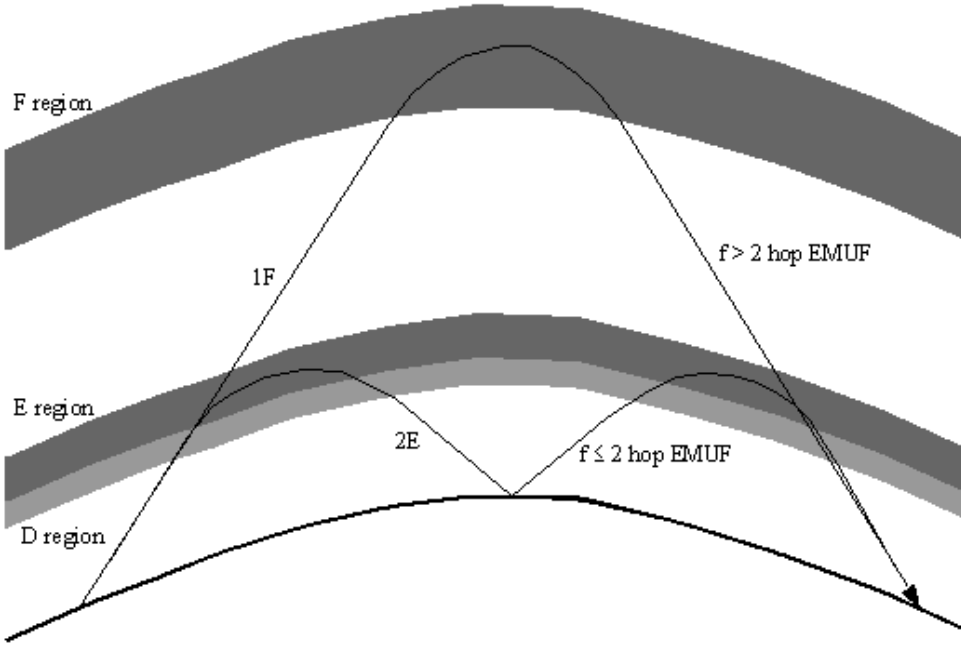
Shares up to 30 channels with a large number of users

* Note: Private IP Network or VPN Tunnels through the Internet with Static endpoints.

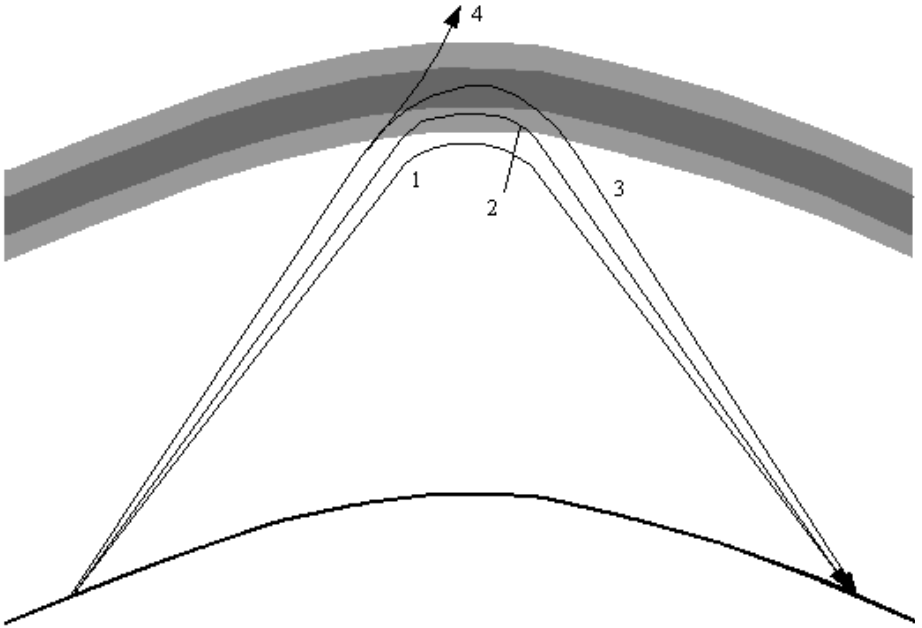


Beyond the Horizon
Non Line-of-Sight Communications



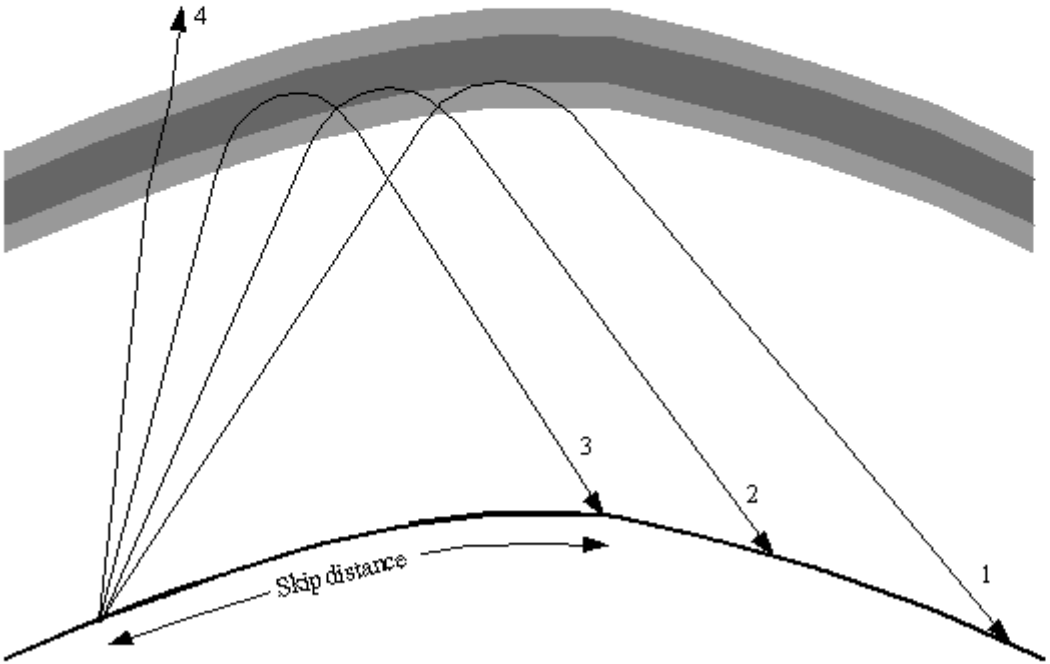


High Frequency Radio



Radio Waves are reflected by waves in the atmosphere.

By appropriate choice of frequencies, reliable communications can be made over ranges from 50 to 10000 miles.



HF Radio in Action

HF Radio at
Yalokole Conservatuion Center

HF Radio

Normal Uses ----- Voice and Data

Aviation – LDOC

Maritime

Point-to-Point

Amateur

Advantages of HF Radio for Emergency Communications

Except for electricity, HF radios do not depend upon infrastructure.

In most cases, simple antennas, such as wire dipoles can be used. (Even if antennas are destroyed during the emergency, new ones can be easily installed.)

Simple to use, however operators must be trained.

Disadvantages of HF Radio for Emergency Communications

Trained operators needed at each end.

Usually no automatic connection to networks.

Data rates are slow. (At best dial-up internet at 9600 baud.)

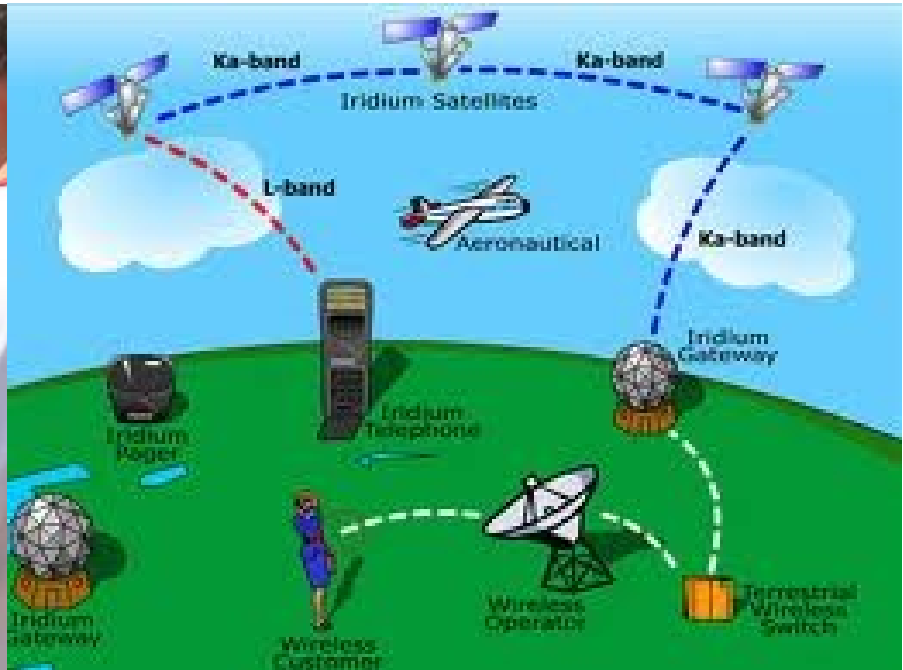
Security is minimal, although that can be an advantage.


Humanitarian Logistics in a Nutshell – Part 2:
Communications Equipment
Democratic Republic of Congo - 2010
http://photodiarist.com/tag/satellite-phones/

Satellite Communications

Low Earth Orbit (LEO)

Geosynchronous Earth Orbit (GEO)



Low Earth Orbit (LEO) Satellites

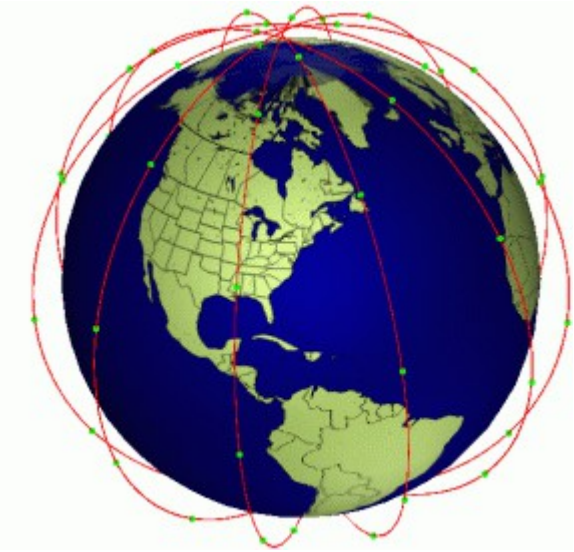
Can be accessed with relatively simple equipment.

Handsets look like Cell Phones with Antennas on Steroids.

LEO Satellites orbit at roughly 100-200 miles above the earth.

Require sophisticated networking technology.

Can be used as an Internet Hotspot.



Geosynchronous Earth Orbit (GEO) Satellites

Satellites are 22,000 miles above the equator and orbit the earth in 24 hours appearing to be stationary to the user.

Require small (or large) dishes to access the satellite.

High bandwidth – Can be used for audio/video/data.

Cell Phones
Voice and Text Messaging

Almost ubiquitous!

Text messages will often get through when voice calls will not.

Data services at cell sites are often disabled during an emergency.

Cell sites and associated hardware must survive the disaster.

Commercial Broadband for our Smartphones has similar problems!

Rapidly Deployable Cell Sites

Interoperability

Adjoining agencies and stakeholders cannot communicate with another in real-time.

First came to the forefront after 9/11, although it was identified as a problem a decade or more earlier.

Problem stems from the fact the different agencies use different frequency bands and are licensed separately.

Territorial boundaries limited local government agencies, federal agencies, and non-governmental agencies from having joint radio/communications facilities.

Massachusetts Mobile Emergency Operations Center

Post 9/11 in the US there are a series of interoperability frequencies allocated that anyone with a license for a primary service can use for inter-agency operations.

There is also more collaboration between the 3 licensing agencies.

FCC – State and local government, business, non-profit organizations

NTIA - IRAC (Intergovernmental Radio Advisory Committee)

DoD – Military Agencies

Key Problems

- Seven frequency bands allocated for public safety.
- Multiple radios cost over $10K per vehicle

Public Safety Broadband using 700 MHz LTE

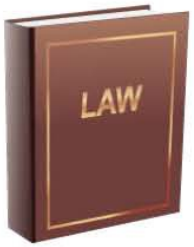
Fully interoperable on a nationwide basis

Bandwidth will not be an issue for normal operation

Bandwidth might become an issue when a large incident occurs in a confined area, however, only one or two cell sectors will be used

Real-time network management will be required with Public Safety having *pre-emptive priority*.

FirstNet Beginnings



THE LAW

2.22.12

FirstNet becomes law
PL 112-96

FUNDING

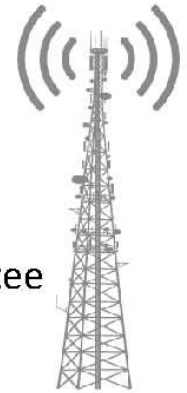
$7B authorized to build the FirstNet network. Funded by spectrum auctions through 2022.

GOVERNANCE

The FirstNet Board has **15** members, including those with telecommunications and public safety backgrounds

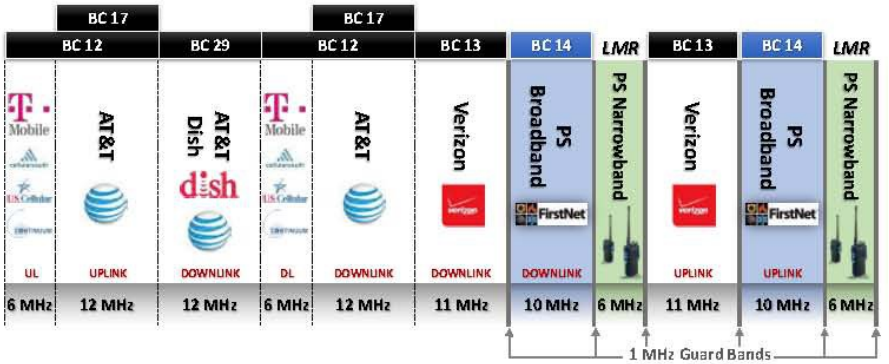
Each Governor appoints **1** Single Point of Contact (SPOC) and governing body to represent the state's interests to FirstNet.

40 member Public Safety Advisory Committee (PSAC) advises FirstNet on public safety intergovernmental matters.

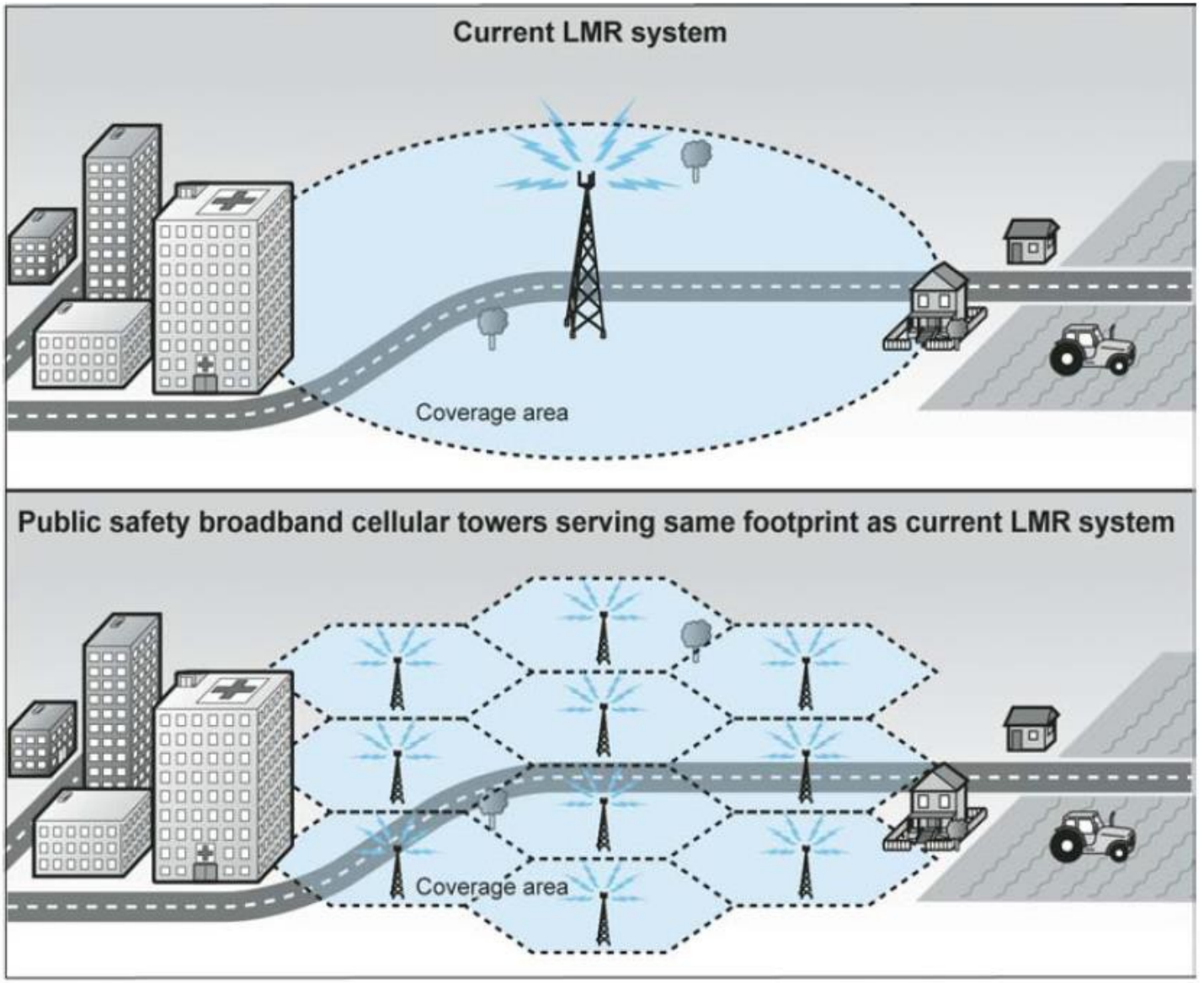


BAND CLASS (BC) 14

20MHz of bandwidth has been dedicated to public safety in the prime upper **700MHz** frequency range.



Differences between LMR and LTE systems



Source: GAO.

LMR vs. LTE

LMR

- Channels pre-configured per site
- Overlapping coverage using different frequency
- Fixed bandwidth / throughput per channel
- Users on one channel don't impact others

Each channel supports a conversation

LTE

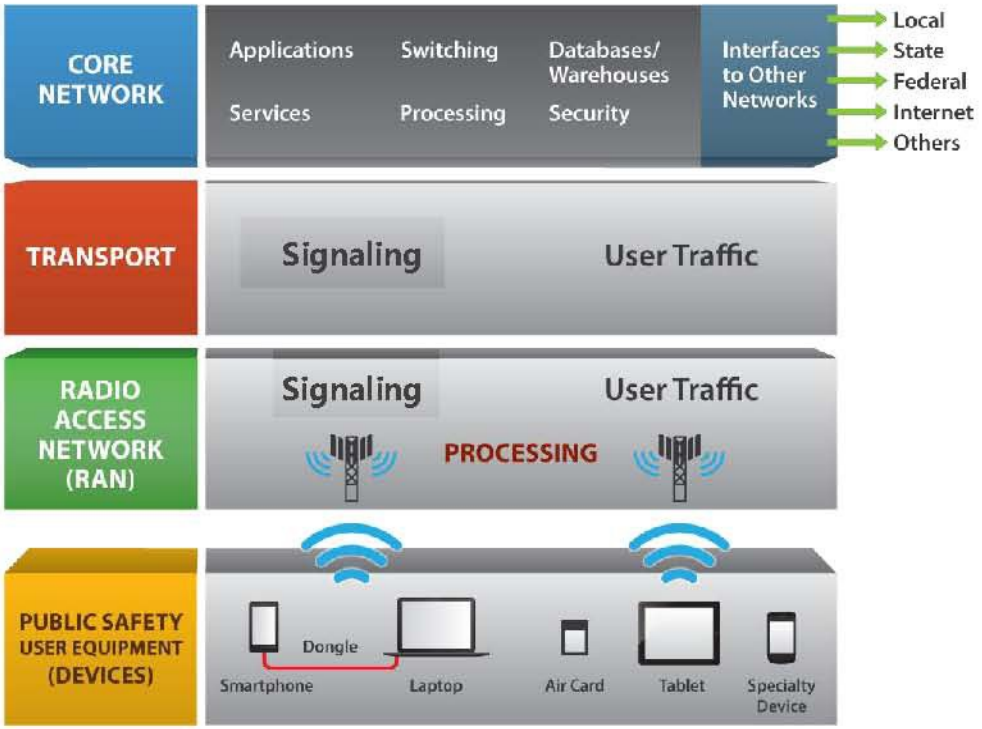
- All sites operate on same frequency thus overlapping coverage needs to be minimized
- "Channels" managed dynamically at each site
- Bandwidth determined by need and availability *minimizing congestion concerns*
- One large data "pipe"
  - *Up to* 74 Mbps capacity near cell tower
  - Capacity reduces as you move away from tower
  - Can handle many users with differing data demands (e.g. field reporting, dispatching)

Variable Data Rate per User – 1 to 100(s) Simultaneous Users

Basic LTE Network Components

At a very high level, the network has 4 basic components:

- Core Network Evolved Packet Core (EPC) or "Core"
- Transport "Backhaul"
- Radio Access Network or "Radio Sites"
- User Equipment (UE) or "User Device"



Devices – The Most Important Element to Public Safety

	Portables	In-Vehicle Routers	Specialized	Accessories
Device Types				
Category Driver	• Build up to an economy of scale		• Special operational needs e.g. in-building, rural	• Unique uses
Function	• Smartphone • Tablets • Modems	• Routers • Hotspots • Consoles	• Drones • Portable repeaters • Rovers	• Ruggedized cases • Battery packs • Chargers, mics.
Connectivity	• LTE, CDMA, HSPA • LMR/ P25 • Wi-Fi, Bluetooth • Direct mode	• LTE, CDMA, HSPA • Wi-Fi • Ethernet • USB	• LTE, CDMA, HSPA • LMR/ P25 • Satellite	• Bluetooth
Location Enabled	Yes	Yes	Some	n/a
Band 14 Support	2H14	1H14	2015+	n/a

The RAN will be a Combination of Terrestrial, Satellite, and 'Deployables'

FirstNet™

Hybrid approach enables public safety users to take their wireless coverage, services, and capacity with them

Off-net mode, no satellite or Core – comms among incident personnel 750-1000 sq. ft.

Mobile Communications units (mobile comms) on PS vehicles – become a mobile cell site/system mounted with an LTE Picocell:
Incident Area Network (IAN)
750-1000 sq. ft.

Public Safety Towers (boomers) 10-25 miles

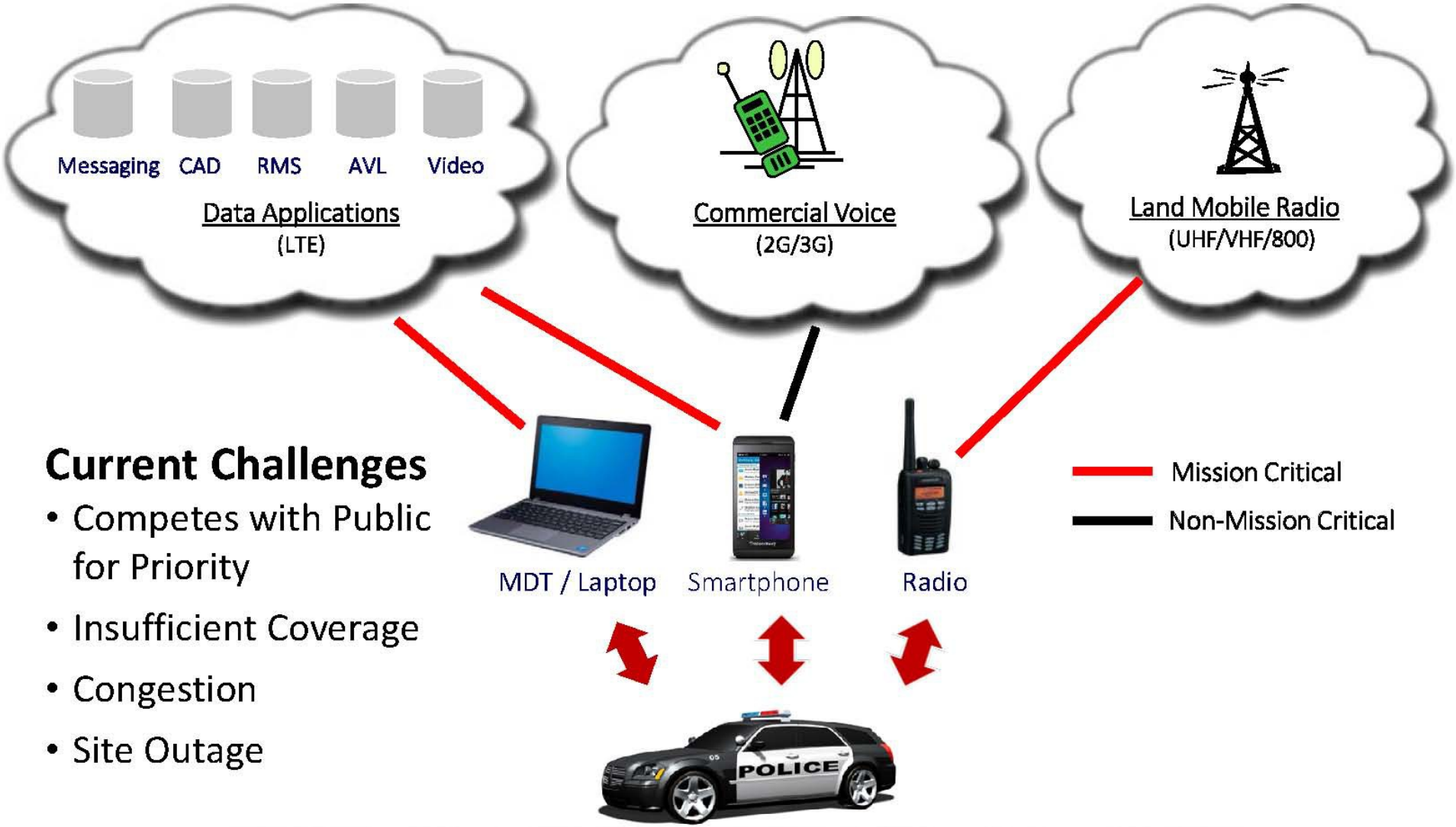
Macrocell LTE up to 1-10 miles

Microcell LTE up to 1 mile

FirstNet Will Have Advanced Capabilities

- **Key FirstNet Characteristics**
  - Quality of Service Priority and Preemption
  - Local Control
  - Hardening
    - Security - Physical and Cyber
    - Structural Hardening
    - Resiliency

Short Term Goal: Make Data Mission Critical For Public Safety



Current Challenges

- Competes with Public for Priority
- Insufficient Coverage
- Congestion
- Site Outage

Complications

- Today's smartphones (smartdevices) are not one-handed devices
  - Require two hands to operate
  - Most use touchscreen
  - Not a problem when first responder is patrolling or sitting in a vehicle BUT it is a problem when on an incident
  - Today's smartphones not designed for harsh environments
  - Touchscreens not conducive to use when wearing gloves

Public Safety usually cannot use both hands on a device!

Internationally Interoperability is limited by Licensing and Equipment Shipment

Each country licenses and regulates communications with guidance from the International Telecommunications Union (ITU), a UN agency.

Except for Shipboard and Aircraft radios that are governed by International agreements, all other communications transmitters are regulated country by country.

Certain classes of equipment may be licensed by rule in one country, but not another.

By international regulation, all equipment requires an station license.

If the equipment is tuned by frequency, then the operator is required to hold an operators license.

Tampere Convention


The "Tampere Hall" in Tampere, Finland, where the treaty on Telecommunication for Disaster Mitigation and Relief was signed on 18 June 1998.

The Tampere Convention treaty simplifies the use telecommunication equipment across borders.

The Tampere Convention calls on States to facilitate prompt telecommunication assistance to mitigate the impact of a disaster, and covers both the installation and operation telecommunication services.

Barriers include the licensing requirements to use allocated frequencies, restrictions on the import of telecommunication equipment, as well as limitations on the movement of humanitarian teams.

Tampere Convention

Signed in 1998 by 68 countries.

Came into force in 2005 after it was ratified by 30 countries.

Currently 44 countries have ratified the treaty.

Major countries that have not ratified the treaty

USA, Russia, Brazil, Chile, Germany, Italy, Portugal

Getting the Word Out to the Public

AM and FM Radio (includes Shortwave Radio in less developed regions)

Constraints

- Not all stations are *local*. Stations may not have a local news/features staff.
- Currently most stations do not have a resident engineering staff. Thus during a disaster if the station is forced off the air, repairs may not quickly be made.

Several manufacturers have developed hand crank radios, where a crank can be turned to generate electricity for several hours use.

More sophisticated types include a flashlight and a cable that can be used to recharge ones cell phone.

Getting the Word Out to the Public

Television

- Station must stay on the air. Most have backup power, antennas, and transmitters.
- Many (most) of us receive our television via Cable, thus if no cable, no TV.
- Digital TV makes reception of just TV audio nearly impossible.

NOAA Weather Radio

- Originally designed for marine weather, now has expanded to all hazards.
- Receivers are available but not universally used.

But, now, who listens to the radio or watches over the air TV?

We're glued to our cable/wifi networks!

Social Networking Sites

- Social Networking sites, such as Facebook are becoming more popular with Emergency Managers to get information out.
- Constraint is that the Internet must work.

Twitter – becoming almost universal

Emergency Text Messages

- Can be used to text a large group of people quickly.
- Assumes cellular network is up and running.

Reverse 911

- Can notify wide area by telephone (but usually not cellphones)

Priority – In addition to restoring power, water, clearing roads, broadband service must be restored!

In some areas non-profit local organizations are preparing for wi-fi restoration.

Questions?