



Disaster Communications

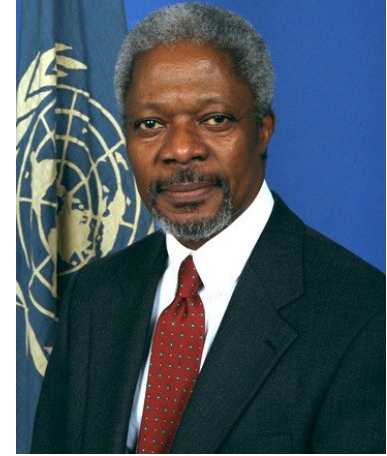
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University of Hartford

SCHMGT 597LG

Humanitarian Logistics and Healthcare

April 26, 2022

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).

Outline

- Technology for Communications
- Current Trends
- Tonga/Ukraine
- Demos



POTS

Plain Old Telephone Service



Has great security.

Universally available in developed countries.

Slow, but efficient.

However, POTS is

- Dependent on wires being connected.

- Dependent on Central Office operation.

- Subject to local restrictions.

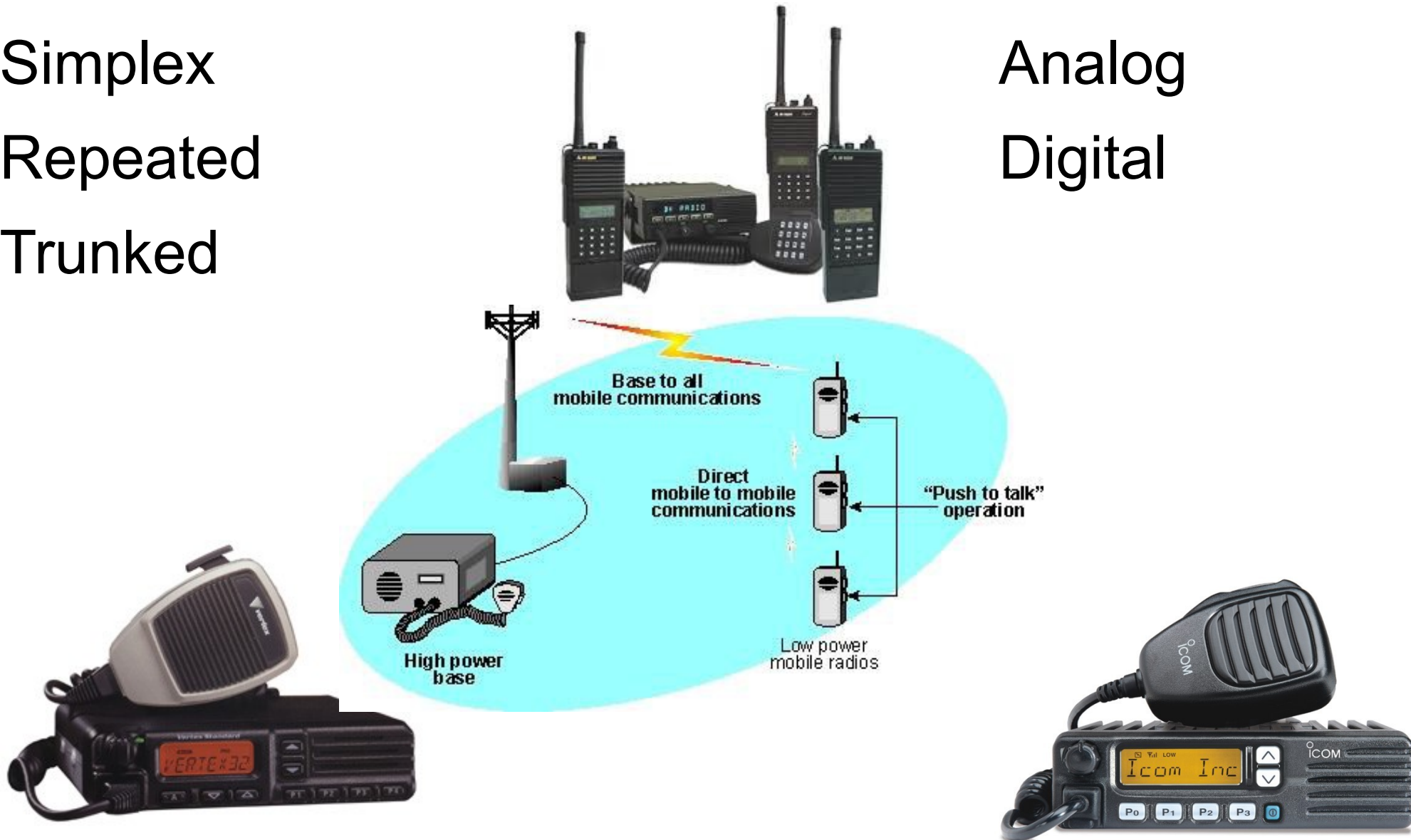
IP (VoIP) phones are not POTS!



2-Way Radio – Conventional – Land Mobile Radio (LMR)

Simplex
Repeated
Trunked

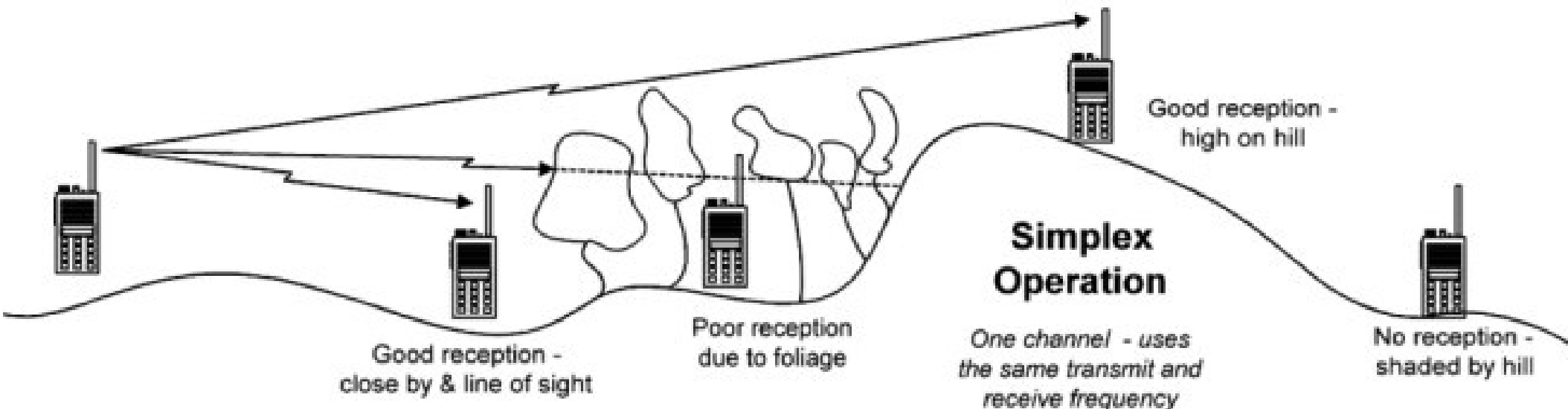
Analog
Digital



Simplex Radio Systems

One radio talks to another with no intermediaries.

Generally requires *Line-of-Sight* among radios.

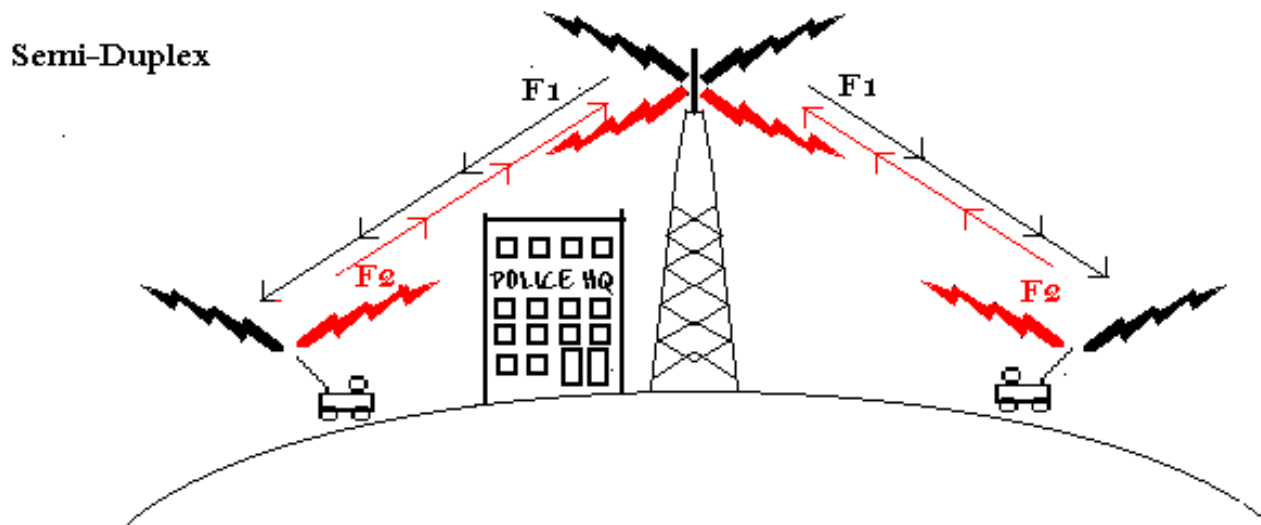


Repeater Radio Systems

All radios receive on frequency F1

All radios transmit on frequency F2

A repeater located 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 problems are almost eliminated

- Portable radios may use lower power

 - (= longer battery life)

Disadvantages -

- Repeater must be operational.

- If the repeater fails, users cannot communicate with each other.

- Solution: Talkaround



Portable Repeaters that can be rapidly deployed!



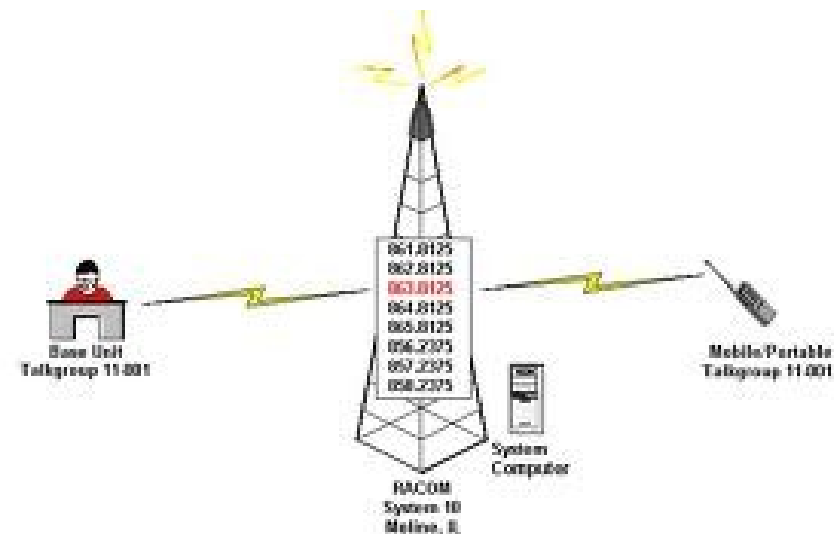
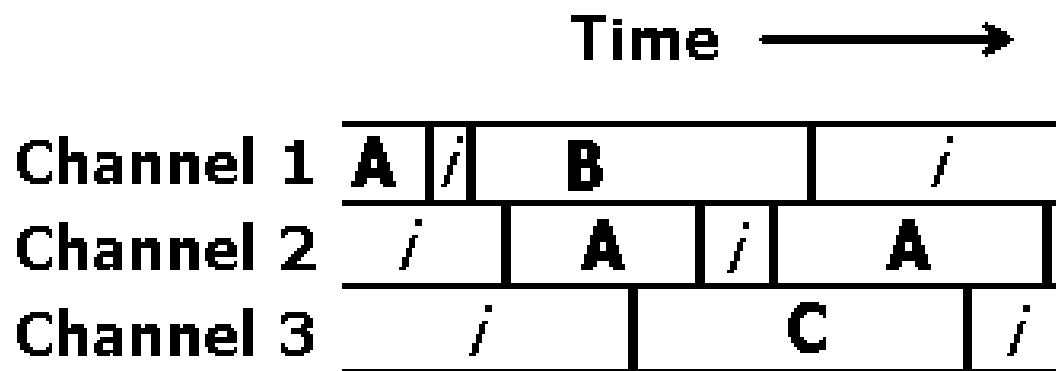
Orchard Hill – Saturday, March 3, 2018

Trunked Radio Systems

Every group of users does not need the continuous use of a radio channel - 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.



Analog vs Digital

Analog radios use conventional analog technology.

Digital Radios convert analog voice signals to digital and transmit the signal digitally.

Multiple Digital Standards

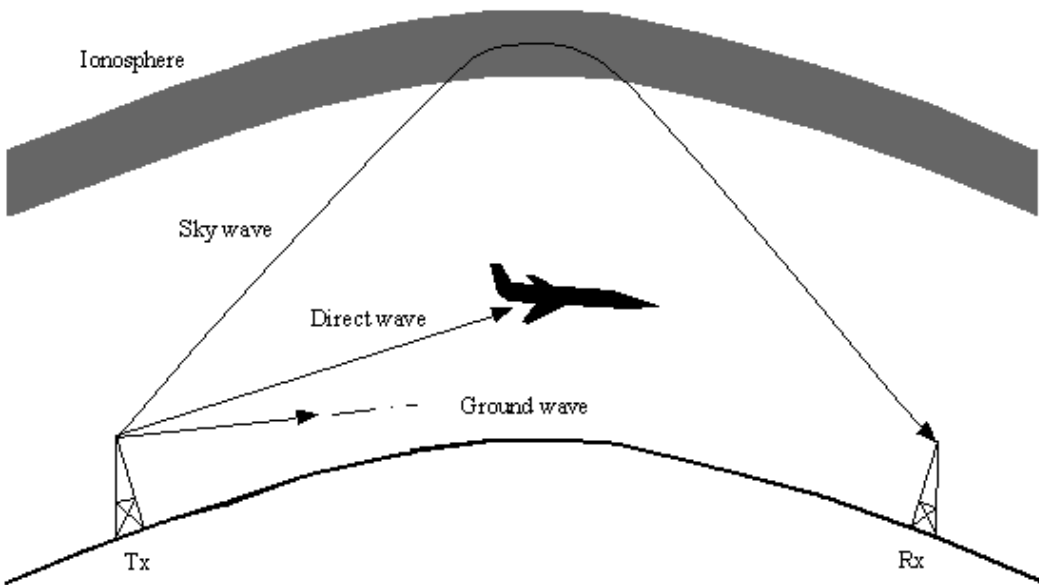
- APCO-25 (P-25)

- DMR

- TETRA

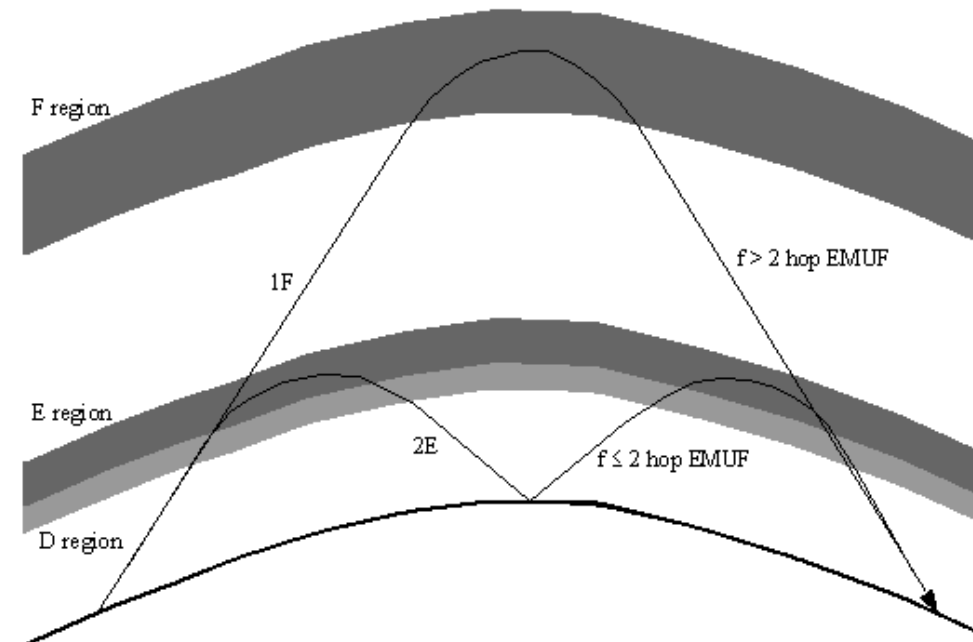
Beyond the Horizon

Non Line-of-Sight Communications



Radio Waves are reflected by the atmosphere.

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



HF Radio in Action

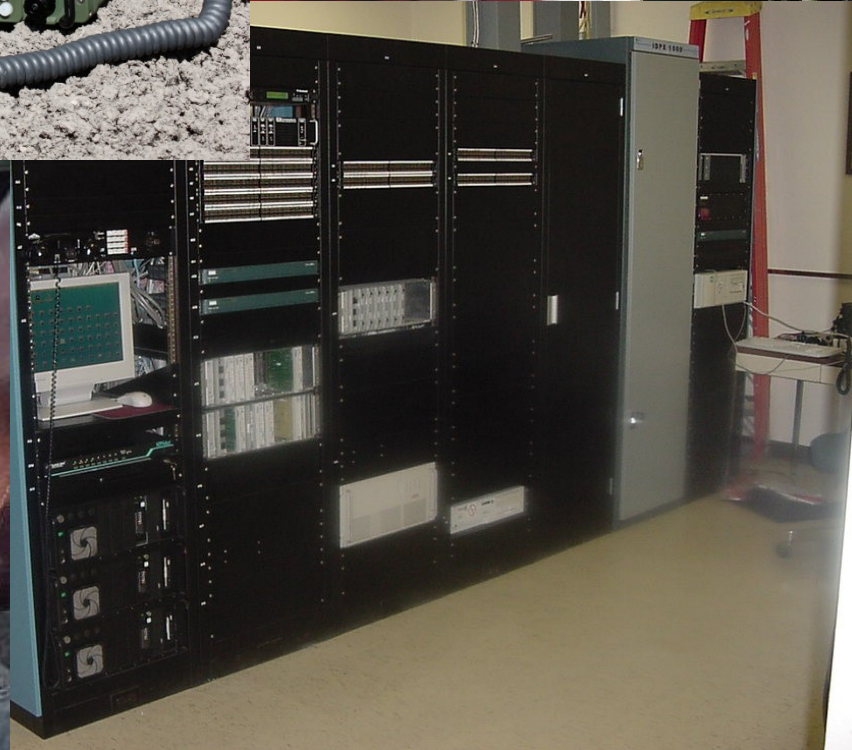


HF Radio at
Yalokole Conservatuion Center



HF Radio

Normal Uses ----- Voice and Data
Aviation – LDOC
Maritime
Point-to-Point
Amateur





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



Satellite Communications

Geosynchronous Earth Orbit (GEO)

Low Earth Orbit (LEO)



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 dishes antennas to access the satellite.

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



Low Earth Orbit (LEO) Satellites

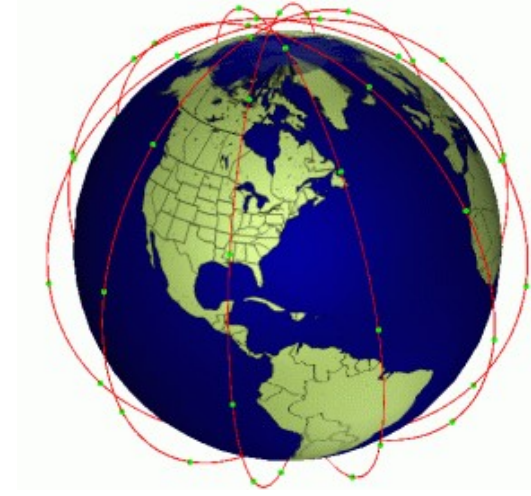
LEO Satellites orbit 100-200 miles above the earth.

Can be accessed with relatively simple equipment.

Handsets look like Cell Phones with Antennas on Steroids.

Require sophisticated networking technology.

Can be used as an Internet Hotspot.





LEO Satellites

66 Satellites

Service started November 1998

Went Bankrupt 9 month later - Almost shut down – Restarted in 2001

Covers the entire earth.

Heavily used by US and Foreign Governments, military, humanitarian agencies, environmental agencies.

Can be used in Polar Regions.

Iridium NEXT new generation of satellites beginning 2017



Founded by Elon Musk

Constellation of over 7000 small satellites
(100-500 kg)

Received Federal Subsidy of \$900 Million to
support rural broadband

Service in 30+ countries – Will not cover the
entire earth since not in Polar Orbit

Essentially an ***Internet Hotspot*** using a
slightly simpler protocol. - Latency is similar
to a fiber optic link.

Classified military version

Cell Phones

Voice and Text Messaging

Ubiquitous – Secure - Private!

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

Smartphone use during a disaster can be problematic.

Cell sites and associated hardware must survive the disaster.

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 by Communications Professionals.

Major Problem - 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.

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

More collaboration among the 3 licensing agencies.

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

NTIA - IRAC (Intergovernmental Radio Advisory Committee) – Federal Agencies (non-military)

DoD Frequency Managers – Military Agencies

Key Problems

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



Massachusetts Mobile Emergency Operations Center



But what about smart devices?

Public Safety users have quickly embraced Smart Devices.

Chief advantages are simplicity and security.

COTS devices are useful, but lack reliability in harsh environments.

In times of emergency, cell service becomes congested!



Mission Critical Users

Mission Critical Users need a communications system that will be there when their safety is on the line.

Mission Critical Uses, such as fire and police dispatch, the main concerns are reliability and situational awareness, not the underlying technology, such as LTE, P25, TETRA, or analog.

Mission Critical Push-To-Talk (MCPTT) to allow radio-like operation over LTE (4G/5G)

Advantages – Situational Awareness – Ease of use

Needs - Security features to protect the system from unauthorized users, eavesdropping, denial of service attacks, and other security risks.

Need ***Proximity Services*** (ProSe) to allow mobiles to identify other mobiles in physical proximity and enable Direct Device-to-Device communication among users when the network is down or where no network exists.

Why current LTE (4G/5G) is not perfect for the Critical Communications Sector:

Additional features needed

Proximity Services (ProSe) to allow mobiles to identify other mobiles in physical proximity and enable Direct Device-to-Device communication among users when the network is down or where no network exists.

User equipment to network relay allows one mobile to act as a relay for another mobile to access to network services.

User equipment to user equipment relay, allows a mobile to act as a relay point among users and allows network-free communications.

Internet Radios – Non-MCCPTT

An internet radio is a radio-like device that works over the internet (or LTE).

Requires a host application server.

Some systems have Smartphone and/or computer apps.

Devices often work simultaneously on LTE and WiFi



FIRSTNET



WHAT

***The First Responder
Network Authority***

Build, operate and maintain
the first high-speed,
nationwide wireless broadband
network dedicated to
public safety



WHY

***Born from recommendations
by the 9/11 Commission***

End the history of public
safety communications
challenges to help keep our
communities and emergency
responders safer

FIRST NATIONWIDE PUBLIC SAFETY BROADBAND NETWORK



Purpose is to provide a Broadband Network for public safety that will work even during emergencies!



Public Safety Broadband using 700 MHz LTE

Fully interoperable on a nationwide basis

Bandwidth is not an issue for normal operation

Bandwidth becomes an issue when a large incident occurs in a confined area. Typically, only one or two cell sectors will be used

Real-time network management will be required to give Public Safety users *pre-emptive priority*.

First Responder Communications Challenges

10,000+ individual radio networks

No dedicated broadband network to unify communications across agencies, devices or jurisdictions

Commercial networks congested during crises



70k+

Public Safety
Agencies



3,100+

Counties



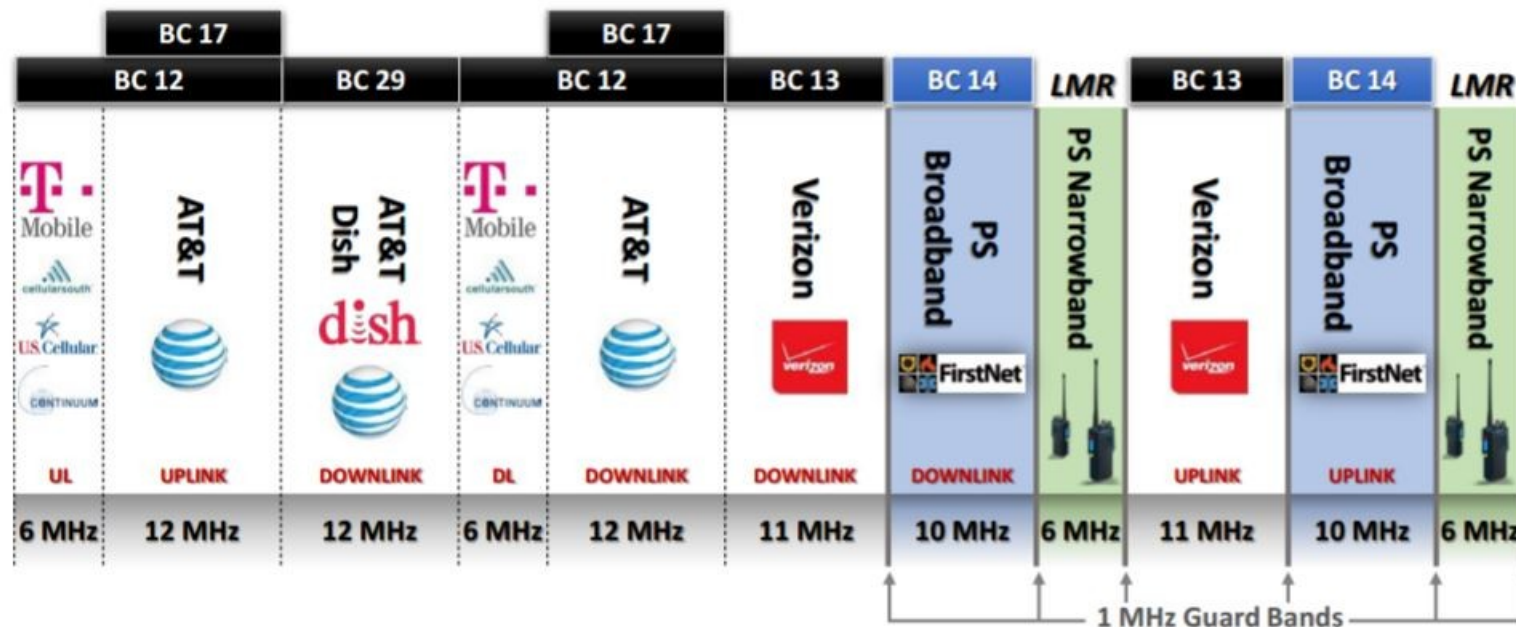
550+

Recognized
Tribes

FirstNet LTE Band 14

20 MHz of Spectrum @ 700MHz

- 3GPP standardized as LTE “Band 14”
- 10 MHz Downlink + 10 MHz Uplink
- Entire 20 MHz swath plus guard bands licensed nationwide to FirstNet
- Allows higher power portable/mobile devices – benefit to rural areas
- 3GPP Standards already in place for 1.25W devices



Non-Mission Critical

The Current State

Mission Critical

Commercial LTE Service / Devices



Data

Voice

Land Mobile Radio (LMR)
for Public Safety



Voice

Non-Mission Critical

The Near-Term Vision

Mission Critical



FirstNet LTE Service / Devices



Data

Voice

Land Mobile Radio (LMR)
for Public Safety



Voice

Devices for First Responders



Combination Radio/SmartPhone



Complications

Today's smartphones (smartdevices) are not one-handed devices

- Require two hands to operate

Most use touchscreen - Touchscreens not conducive to use when wearing gloves

- Not a problem when first responder is patrolling or sitting in a vehicle BUT it is a problem when on an incident

- Not designed for harsh environments

- Need built-in Card Readers, Barcode Readers, etc.

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 equipment is regulated country by country.

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

All transmitters require a *station license*.

Equipment that is tuned by frequency requires the operator to have an *operators license*.

Tampere Convention

The Tampere Convention treaty simplifies the use of 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 of 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.



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

Status of the 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

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



In some areas non-profit
local organizations are
assisting in wi-fi
restoration.



Companies are
also assisting

Cape Cod
Sunday
March 4, 2018

Undersea Volcanic Eruption near Tonga January 15, 2022



Tonga Volcanic Eruption

Ash plume blocked satellite communication.

Volcanic Ash covered satellite dishes.

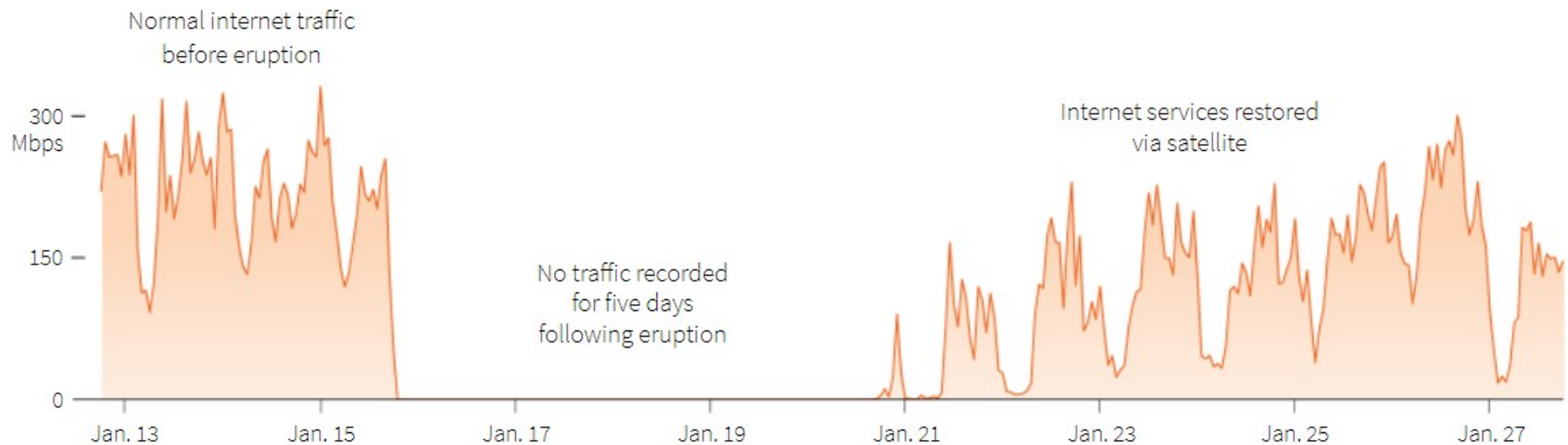
Undersea movement severed the main internet cable to the main island.

Cell sites on the islands were down.

Cables to outlying islands were severed.

Tonga Internet Traffic

Internet traffic in Tonga



Note: Internet traffic measured in hourly average of megabits per second (Mbps). Data is a sample of network traffic to all telecom operators in Tonga as monitored by Kentik. Does not represent all internet traffic to Tonga.

Submarine Cable Breaks



Restoration

Intra-island cell service was only minimally impacted.

Limited communications re-established 5 days after the eruption.

A repair ship took 20 days to replace a 92-kilometer section of the 827 kilometer long submarine fiber-optic cable that connects Tonga to Fiji and other international networks.

Cable Repair – CS Reliance



Other Radio Systems Helped

Chatty Beetles from NOAA (Iridium)



War on Ukraine

Ukrainian Military uses similar communications to Western Europe and the US.

Typical Motorola, Harris, Vertex

Almost all communication is encrypted using a 256-bit encryption algorithm.



Russian soldiers themselves report that the Ukrainian army uses the latest tactical radios manufactured by Harris, Motorola and Aselsan.



Starlink in Ukraine – Civil and Military

Starlink received permission to operate in Ukraine several weeks after the invasion. (28th Country)

Used by the Ukrainian Government to stream to other countries. - Rumored that all President Zelenskyy's connections to western governments are via Starlink.

USAID has provided Starlink terminals for Civil and Humanitarian operations.

Starlink in Ukraine – Military

British media reports that Ukraine's army is making very successful use of Starlink for drone attacks on Russian tanks and positions. The Telegraph reported that Starlink is of particular military significance in areas where the infrastructure is weak and there is no internet connection.

The aerial reconnaissance unit Aerorozvidka is using Starlink to monitor and coordinate unmanned aerial vehicles, enabling soldiers to fire anti-tank weapons with targeted precision.

An officer with the Aerorozvidka unit described the system to The Times: *We use Starlink equipment and connect the drone team with our artillery team. If we use a drone with thermal vision at night, the drone must connect through Starlink to the artillery guy and create target acquisition.*

Russian Military Communications

Open-source intelligence and Ukrainian reports suggest that radio communications across the Russian forces are poor

Makeshift solutions

- Unencrypted high frequency (HF) radio for long-range communications
- Baofang Walkie Talkies
- Mobile phones to communicate.

In contrast to the impression provided by the Russian Ministry of Defence (MoD) over the years that the majority of the Russian Armed Forces (RuAF) were operating digital radios and systems designed to facilitate planning and decision-making.

RUSSIAN FORCES IN UKRAINE USE CHINESE WALKIE-TALKIES

- » Russian President Vladimir Putin appears to have sent soldiers into battle with cheap hand-held radios.
- » As per reports emerging on social media, Russia's feared infantry is using China's Baofeng walkie-talkies.
- » These Baofeng walkie-talkies help communicate up to 5kms depending on the terrain.
- » These cheap and popular radio sets are popular with trekkers, camping and wildlife enthusiasts.
- » Baofeng walkie-talkies can be ordered from online shopping platforms for as low as ₹3,000 for a pair, including on e-commerce portals in India.



Таблица позывных должностных лиц ГАДн
на р/ст Baofeng

Состав сети	Позывные	
	Основные	Запасные
НА	Нева 77	Кан 99
КД	Байкал 12	Урал 73
НШД	Енисей 17	Обь 92
ЗКД по ВР	Терек 43	Лена 45
НРД	Амур 15	Яна 76
Командир 1 ГАБ	Волга 80	Тобол 47
Командир 1 ГАВ	Кама 11	Шипка 11
Командир 2 ГАВ	Кама 22	Шипка 12
командир ВУБ	Кама 33	Шипка 13
Командир 2 ГАБ	Днепр 87	Иртыш 23
Командир 1 ГАВ	Ангара 47	Ишим 21
Командир 2 ГАВ	Ангара 48	Ишим 31
Командир ВУБ	Ангара 49	Ишим 41
Командир 3 ГАБ	Катунь 12	Печера 81
Командир 1 ГАВ	Дон 65	Вятка 47
Командир 2 ГАВ	Дон 75	Вятка 48
Командир ВУБ	Дон 85	Вятка 49
НС –командир ВУД	Ока 76	Свияга 67
Командир ВОД	Хопер 45	Двина 83
Циркулярный	Кольцо 99	Круг 11
Переход на зап. частоту	Скачок 54	Занавес 62
Частота	435500	455200



Available in the US on Amazon

Amazon's **Choice**



BaoFeng UV-82HP High Power Dual Band Radio:
Portable Two-Way

★★★★☆ ~ 3,969

\$69⁸⁹ ~~\$98.99~~

✓prime Get it as soon as **Sat, Apr 23**

FREE Shipping by Amazon

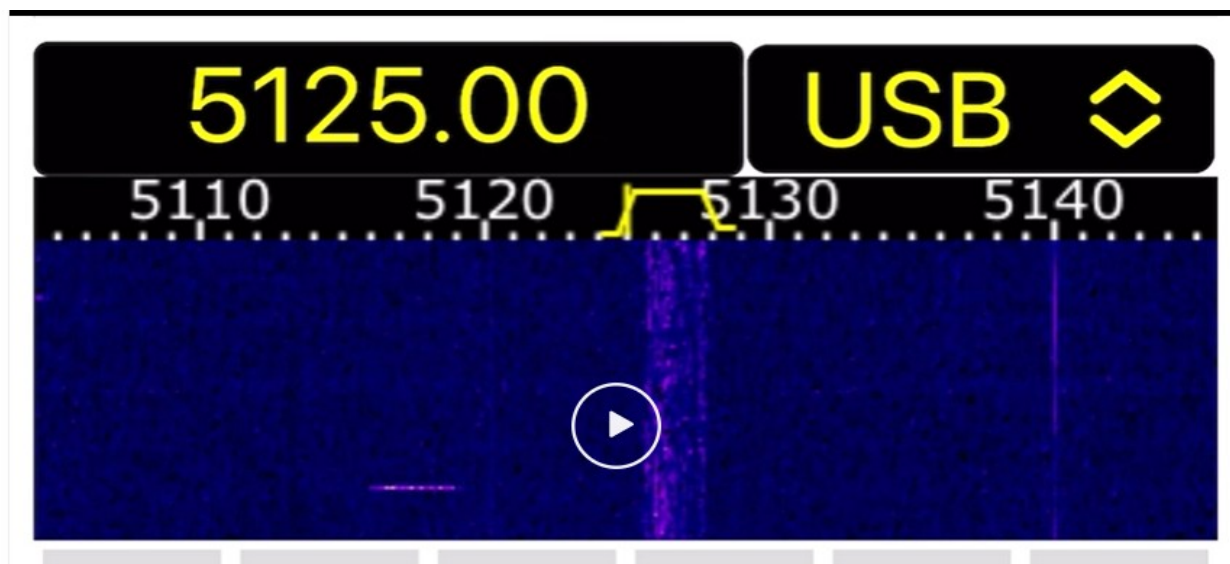
Disadvantages of BaoFeng Radios

Relatively easy for electronic warfare experts to exploit.

- Lack of discernible military-grade security means the radios should be relatively susceptible to straightforward jamming.
- Lack of security could make it easy to feed false or misleading traffic into networks depending on these radios.

Electronic Warfare

Playing the Ukrainian National Anthem over plain voice communications



The Pentagon confirmed Elon Musk's claim that SpaceX successfully defended its Starlink satellite broadband internet service against Russian hacking and jamming attacks.

Demos
and
Questions?