COBHAM

RADIO-BASED AND WIRELESS COMMUNICATION

– choices to be made, opportunities to be had

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RADIO-BASED AND WIRELESS COMMUNICATION

choices to be made, opportunities to be had

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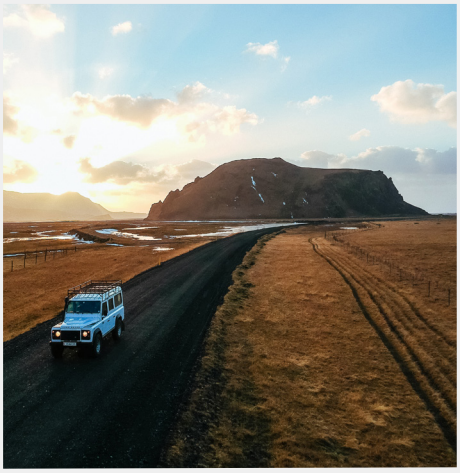

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1

RADIO-BASED AND WIRELESS COMMUNICATION

– choices to be made, opportunities to be had

Radio-based and wireless communication provides a key part of the infrastructure underpinning the ways that emergency services and public safety organizations operate. And in a world in which digital capabilities are the basis for virtually everything, they now also have to be able to deal with rapidly increasing volumes of data.

The desired capabilities are needed to provide emergency response capabilities of all kinds at times when lives, countryside, property and possessions are at risk and in danger.

This means these communication systems must work reliably at sharp-end, practical levels. This often also means having to work in extreme conditions and unplanned, unforeseen contexts.

Such communication is a technically complex field involving many different parties and perspectives at administrative, funding, decision-making and practical levels. The considerations involved usually include:

- The specifications and practical capabilities of your existing communication equipment
- How much these legacy setups and configurations limit or influence your decision-making
- Whether the technical decision-making at your organization or agency tends to be driven by top-down or bottom-up thinking
- How well that equipment meets your organization's current operating needs
- How much those operating requirements are likely to change in the near-term and long-term future – and how much of those needs will be digital
- Which technical standards and data privacy compliance requirements are in force
- Which levels of security and encryption are required – now and in the future
- The purchasing, operating and maintenance budgets you have available – now and in the future
- Public expectations and concerns about emergency response capabilities and the quality of service to be provided
- Political expectations about what your organization should be capable of in the future.

This means there is no best/worst or right/wrong decision. Effective planning, technical specifications and purchasing frameworks must take countless different concerns and priorities into consideration.

This often results in hybrid communication setups featuring gateways, patches and other kinds of linkages between different technology platforms, legacy installations and proprietary equipment.

2

CAPABILITIES, PRIORITIZATION AND CHOICES

There are many kinds of wireless and radio-based communication, each developed and used for certain purposes and user scenarios.

There are substantial differences between the technologies most widely used and best liked in different parts of the world – for all kinds of historical, political and strategic reasons.

However, the one common denominator is that field operatives need to stay connected while moving around to carry out their duties – but are not always within range of the towers and masts used in a particular wireless or radio-based network.

This is an outline of the most important technologies and types of networks most widely used for this, along with a broad overview of the pros and cons for each.

LAND MOBILE RADIO (LMR) networks

Land Mobile Radio networks usually consist of a private network solution. These kinds of proprietary networks normally use two-way VHF/UHF radios – either mobile (vehicle-mounted) or portable (handheld) – and repeaters that are often installed in a building with an antenna on the roof or on a tower or mast.

LMR radios can be used in two different ways. They can connect via the repeater network and talk to other radios that are quite far away but – crucially – also connected to the repeater network. Or they can operate in direct mode, with one radio communication directly to other nearby radios, without using the repeater network – but then the range is much less.

Over the years, LMR networks have evolved from traditional analog two-way radios that are quite limited in features and where voice communication quickly degrades with distance from the network, and are notably inefficient with regard to use of any chosen frequency spectrum.

By contrast, modern digital radios provide better voice communication quality and often also include features that include GPS location, emergency/man-down alerts and text messaging.

PROS AND CONS

of analog LMR networks and radios

1 Private network

ADVANTAGES

- Private, proprietary radio networks are not shared with other users. This means they don't get congested during critical events and emergencies.

DISADVANTAGES

- Only suitable for voice communication – not for data.
- Proprietary networks are only rarely able to communicate with each other – additional specialist equipment is usually required to link them together.
- Do not normally provide access to agency/inter-agency coordination and action structures.
- Building, operating and maintaining any proprietary radio network is relatively expensive.
- The operator organization or agency must serve as its own service provider, and therefore has to meet all deployment, maintenance and repair costs.
- Usually weak on security – communication encryption is rarely possible.
- Towers/masts and other infrastructure are very vulnerable to extreme weather, natural disasters, etc.

2 Features

ADVANTAGES

- Radios often include special features to alert others about a critical problem, such as man-down warning functions that indicate that an operative has stopped moving.

DISADVANTAGES

- Radios are not as sophisticated as cellular phones and do not include often-needed capabilities such as web access, navigation, data transfer, etc.
- Making a call from a radio to a cellular phone is normally impossible, although it *can* be done with considerable expensive additional hardware.

3 Coverage

ADVANTAGES

- Owners and operators determine coverage by building (or contracting) the network needed for any specific set of capabilities and user requirements.

DISADVANTAGES

- Placing repeaters in distant locations to increase and improve coverage can result in expensive backhaul connections to the other repeaters.

THE KINDS OF EQUIPMENT NORMALLY NEEDED

- Towers/masts
- Backhaul equipment
- Network core
- LMR radios – either mobile or handheld
- Dispatch consoles and operators

THE KINDS OF EQUIPMENT NORMALLY NEEDED TO UPGRADE OR EXTEND EXISTING LMR NETWORKS AND RADIOS

- Additional towers/masts
- Additional repeaters
- Backhaul equipment
- Additional radios

DIGITAL MOBILE RADIO (DMR) NETWORKS

As the name implies, digital radio networks use digital technology to transmit or receive data and voice communication across the radio spectrum.

Digital radio networks have become increasingly popular since the 1990s. Digital capabilities make it possible for operatives to communicate effectively with each other as well as with dispatchers and inter-agency coordination setups. Digital capabilities also help open up access to a wide range of back-end systems and the increasing use of Internet Protocols for transmitting video, surveillance and monitoring footage.

In many cases, encryption is also essential. In practical terms, this is only really possible with digital hardware.

PROS AND CONS

DMR networks and radios

1 Private digital radio network

ADVANTAGES

- Can usually provide voice communication of higher quality than analog LMR – with encryption if needed.
- Often used to help extend the service life of obsolescent analog radio equipment and legacy communication infrastructure, by adding digital capabilities.

DISADVANTAGES

- Digital capabilities available from legacy solutions hardly ever live up to the functionality requirements associated with modern operating environments.
- Patching together different legacy systems and proprietary hardware rarely gives a satisfactory, fit-for-purpose communication solution.
- Any analog/digital mix usually results in big restrictions on capabilities – so it's often considered a "least worst" compromise solution.
- Towers/masts and other infrastructure are very vulnerable to extreme weather, natural disasters, etc.

2 Features

ADVANTAGES

- GPS location, texting, talker name, alert messages, etc.

DISADVANTAGES

- Relatively high cost of deploying, operating, maintaining a private LMR network.

3 Coverage

ADVANTAGES

- Better coverage and voice quality compared to analog LMR networks.

DISADVANTAGES

- Relatively high cost of adding more towers, masts, etc. in order to improve and extend coverage.

THE KINDS OF EQUIPMENT NORMALLY NEEDED

- Towers/masts
- Backhaul equipment
- Digital radios – either mobile or handheld
- Dispatch consoles and operators

THE KINDS OF EQUIPMENT NORMALLY NEEDED TO UPGRADE OR EXTEND EXISTING DMR NETWORKS AND RADIOS

- Additional towers/masts
- Additional repeaters
- Backhaul equipment

CELLULAR NETWORKS

Nowadays most people carry a cellular mobile phone. People all over the world are familiar with cellular phones and how to use them, and they usually work fairly well. They often contain mobile apps that can be particularly useful in performing and documenting work tasks.

However, cellular phones have important limitations with regard to signal coverage and with regard to communication prioritization in the event of emergencies, accidents or disaster situations.

PROS AND CONS

of cellular networks

1 Public network

ADVANTAGES

- Works well with both voice and data.
- Under normal circumstances, wireless communication using cellular networks is reasonably reliable.
- Cellphones are familiar and relatively simple to use, which means less user training is required.

DISADVANTAGES

- All users are contending for the same limited bandwidth, resulting in major congestion and service fall-outs whenever there is a big event or an emergency.
- Service can be cut off completely in emergencies and disaster scenarios that affect power supplies and damage cellular towers/masts and other infrastructure.
- Cannot act as substitutes for analog or digital radio networks – can only serve as a supplement.
- Do not normally provide access to inter-agency coordination and action structures.

2 Features

ADVANTAGES

- Mobile apps are available to help provide users with job-related specialist capabilities.
- This can help make manpower more cost-effective as well as providing better service quality.

DISADVANTAGES

- Extra steps must be taken to ensure voice and data privacy.
- Device management of workers' phones is critical to ensure they are only used as intended.

3 Coverage

ADVANTAGES

- You can select which mobile operator offers better coverage in your area.

DISADVANTAGES

- Reliable coverage is normally only available in more populated areas.
- Many remote and rural areas often only have limited, patchy cellular coverage – or none at all.
- Towers/masts and other infrastructure are very vulnerable to extreme weather, natural disasters, etc.

THE KINDS OF EQUIPMENT NORMALLY NEEDED

- Devices (handsets, tablets, cellphones, etc.)
- Computers (optional)
- SIM cards + subscriptions

THE KINDS OF EQUIPMENT NORMALLY NEEDED TO UPGRADE OR EXTEND THE CAPABILITIES OF CELLULAR NETWORKS

- Cellular networks are upgraded by the provider, rather than the users/customers

SPECIALIZED CELLULAR NETWORKS

These are special wireless broadband networks specifically allocated and reserved for use by first responders and public safety organizations. These aim to help rectify the many problems that conventional cellular networks give with regard to incompatibility and lack of interoperability between the wireless communication systems used by individual agencies and public safety organizations when emergencies arise.

One example of such ring-fenced specialized cellular networks is FirstNet in the US. Other similar government-sponsored networks have been – or are being – set up in Australia (LANES), South Korea (Public Safety LTE) and the UK (ESN).

In the event of emergencies and disasters, normal commercial cellular networks usually get blocked quickly when lots of people are trying to make calls at the same time. By contrast, a specialized cellular network runs on a separate core network operating on a particular frequency spectrum set aside for exclusive use by first responders and other agencies and operatives responsible for public safety or critical infrastructure activities. This means it always remains available to those who need to use it.

Nevertheless, specialized cellular networks are not a replacement for LMR networks or commercial cellular networks. They are designed to piggy-back on the infrastructure available from mainstream commercial cellular networks, and are therefore subject to most of the same weaknesses, vulnerabilities and disadvantages.

Despite considerable efforts made to establish robust, resilient cellular networks, there are many scenarios – including extreme weather and natural disasters – in which such networks are almost certain to fail, leaving users unable to connect.

PROS AND CONS

of specialized cellular networks

1 Public-sector cellular network for emergency services and first responders

ADVANTAGES

- Can provide both voice and data communication services.
- Priority and preemption ensure that critical communications get service first.
- Deployment and maintenance costs for the network are paid for by the network operator.
- Built on top of existing cellular networks, resulting in certain cost savings.

DISADVANTAGES

- Specialized cellular networks are designed to "piggy-back" on traditional commercial cellular networks, and are therefore subject to most of the same weaknesses, vulnerabilities and disadvantages – including being easily affected by extreme weather, natural disasters, etc.
- There are often practical issues associated with prioritizing access for different groups of first responders and other public safety organizations.
- Do not normally provide access to inter-agency coordination and action structures.

2 Features

ADVANTAGES

- All the features people normally use on their smartphones are still available, and at similar cost.

DISADVANTAGES

- Organization-specific device management measures are normally needed to make sure these units are only used as intended.

3 Coverage

ADVANTAGES

- The coverage provided by specialized cellular networks is usually aligned with a particular provider's commercial coverage, which usually extends over the more populated and traffic-intensive areas in any particular region or country.

DISADVANTAGES

- Many rural and remote areas are not covered by commercial cellular coverage at all, and therefore cannot access these kinds of specialized cellular networks.

THE KINDS OF EQUIPMENT NORMALLY NEEDED

- Devices (handsets, etc.)
- Computers and tablets (optional)
- Proprietary agency-restricted SIM cards and subscriptions

THE KINDS OF EQUIPMENT NORMALLY NEEDED TO UPGRADE OR EXTEND THE CAPABILITIES OF SPECIALIZED CELLULAR NETWORKS

- Specialized cellular networks are normally upgraded by the provider, rather than the users/customers – under contract and via tender, etc.

SATELLITE-BASED NETWORKS

Once considered unusual and high-tech, satellite-based communication is now mainstream and well on its way to commoditization. On January 1, 2021, there were 2,224 communications satellites registered in Earth orbit, and the number is now growing fast. For example, in 2018, the US Federal Communications Commission approved plans to send 12,000 Starlink satellites into orbit[1].

Satellite-based communication wireless networks now play a pivotal role in modern life. They have the big advantage of high reliability in the most rigorous conditions, because they avoid almost all the vulnerabilities and practical drawbacks encountered with ground-based hardware.

This makes them ideal for use – either as prime infrastructure or as a supplement to other systems – whenever conventional land-based wireless networks are inadequate or unsuitable.

Satellite-based networks are also almost the only choice for radio-based and wireless communication over extreme distances, because all the costly ground-based infrastructure is not needed.

[1] https://www.scientificamerican.com/article/starlink-internet-from-space-and-the-precarious-future-of-broadband-in-rural-america

PROS AND CONS

of satelite-based networks

1 Public commercial-grade network

ADVANTAGES

- Provides both voice and data communication services.
- Always available and very reliable.
- Quickly scalable at relatively low cost.
- Avoids most vulnerabilities with ground-based hardware and installations. Unaffected by weather, natural disasters, etc.

DISADVANTAGES

- Often perceived (incorrectly) as relatively new/complicated and untried.
- Often perceived (incorrectly) as relatively expensive to use.
- Possible problems with getting contractually and technically "locked" into services provided by a specific satellite service provider.

2 Features

ADVANTAGES

- Voice communication costs are relatively low.
- Many satellite operators now provide flat-rate airtime packages that ensure fixed, budgetable monthly costs for as-needed roaming.

DISADVANTAGES

- Traffic costs are normally higher than the corresponding costs for use of cellular networks.
- Data transfer rates are often relatively slow compared to cellular services.

3 Coverage

ADVANTAGES

- Coverage is available almost everywhere, even in remote places lacking communication infrastructure, or where the infrastructure has been damaged or destroyed.

DISADVANTAGES

- Coverage is only available if there is a clear view of the sky – signals can get blocked if users are underground or inside buildings or other structures.
- Not suitable for indoor use.

THE KINDS OF EQUIPMENT NORMALLY SNEEDED

- Satellite terminals
- Computers and tablets
- SIM cards and subscriptions

THE KINDS OF EQUIPMENT NORMALLY NEEDED TO UPGRADE OR EXTEND THE CAPABILITIES OF SATELLITE-BASED NETWORKS

- Satellite-based networks are normally upgraded by the provider, rather than the users/customers – under contract and via tender, etc.


COMPLICATED
DECISIONS

3

Each of these technologies has – or once had – its own advantages.

Our experience with wireless and radio-based communication setups all over the world is that such preferences and decisions are rarely wholly technical or entirely operational. Certain systems and configurations are often seen as having certain specific advantages because of history, geography or special-interest concerns and influences.

At "lower" operational levels, familiarity often has a big value – people know what they're used to working with and have perhaps built up years' of practical experience with a particular system. For all kinds of practical reasons, users often perceive change as difficult, bothersome and time-consuming. On the other hand, administrators and decision-makers often associate change with downtime, big costs and needs for lots of costly training.

This all tends to mean there is no best/worst or right/wrong choice if you're faced with decisions about communication solutions for the future.

NOWADAYS, THE FOUR *BIG*, BASIC CONSIDERATIONS TEND TO CENTER AROUND:

- The need for reliable, seamless signal coverage that users can rely on – and *know* they can rely on
- The scope of digital services required – particularly whether or not video feeds are needed
- Old equipment and proprietary systems usually involve extremely high operating, maintenance and service costs, as well as security and logistics vulnerabilities. This often results in life cycle costs that far outweigh initial purchase prices and CAPEX outlays
- The bandwidth available to facilitate these continually expanding functionalities and services

4

MIX'N'MATCH

In real-world scenarios for wireless and radio-based communication operations, it's rarely a question of either/or – for at least three main reasons:

- Few public safety organizations have setups that are even close to ideal – perhaps not even when they were originally installed. In emergency services and other parts of the public and para-public sector, many purchasing decisions end up being compromises – sometimes technically and operationally unfortunate ones.

  In our experience, purchasing decisions about communication hardware and systems are often based on unholy mixtures of practical expediency, budgetary constraints and the dark art of the "perceived possible". Pragmatic patching and practical "fixes" based on legacy equipment tend to take precedence over the kinds of technical innovation and forward-looking new thinking that could enable big leaps in operational capabilities and efficiency.

- The communication setups that most public safety organizations use feature a mixture of legacy equipment, with a range of specialist systems and hardware with customized functionalities tacked on. Standardization is often limited, which tends to mean prices are relatively steep.

- Decision-makers rarely want to make major capital investments in new infrastructure, and therefore often tend to prefer to "mix'n'match" any new hardware with existing setups, to help keep capital costs down and limit practical service disruptions.

This is why integration, improving, enhancement, linking and switching between any networks and equipment currently available are often the easiest way for operators to ensure cost-effective access to voice and data services in any given location.

5

THE "INTEGRATION APPROACH"

Intelligent, vendor-agnostic application of this kind of "integration approach" often paves the way to an organization being able to make the most of the systems already has.

This in turn often helps significantly reduce the need to invest the really big bucks into installing and maintaining new equipment and infrastructure, even if that might be the ideal solution.

However, it also places considerable demands on suppliers of traditional radio networks and ancillary equipment for these. Such companies are often "wedded" to and locked into proprietary solutions or legacy technology, and have vested interests in highlighting and emphasizing the benefits of these. Such kinds of "tunnel vision" and proprietary ring-fencing rarely give the best answers, and are unlikely to put decision-makers in line for technical solutions tailored to their organization's specific operating requirements and service priorities.

In the real world, and with modern technical capabilities, the situation is usually much less "black and white". A lot is possible with relatively limited investment and changes, by applying appropriate combinations of know-how, hardware and modern digital capabilities that together enable operators to escape from legacy limitations and restrictions, and provide new opportunities for better, more capable, more cost-effective communication frameworks.

6

"AUGMENTED NETWORKS"

In the specialist world of resilient communication, the current magic words for introducing future-proof value for money are "augmented networks".

This usually refers to systems that make it possible to "mix'n'match" – combining legacy systems with new technology, seamlessly linking different familiar, amortized communication setups to get "the best of multiple platforms", based on the practical needs of each individual operator and organization.

There is no "one size fits all".

Just a question: "What size fits you?"

7

BYOD – BEST FRIEND ON THE JOB

It's a basic, practical fact of life that people tend to prefer to stick with equipment they know and are familiar with – "better the devil you know than the devil you don't".

In unpredictable – sometimes dangerous – situations in which a lot can be at stake, a communication device can quickly become an operative's "best friend".

For system administrators and decision-makers responsible for purchasing and commissioning new hardware for entire organizations communication networks, such thinking amounts almost to bring-your-own-device (BYOD).

There can be big value in the ability to join up the dots and link together existing, familiar hardware, while providing new levels of reliability, coverage and capabilities.

8

DIGITAL FLEXIBILITY FOR THE FUTURE

Modern radio-based and wireless communication solutions using digital technologies can pave the way to high-quality, high-bandwidth linkages – encrypted for maximum operational security, if and when needed – that provide stable, reliable transmission of voice, data and video, incorporating and linking up virtually any kind of legacy hardware and existing solutions.

Digitally driven solutions also provide maximum future-proof flexibility along with pathways to a comprehensive selection of new software-based tools and functionalities, and strong improvement, renewal and update paths.

Photos: Shutterstock and unsplash: Robert

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