

# Improve radio coverage

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## White Paper

John Yaldwyn  
*Chief Technical Officer*  
4RF Communications Ltd  
New Zealand  
[www.4rf.com](http://www.4rf.com)

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## Introduction

Low-capacity, point-to-point digital radio offers a cost-effective means of extending coverage to areas with poor communications infrastructure.

A common concern among network operators is extending voice and data connectivity to areas with poor or non-existent communications infrastructure. Two obvious examples are public safety networks located in remote areas and rural subscribers who require telephone and high-speed Internet access. But even in urban areas, adequate coverage may be elusive; there are often critical mobile radio network sites such as hilltops that suffer from poor fixed network access.

To solve these connectivity difficulties, a growing number of network operators are turning to low-capacity digital radio technology to provide “thin-route” connections. The technology is gaining favor among a wide spectrum of users, including private land mobile radio, utility companies, and public safety organizations.

## Connectivity Options

Operators that need to provide communications in suburban and rural areas have three basic delivery options: traditional copper wireline connections, fiber, or radio. While satellite has its place in serving the most isolated areas, it is generally not a viable option due to its prohibitive cost and technical issues such as circuit latency.

In cases where initial installation costs can be justified, copper and fiber installations may be appropriate, particularly in areas where growing demand for bandwidth is expected. In rural areas, copper and fiber connections are rarely warranted, however, since the trenching or pole line costs are too great when only a few homes or a radio base station are being served.

Because of these considerations, radio is often the operator’s transmission method of choice as it allows them to control costs while effectively providing coverage over difficult terrain. Several radio transmission methods can be used, including microwave, conventional analog, wireless LAN, and point-to-point digital radio. The question then becomes, which is the most appropriate radio-based solution for the application?

In many low-density rural applications, classic microwave transmission solutions typically offer far too much capacity and overhead. For example, PDH microwave connections deliver a minimum of 30, and typically 120, voice circuits. For many mobile radio operators, the capital costs of microwave radio transmission systems have until recently been too high to justify their use on the low-traffic links typical of public or private mobile radio networks.

At the other extreme is conventional analog radio. While analog systems are cost-effective for one or two voice-circuit connections, they lack support for RS-232/V.24 or Internet protocol (IP) connections over Ethernet-type data connections, making any cost gain a short-term benefit. In the long term, the demand for Internet and other enhanced services will likely drive operators to replace their analog systems with a digital alternative.

Wireless LAN systems, while providing a low-cost option for connectivity, have a limited and rather ad hoc range. And as their popularity grows, so does their susceptibility to interference from other users. Service quality cannot be guaranteed, given the unlicensed nature of the radio spectrum used, and even if a suitable wireless LAN

solution is engineered, all traffic must be converted to IP prior to connecting via the LAN interface. This requires operators to purchase expensive additional equipment to go with this otherwise “low-cost” option.

Recent advances in RF design, electronic integration, and high-performance modulation techniques have opened the door to a new breed of low-capacity, point-to-point digital radio systems that use licensed radio bands to provide highly efficient, reliable, and cost-effective transmission solutions. These carrier-grade digital radio solutions also feature high-performance modulation techniques such as forward error correction (FEC) algorithms, digital transmission interleaving, and advanced radio equalization to minimize any potential transmission degradation due to atmospheric effects and other interference sources.

The use of licensed radio bands ensures robust and reliable service to end users since the operator has exclusive use of the frequencies, which keeps interference to an absolute minimum and guarantees the performance of the radio solution.

In today’s mobile world, digital connections are necessary to support the newer digital mobile networks such as Project 25 and TETRA. Older systems such as EDACS and MPT-1327 need a mixture of analog voice and digital signaling connections. The new digital radio products support both analog and digital mobile radio networks. This makes the operator’s decision to upgrade from analog trunked radio to digital easier, as the existing radio link infrastructure can often remain unchanged.

For organizations that currently lease telco circuits, installing a wireless link can pay for itself in two to three years. While cost savings are often significant, improved control and security can be decisive factors. For applications driven by security concerns, a company or organization may prefer to set up and control its own links, saving on long-term communication costs and ensuring data security and integrity.

### **Who Needs Low-Capacity Digital Radio?**

Low-capacity digital radio is finding favor among a wide group of users, including private land mobile radio networks, oil and gas utility companies, public safety organizations, and traditional telephone companies.

The technology can bring modern phone and Internet access to individuals, communities, and businesses in remote locations or near physical barriers such as mountains, oceans, and deserts. Communities that until now have endured antique analog country sets or congested Internet-unfriendly multi-access radio systems can directly connect to the regional public-switched telephone network and the World Wide Web.

The traffic in these wireless point-to-point applications is often a mix of voice and IP computer communications, but in some cases — such as in remote monitoring and control in electrical distribution, oil and gas, and similar industries — the main traffic load may be telemetry data.

Low-capacity links are also frequently used in the trunked mobile radio networks used by police, fire, and other emergency services. They are even deployed in metropolitan and urban environments where leased copper lines are simply not available.

Geography is another driver for low-capacity wireless links. Companies in the oil, gas, and mining fields, for example, often have operations in remote areas where there is no existing wired telecom infrastructure. With these types of operations now going high-tech with remote control and enhanced monitoring, there is a need to

establish modern voice and IP-based computer communications for both permanent and temporary sites in remote locations.

Yet another situation where wireless point-to-point systems can be used is in a region or country where the telecom infrastructure has been damaged and needs rebuilding as quickly as possible. In such cases, the wireless links may serve as a long-term or temporary solution until the wired infrastructure is in place, at which point the wireless links can easily be taken down and redeployed elsewhere.

### **Integration Holds the Key**

One factor that has lowered the cost barrier to rolling out digital radio technology on low-traffic routes is the integration of radio and multiplexing functions. Integration not only reduces acquisition costs, it provides lower installation and lifetime costs for power supply, spares, servicing, and training.

Low-capacity digital radio systems are now available with a ready-to-go, predefined combination of connections. For example, they may contain a mixture of analog telephone lines and a high-speed digital IP circuit. As requirements change, the interface cards can be swapped. For more complex networking requirements, operators may choose a multislot digital radio product that offers highly flexible combinations of circuit-switched voice, fractional E1 (2 Mbps), and IP connections. Such systems are ideal for applications where the radio link must cost-effectively fulfill a range of requirements, such as a mixture of analog and digital networks in a single product.

A key advantage of low-frequency digital radio systems is the range they provide. Digital radio systems operating in the UHF and lower microwave frequency bands (300-1500 MHz) typically offer a working range of 60 to 70 kilometers. And depending on factors such as the terrain and mast height, distances of more than 100 kilometers can reliably be covered.

Digital control techniques enable tight channel spacing that makes very efficient use of available radio spectrum, which is especially valuable in areas where spectrum is in short supply. The latest digital radio systems require just 25 kilohertz of radio spectrum to provide more than 100 kbps of digital traffic. In wider radio channels, 500 kilohertz of radio spectrum can carry a mixture of telephone and data traffic up to a total bandwidth of 2 Mbps or more.

The development of low-capacity, point-to-point digital radio systems is enabling a new generation of highly flexible linking solutions for a variety of multiple-technology radio networks and subscriber and private network applications. These new technologies facilitate more reliable and economical connections, and the integrated design of recent product offerings makes the deployment of such solutions extremely simple.

The benefits enable operators of public telephone, mobile radio, and private networks to implement high-quality telecommunications links efficiently and at lower price points.

John Yaldwyn is the *Chief Technical Officer* and founder of 4RF Communications Ltd. 4RF provides carriers throughout the world with high-performance Aprisa™ digital UHF and microwave wireless access solutions for the transmission of voice and data in remote broadband applications. [www.4rf.com](http://www.4rf.com)