Next Generation Transport Microwave for 3G Network Infrastructure

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Abstract: Innovative communication tools have always led to rapid advances in economic and social development. In the face of rapid change and complex technologies, wireless service providers who are responsible for choosing network transport must balance economic, security, performance, efficiency, application use, and existing infrastructure issues against the pressures of market expansion, technological change, unpredictable subscriber preferences, and competition. To a large extent, their company's profitability and competitive advantage will hinge on their choice. Digital microwave radio has proved to be a cost effective, efficient to install and reliable means to build a wireless infrastructure. This paper describes the attributes of cost effective wireless transport infrastructure and demonstrates how modern digital microwave can meet these requirements, and specifically show that the new Harris Stratex Networks TRuepoint ® 6000 radio platform is uniquely qualified to do this for operators worldwide.

Keywords: microwave, radio, wireless, infrastructure, telecommunications

1. PROVEN TRANSPORT MEDIUM

One transport medium has proven over time to provide the flexibility, reliability, and cost-effective deployment characteristics critical to a wireless service provider's infrastructure backbone. Digital microwave radio is the transport technology of choice for meeting low or medium capacity needs using Plesiochronous Digital Hierarchy (PDH); fulfilling high and very high capacity requirements with Synchronous Digital Hierarchy (SDH); applications in the current and next generation wireless infrastructure. A proven concept, digital microwave is easily implemented to meet rapidly-changing service needs. With its suitability for carrying PDH, SDH, and IP/Ethernet services, digital microwave transport offers a compelling alternative to other transport mediums.

Several new market trends are combining into play with the wide scale rollout of hybrid conventional voice (TDM) and new IP services. As the boundary between traditional PDH and SDH is diminishing, software-programmable traffic capacity and type (PDH/SDH/IP), bandwidth radio must handle dynamic bandwidth allocation for TDM and IP data. A single radio terminal can serve more network applications than before without external terminal equipment, such as TDM, IP, mixed TDM/IP, add-drop, ring protection.

Critical attributes or contemporary digital microwave include

- Versatility—to support diverse network requirements
- Compact and highly integrated
- Flexible and upgradeable
- Rapid installation, easy maintenance

A lower cost of ownership is a paramount consideration.

1.1 Which Transport Choice is the Best Choice?

In today's bandwidth-hungry applications for a new 2G - 2.5G and new 3G and 3G+ modernized wireless networks transporting voice, data wideband IP, utility protection and control, crucial public safety, or other circuits networks, fibre transport is an excellent choice for networks requiring extremely large capacities of multiple STM-N of 2.4 Gbit/s or greater. However, a major impediment to fibre is its cost of installation, including the costs of right-of-way facilities and civil engineering. A second disadvantage of fibre is its vulnerability to route damage over long service times. Microwave transport offers technical and economic advantages when availability, cost effectiveness, implementation time, and/or terrain are significant system design considerations. Considering "capital expense", CAPEX, the installed cost of approximately 5 - 10 km of fibre can be about the same as a link of radio, which may extend over 40 - 50 km.

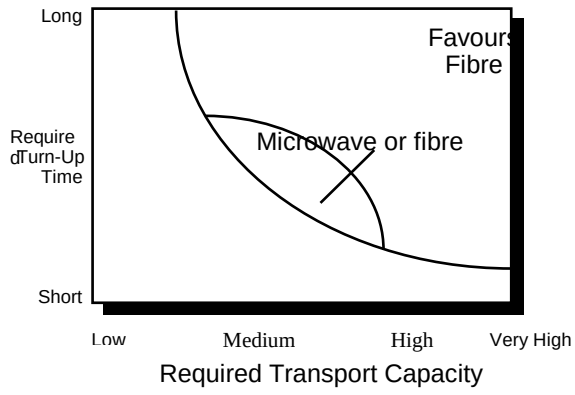
The selection of digital microwave radio, lightwave, or both technologies, may encompass one or more of the following:

- Commissioning time schedules,
- System cost objectives,
- Terrain, geoclimatic, access, and other off-premises construction and long-term operational conditions,
- Bandwidth requirements,
- Availability and performance objectives,
- Rights-of-way for fibre and suitable site locations for microwave facilities and infrastructures,
- Route security concerns - fading in radio links; backhoe cuts, lightning, gophers, cable deterioration in fibre optic routes, and path-blockage fog in free-space optical (FSO) links.
- Personal preconceptions and experiences.

With all this, the selection of a transport medium (owned or leased, copper or fibre, wireless optics or radio) as an optimum choice for a user's needs and objectives by an outsider can be challenging for the system operator

Microwave and lightwave are no longer competing telecom transport and access media, but compatible network elements both important to the optimum planning and deployment of new and upgraded networks and systems meeting the critical needs of present-day users, as seen in Fig. 1.

Microwave allows rapid network deployment over any terrain. Microwave can provide telecommunications service in hours—rather than days or weeks—reducing time to market for new services. Space-efficient modular design and outdoor enclosures allow integration in close quarters, reducing installation costs and completely eliminating civil engineering and right-of-way delays. Microwave gives you far greater flexibility to quickly add capacity and accommodate rapid growth in services and subscriber base.



This demonstrates the relationship between "Required Transport Capacity" and "Turn-up Time" for microwave and fibre applications. Microwave is favoured for quick turn-up, low, medium, and high capacity applications. Whereas fibre is favoured for long lead-time, very high capacity applications.

Increase Cost Effectiveness

Ease of deployment eliminates civil engineering and right-of-way costs. A product family concept provides a broad selection of capacities and frequency bands, which reduces the necessary spares complement and personnel training requirements. Automated management and alignment features significantly reduce monitoring and maintenance costs. As the number of subscribers grows, it is critical that the network can be upgraded without additional large capital outlays for transport.

Guarantee Reliability

Subscribers expect dial-tone service availability, and will churn without hesitation to find a reliable service. By eliminating fibre optic link backhoe fade and providing high component reliability, microwave transport delivers better than 99.999 percent service reliability—less than 12 minutes of short-term, two-way outage per year with no traffic disconnect. Robust digital features, such as simplified local and remote diagnostics to card level, integrated system-wide network management system, and instrumentation ports increase system availability and performance by reducing troubleshooting and restoration time. You can ensure your subscribers of around-the-clock service availability and ensure yourself of high levels of customer satisfaction.

Ensure High Quality

Quality is critical to a competitive advantage, and digital microwave delivers inherent high quality and security. Signal processing techniques such as Forward Error Correction and adaptive equalization result in a low error floor and a high dispersive fade margin (DFM). These factors characterize good radio performance in the presence of spectrum distortion. Digital microwave eliminates multi-hop noise, and is resistant to fading and interference. The result is high-quality transmission, regardless of path or distance.

Improve Transport Efficiency

To maximize your network's effectiveness, you need to be able to carry multiple services to meet a wide range of subscriber need. Microwave is the ideal platform for transporting legacy PDH traffic, as well as high-speed SDH traffic and the new IP/Ethernet based data and broadband applications. In more challenging climate and terrain applications, various diversity techniques are used to ensure stringent performance standards are met. Receivers employ errorless data switching, which by definition,

contributes no bit errors during diversity switching between receivers. This results in reduced latency, because retransmission activity is reduced and higher performance, enabling service providers to increase throughput and maximize network efficiency.

Maximize Network Control

Microwave provides unmatched network control. Owning your own network gives you complete control over site access and repair time. You also gain clear channel, superior reliability, higher security, and higher quality performance than you can obtain from leasing someone else's lines. Expansion or relocation of sites is easier when you own your network. And from a financial standpoint, microwave keeps delivering high-quality, reliable service long after a leased-line payback period has passed.

Simplify Network Management

Microwave transport can greatly simplify network management. Equipment performance anomalies are quickly located by an integrated performance monitoring and efficient graphical analysis tools, and a network monitoring system and resolved by card or module replacement—not by manually tweaking analogue components. Remote supervision and maintenance features simplify monitoring of remote or inaccessible network segments. If necessary, modules can be replaced simply by plugging in a new unit. Auto-alignment and self-reporting features eliminate the need to buy and maintain expensive test equipment. Auto tuning ensures that the radios continually optimize performance, and electronic inventory automatically assesses equipment to save time and increase accuracy. Built-in network management tools enable remote monitoring and control of microwave sites and enable channels to be integrated and provisioned from a remote location.

1.2 Lower Total Cost of Ownership

There are three stages in network deployment where cost benefits can be realized.

- Initial system set-up
  - Minimized equipment cost

    TRuepoint® 6000 is compact (1:3 occupies a partial rack with 12 radios accommodated in a 2200 mm/7 ft rack) and integrated design minimizes racking space occupancy. Built in multiplexer, ring protection, nodal configuration and software provisioning between TDM and IP, save cost of external ADM equipment, extra radios, OEM switches and extra bandwidth. Adaptive power amplifier technology allows more power without using bigger and more costly additional amplification.
  - Simplified system planning

    Simplified by a versatile network architecture support; full flexibility to offer best fit for customers' networks, and a choice of commonly deployed 1+1 repeater configuration or multichannel M:N single vendor supply.
  - Speed deployment / installation & commissioning

    Advanced user-friendly configuration tools and advanced and efficient equalization and connection feature simplifies installation.

- Cost Effective Operation and maintenance
  - High system reliability and security

    High system gain, ATPC/RTPC, Reverse Channel Switching and anticipatory errorless receive switching are advanced technologies that assure high reliability and save cost related to path fading or failures. Industry leading SNMP with Security options brings high security to customer networks.
  - Advanced network monitoring and diagnostics capability
  - Ease of trouble shooting and maintenance
  - Less sparing
  - Simplified training

- Fast and Easy System upgrade / network expansion
  - Minimized cost for upgrade / expansion – "Pay as you Grow"
  - Minimize traffic impact during system upgrade
  - Less rack space or real estate required

In summary, The Harris Stratex Networks TRuepoint® 6000 has been designed to meet all these attributes

2.0 Transport Equipment Characteristics

The TRuepoint® 6000 Platform radio is designed to provide very reliable links carrying low to medium capacity PDH traffic (available in North America only), high and very high capacity SONET/SDH, Ethernet data, and Mixed PDH and Ethernet data for all markets in Africa, Asia, Europe, Middle-East, North America (PDH), South America.

For worldwide CEPT/SDH applications, TRuepoint® 6000 provides a full transparent ITU/ETSI confirming STM-1 transport airlink with a choice of TDM Electrical, Optical and IP Ethernet Interfaces with non-protected (2 fibres) or protected (4 fibres) connections to standard ITU/ETSI conforming multiplexers. Dynamic bandwidth allocation provides flexible capacity assignment to TDM and Ethernet LAN/IP interfaces. A nodal architecture supports transmissions in multiple directions within a single chassis.

The TRuepoint® 6000's 440 mm single-chassis supports up to:
- Two 1+1 terminals,
- Four 1+0 T/Rs,
- A 1+1 repeater,
- TRuepoint® 6500 0:4/1:3 multiline.

TRuepoint® 6000 can be easily field-converted from a 1+1 Hot Standby-Non diversity, Frequency Diversity, or Space Diversity to TRuepoint® 6500 1:N in the same chassis without a backplane change.

The conversion comprises adding a new M: N Antenna coupling Unit (ACU), plugging in modules, and provisioning the software.

The TRuepoint 6500 ® radio can be configured with up to three chassis on a single rack to accommodate up to 12 RF channels in either 0:12 or 1:11, depending on the frequency band, with the full ETSI/ITU conformance

A key characteristic to deploy radios in the many varied worldwide frequency band arrangements are antenna coupling unit (ACU) options with a wide variety of optimal RF transmission architectures and expansion ports to easily accommodate parallel radio paths for capacity expansion. With a built-in Co-Channel Dual Polarization (CCDP) frequency plan and radio equipped with a Cross-Pol Interference Cancelling (XPIC) function, users can double the hop's capacity over the same RF channel, significantly reducing licensing fees.

TRuepoint® 6000's advanced transmission features ensure robust performance under a variety of normal — and even the harshest — environmental conditions. In 1:1, 1:N and space or quadruple diversity configurations, Anticipatory Errorless Receive Switching ensures that when the system detects any performance degradation due to multipath fading or equipment degradation, errorless data switching occurs. Adaptive Time Domain Equalizer (ATDE) and Adaptive Slope Amplitude Equalization (ASAE) provide robust protection from selective (dispersive) fading events. An embedded SNMP agent (compatible with Harris Stratex Networks' NetBoss®, StarView™ and FarScan™ management platforms) provides flexible, versatile monitoring. An easy-to-use Web-based craft interface with the Security feature is provided for convenient operation via a user's laptop computer. An optional Keypad interface also allows full network visibility down to card level from a single site.

Other features, such as single-ended remote software download and inventorying capability and easy module replacement with redundant Configuration storage, simplify maintenance tasks, while wideband transmitters and receivers simplify sparing. One transceiver model covers UNII 5.8/LL6/L6/U6 GHz, another 7/8 GHz and another 10/11 GHz.

3.0 CONCLUSION

Digital microwave is standards-based, enabling users and operators to integrate their microwave network with other digital transport and switching equipment selections. It also enables transport of a wide range of existing services, making it easy to build and grow a 2G – 2.5G – 3G – 3G+ multiservice network. As a proven solution for global telecommunications infrastructure, microwave represents a viable, robust, economical transport solution for new wireless networks where the deployment of a Harris Stratex Networks TRuepoint® 6000 has been designed for low total "Cost of Ownership". As the primary network or as a complement to fibre backbones, microwave delivers the flexibility to cost effectively and efficiently meet today's voice and data needs—as well as deliver today's and tomorrow's multimedia services.