InfiNet Wireless

solutions for Internet Service Providers backhauling

Application Notes

Introduction

Internet Service Providers (ISPs) advertise today highly increased data transfer speeds. Internet connectivity must be available at any time and has to be as fast as possible. For these reasons, the backhaul requirements have become more and more tight, concerning the capacity offered and its reliability. Optical fiber can be a good solution for providing very high capacity for the backbone connectivity, but in terms of backhauling, where lower capacity and more flexibility are needed, the costs and installation complexity are not justified. It is a challenge to choose a good backhauling solution that offers both speed, availability and it is cost effective.

The scope of the current paper is to point out the demands of an ISP backhaul and to emphasize the features and capabilities of the InfiNet Wireless Point-to-Point products which were especially developed to meet these demands.

Wireless Option

One of the initial decisions to be taken by the ISP for a backhauling solution is either to adopt a wired option, or a wireless one. Below are presented the main advantages when choosing a wireless solution:

- **Lower costs:** the TCO for deploying a wireless network is much lower compared to implementing a wired solution. The purchase of wireless equipment, together with the installation and location rental costs are less expensive and less time consuming than in the case of setting up a wired based infrastructure and in most cases, even for the licensed bands

- **Reduced time and complexity for installation**: installing the wireless equipment can take from a few hours to couple of weeks depending on the size of the project. Also, no special skill is required for making the equipment functional, as most devices tend to be close to the concept of plug-and-play. Wiring projects on the other hand will take months to deploy and require special plans, approval for trenching, etc

- **Increased flexibility and scalability:** the installation location is flexible since only one small form wireless equipment has to be connected. Also, the placement of the devices can be modified anytime with the least effort, compared to the wired solutions. Additionally, new equipment can be inserted very easily in the existing wireless infrastructure

- **Redundancy:** a less obvious advantage is represented by the implementation of redundancy, which in case of wireless solutions is simpler and less expensive. If for wired solutions we talk about setting up new cables (time consuming, expensiveness and restrictiveness), for wireless solutions it is just about mounting the antennas/devices in the same location and orienting them in different directions in order to meet the requirements of the network topology

As it is also important to asses certain capabilities, below is a summary of some key points:

	Costs	Capacity	Distance	Flexibility
Wireless sub-7 GHz	Low-medium	Medium	Medium-long	High
Microwave	Medium	Medium-high	Short-medium	Medium
Fiber	High	High	Long	Low

Table 1 Available technologies comparison

InfiNet Wireless products operate in sub-7 GHz frequency bands and are capable to offer strong long haul connectivity links (over 100 km) and high capacities (up to 500 Mbps). Using advanced radio techniques and sub-7 GHz spectrum, InfiNet Wireless units can provide a very good performance in both LOS and NLOS scenarios.

Backhaul Requirements

The backhaul represents the part of the network that ensures connectivity of the end point devices with the high speed backbone, or with the core network. The backhaul can be divided in two main segments:

- **Last Mile** – **refers to the direct connection with the end point devices, like access points. This network segment usually requires PTP/PTMP implementations, NLOS scenarios, lower capacity, shorter distances and high availability.**

- **Aggregation** – **refers to the backhaul segment that is responsible for binding multiple links and providing connectivity up to the backbone. This requires higher capacities, increased availability and long distances.**

As each business sector has its own requirements, there is also a specific set of demands applicable to the ISP backhauling that will be presented in more detail in the following sections.

Costs

The costs for deploying the backhaul infrastructure are desirable to be lower compared to the ones practiced for the backbone implementation, while still ensuring the necessary quality of service. It was already established that wireless means lower costs, therefore just an intuitive visualization of the involved costs for different wireless technologies will be introduced as follows:
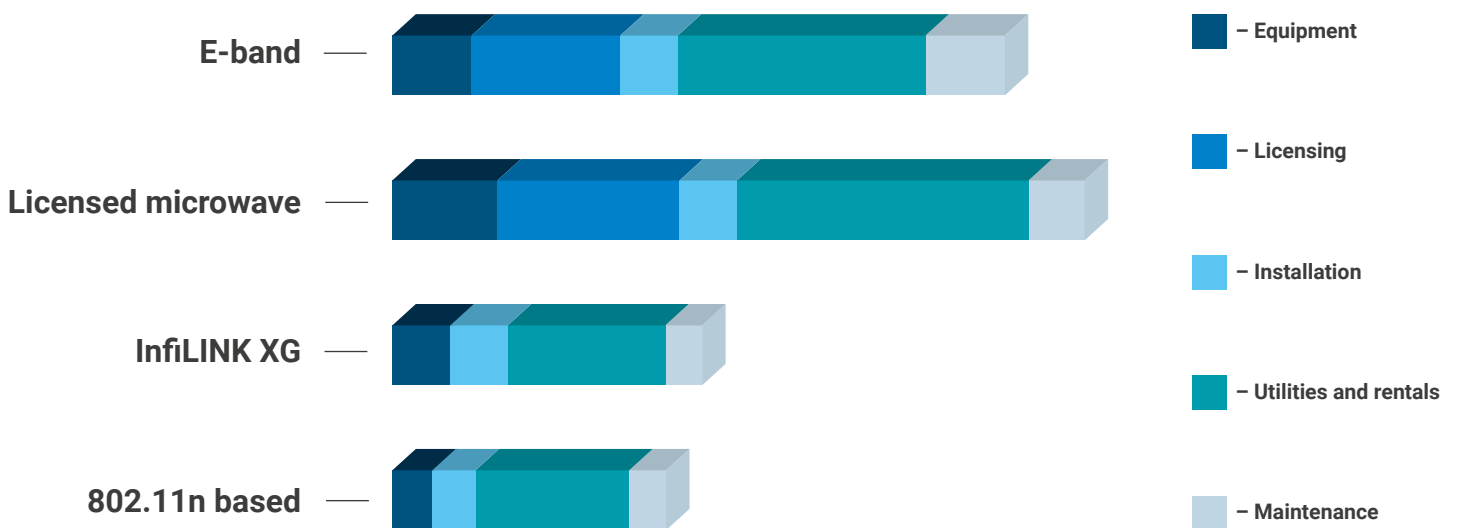
Figure 1 TCO components

Capacity

The marketing focus point for an ISP represents the speed of the Internet connectivity that can be advertised. In order to offer competitive services and to back-up the marketing policies, smart investments have to be made in network equipment that is capable of sustaining high throughput. Capacity is a key factor in choosing the proper backhauling solution which has to be able to aggregate traffic towards the backbone. InfiNetWireless units can offer up to 500 Mbps capacity with an unmatched spectral efficiency of up to 14 Mbps/Hz.

Availability Versus Distance

Another important aspect to consider is the availability of the backhaul which has to be very high since the traffic of many users is aggregated towards the core network. The longer the distance over which the link is functional at 99.999%, the better it is in terms of backhaul availability. The availability will reduce over very long distances at 2-3 nines.

Short range links are implemented for the last mile, but for the aggregation backhaul, long range links are expected to be deployed and this translates into the challenge of maintaining high availability values over long distances. Below is a representation of the longest reach at 99.999% availability, highlighting the InfiLINK XG as a top product:
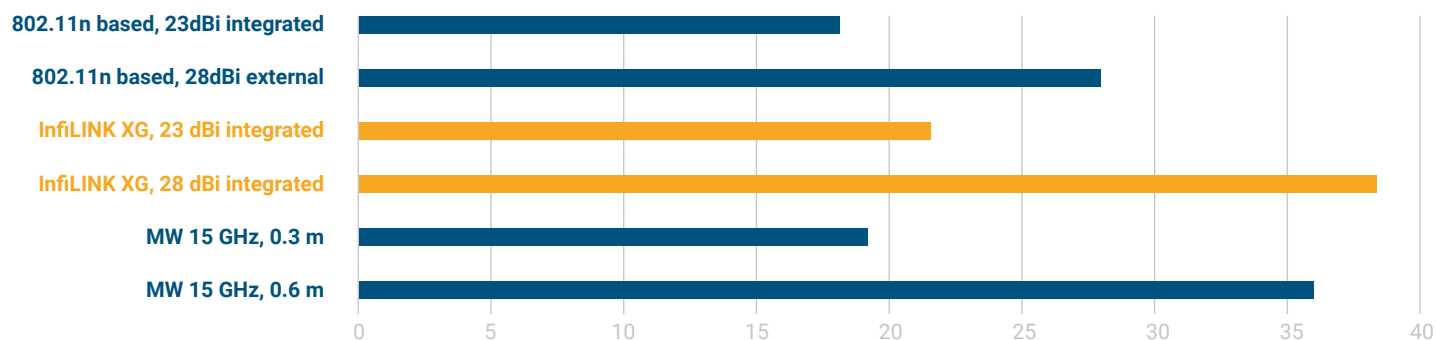

Figure 2 Availability versus distance

QoS

As different services have different demands, traffic prioritization is most often needed. Gaming, live streaming and voice are among the most demanding service classes. In order to ensure a high quality of experience the latency, jitter, packet loss have to be kept as low as possible and several prioritization methods/protocols have to be supported by the backhauling equipment.

Installation

Whether it is used as redundancy or as main solution, the backhauling infrastructure is desirable to be quickly deployed. Equipment that is easy to install and maintain has an advantage over the complex and long duration implementations. Quite often, NLOS is necessary for the last mile since the ISPs access points might not have direct visibility with the next PoP. This implies choosing a wireless product that operates in a sub-7 GHz bandwidth, since higher frequencies are prone to absorption and are not suitable for NLOS.

Reliability

The equipment destined for the backhaul should be able to operate in the most extreme climates and over diverse geographic terrains. Resistance in harsh weather conditions, large temperature ranges, lightning protection, robust design are some of the key points to be considered when selecting a proper solution.

Security

For ISPs, security is one of the top issues. Whether it refers to logical separation of specific users using VLANs, network protection against broadcast storms, information security using encryption, password protections, these all requirements must be met by any ISP and that translates into implementing a backhaul capable to ensure all the security measures.

Vendor Warranty, Maintenance & Support

Besides network security, downtime of ISP network is a top critical issue. That's why, together with vendor's warranty, maintenance and support services, the ISP must ensure always-on network. More than that, these services help the ISP to maximize the infrastructure investment while also reducing the TCO.

InfiNet Wireless Solution

InfiNet Wireless products have a complex standard based design, but they are meant to be at the same time easy to install and to manage. By having implemented plenty of networking feature sets, InfiNetWireless units are suitable for seamless integration into an existing ISP's infrastructure. High end technologies, together with a lot of experience over the years, have resulted in very reliable end products that can offer the best performance over long distances while maintaining the capacity and quality of service to the desired high levels. To complete the picture, multiple scenarios can be sustained by using customized products with integrated or external antennas for either short or long distances and multiple topologies (PTP, PTMP, chain, mesh etc) are supported.

Below are presented the solutions offered by InfiNet Wireless for ISP backhauling:

InfiLINK XG

InfiLINK XG is the latest product released of InfiNet Wireless, the most innovative and reaching the highest levels of performance. InfiLINK XG features the following capabilities:

- **Frequency bands:** 2.0 - 3.0 GHz, 3.0 - 4.0 GHz, 4.0 - 5.0 GHz, 4.9 - 6.0 GHz and 6.0 - 6.425 GHz, both licensed and unlicensed, uses innovative radio technologies AMC, DFS/IDFS, ATPC, MIMO, Cyclic Single Carrier modulation, automatic distance learning.

- **Capacity:** unmatched capacity of 500 Mbps is achieved using the 40 MHz bandwidth and over 130 Mbps in 10 MHz.

- **Superior spectral efficiency:** it can reach up to 14 bps/Hz spectral efficiency, using the Cyclic Single Carrier modulation with coding schemes up to QAM1024 and bandwidth up to 40 MHz.

- **Distances:** over 30 km with integrated antennas and more than 100 km with high gain external antennas. Ensures a system gain of 178 dB even with integrated antennas. Performs in LOS/NLOS scenarios.

- **Ultra low latency:** the air frame duration is configurable (from 2 to 10 ms) and for lower sizes, ultra-low consistent latency of 0.5 ms can be achieved at any distance. The latency is constant and depends on the air frame duration by having variations in the 0.5 - 3 ms interval (end-to-end one-way value).

- **QoS:** supports IP ToS and DiffServ, has 4 internal priority queues. It is also aware of the 802.1p standard.

- **Reliability:** with a robust and compact design it features dust and moisture protection, being IP66/IP67 compliant; lightning protection incorporated, -40 °C to 60 °C temperature range.

- **Security:** advanced 128 bit over the air encryption; network storm and flood protection, it is password protected and supports SSH, HTTPS connectivity.

- **Power:** low power consumer: below 30 W; low transmit power: up to 27 dBm (average, per Tx chain) @ QPSK to QAM64 and up to 26 dBm @ QAM256, up to 18 dBm @ QAM1024; supports Proprietary PoE.

- **Networking:** supports VLANs, ARP, DHCP.

- **Synchronization:** full synchronization support via built in GPS receiver.

- **Availability:** ensures 99.999% availability over distances longer than 15 km.

InfiLINK 2x2 PRO

InfiLINK 2x2 offers a variety of solutions from simple LAN-to-LAN implementation until complex backhauling scenarios. With a vast and advanced set of features, InfiLINK 2x2 PRO can accommodate successfully the highest demands for an ISP backhaul.

Frequency bands: 3.1 - 4.0 GHz, 4.9 - 6.0 GHz and 6.0 - 6.425 GHz, both licensed and unlicensed, uses advanced radio techniques DFS/IDFS, Automatic Bitrate Control, Automatic Distance Learning, ATPC, MIMO, OFDM.

Capacity: capacity up to 280 Mbps net throughput at 40 MHz bandwidth. Offers cost effective solutions by providing upgradable capacity ("pay as you grow").

High spectral efficiency: it can reach up to 7 bps/Hz spectral efficiency, using MIMO, OFDM and advanced coding schemes up to 256 QAM.

Distances: over 80 km using high gain external antennas. Performs in LOS/NLOS scenarios.

QoS: supports IP ToS and DiffServ, it is aware of the IEEE802.1p standard and has 17 internal priority queues, offers full voice/RTP support, supports traffic shaping, ensures low latency at average values of 3 ms.

Reliability: with a robust and compact design it features dust and moisture protection, being IP66/IP67 compliant, lightning protection incorporated, -40 °C to 60 °C temperature range.

Security: advanced 128 bit over the air encryption, network storm and flood protection, it is password protected and supports SSH, HTTPS connectivity.

Power: low power consumer: below 20 W, low transmit power: up to 27 dBm. Supports Proprietary PoE.

Synchronization: full synchronization support via external synchronization hub AUX-ODU-SYNC.

Networking: supports VLANs, NAT, ARP, Ethernet over IP, MAC/IP filtering, RIPv2 and OSPF, tunneling, L2/L3 Firewall, DHCP.
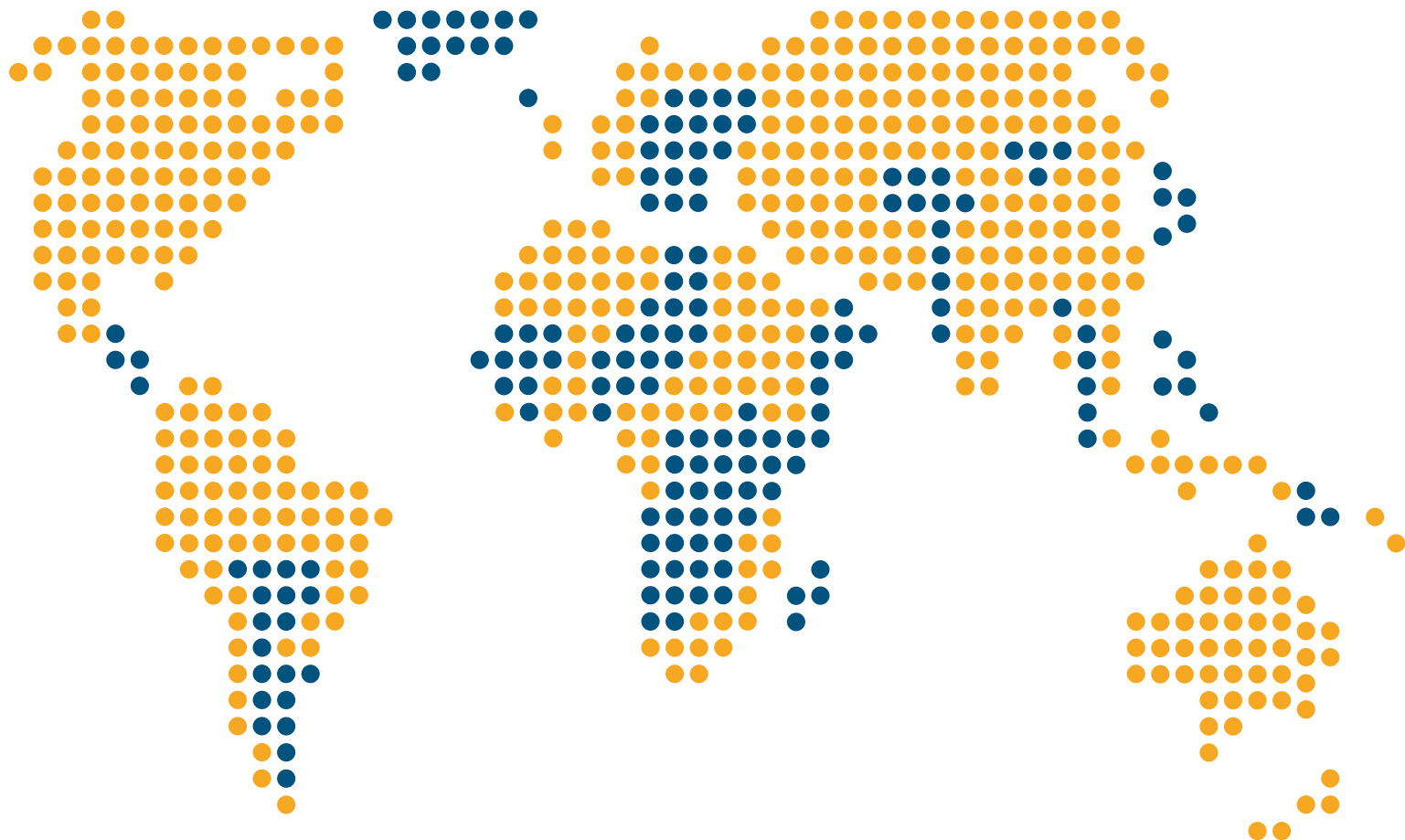
Practical Implementations

InfiNet Wireless has a vast portfolio that includes complex and highly reliable solutions for customers all around the world. As the facts speak better for themselves, couple of successful backhauling deployments using InfiNet products will be presented below ▶

METRONET

UK

Metronet UK was founded in the Greater Manchester area with the scope of providing a cost effective alternative to DSL and to leased line connections by using broadband wireless. Among the included services, the company offers Internet connectivity to any end user under the coverage area, supports CCTV video and ANPR (Automatic Number Plate Recognition).

Objectives and benefits

▸ A target for 99.95% availability was set and it was fully met by using InfiNet Wireless products
▸ "Fixed menu-priced" managed services of up to 200 Mbps across the wireless last mile connections had to be ensured, along with a 300 Mbps capacity for the core network
▸ A complete range of services had to be served with the specific priorities, from VoIP to IP CCTV surveillance and advanced data services
▸ Security had to be considered as a top priority since services were provided also to public sectors such as the police and law enforcement agencies.
  Metronet uses high secure IP radio connections with strong encryption and frequency hopping
▸ Functionality had to be ensured through all weather conditions and geographic topologies

Solution technology

▸ For the last mile backhaul: InfiMAN and InfiMAN 2x2 Point-to-Multipoint, together with the CPEs R5000-Mm and R5000-Sm products for the customers requiring warranted throughputs of 30 Mbps, 50 Mbps and 80 Mbps. NLOS deployments had to be performed for obscure pathways with obstacles on the wireless path.
▸ For the core/aggregation backhaul: R5000-Om and R5000-Mme products were used, with throughput up to 280 Mbps, operating in harsh climatic conditions.

ENFORTA

Russia

Enforta is the number one company in Russia that offers wireless-based broadband telecommunication solutions, with a footprint covering over 70 million people and operating in 78 of Russia's largest cities.
The demand involved a large scale deployment backhauling, in diverse and extreme climate conditions, by sustaining the high availability, reliability and capacity requests. After performing trials for different backhauling solutions, Enforta chose InfiNet Wireless products for having met the best with their requirements:

▸ A cost-effective, scalable network was deployed in the 5.15 ~ 5.35 GHz band. The flexibility of the InfiNet products for

configuration, deployment and bandwidth/frequency allocation reduced both the costs and installation time.

▸ A high capacity InfiLINK Point-to-Point solution was adopted, to support the high throughput demands over long distances.

▸ High availability of the backhauling was successfully proved, along with the best support for the different QoS requirements.

▸ Coverage was also provided in remote suburban areas.

▸ Operation in diverse geographic topologies and under extreme weather conditions was ensured.

IRSN

Russia

IRSN is the largest ISP in the Baikal region, offering communication services to the government, to corporate and to private sector customers. The solution based on InfiNet Wireless products proved to be the best in class and ensured the completion of the following objectives:

▶ Ensured high capacity for carrying video conferencing, voice and data traffic at the same time, using InfiLINK 2x2 products with up to 280 Mbps in 40 MHz.

▶ Covered long distances by implementing links in the range of 11 to 60 km.

▶ Ensured reliable functionality in the harshest weather conditions: low temperatures, heavy snow, fog. There are no sudden drop in capacities due to precipitations because of the used frequencies below 6 GHz and with the support of advanced radio techniques.

▶ Support for VLANs, VPNs and advanced QoS features represented key differentiator for IRSN which required a high end product with rich networking capabilities.

▶ The backhaul implementation using InfiLINK 2x2 products proved to be a cost effective one, allowing a large number of subscribers to connect and benefit of the full services.

▶ Security was also a key point in choosing InfiNet units. Advanced security had to be integrated into the backhaul solution.

TOM-TECHNIK KFT.

Hungary

Tom-Technik Kft. is an ISP operating on wide geographical areas in the Southern Plains of Hungary. Their request was to develop a feasible and cost-effective wide-area wireless network, easy to deploy and to maintain. After performing several trials, the best solution was achieved using InfiNet products for the backhaul connectivity. The benefits of the deployment are listed below:

▸ The products selected were the InfiLINK 2x2 PRO with high gain external antennas, reaching a 300 Mbps capacity and ensuring increased availability.

▸ Since a cost effective solution was needed and based on the tests performed, it resulted in the use of the 5 GHz InfiNet Wireless units capable to provide optimal both technical and commercial implementation.

▸ The standard based design of the InfiNet units facilitated a smooth integration with the existing infrastructure and seamless connectivity to the backbone.

▸ A fast and easy deployment reduced the installation costs.

▸ The solution using InfiNet products proved to be highly reliable and robust in any weather conditions and over long distances.

Conclusions

Choosing the proper backhauling technology continues to be a challenging task. There are many options available and also many vendors to choose from. The important aspect for debating remains related to finding a solution that offers the desired quality and it is also financially convenient. The current document presented the aspects to be considered when deploying a backhaul for ISPs, highlighting the relevant capabilities of the InfiNetWireless products.

InfiNet Wireless offers a variety of products suitable for multiple scenarios and topologies. The high end technologies, the rich set of networking features, the robustness and reliability of the products are part of the many advantages. Whether it is intended as main solution or redundancy path, a backhaul implementation using InfiNetWireless products will ensure fast installation, easy maintenance, cost savings and high throughput over long distances while maintaining the desired QoS.