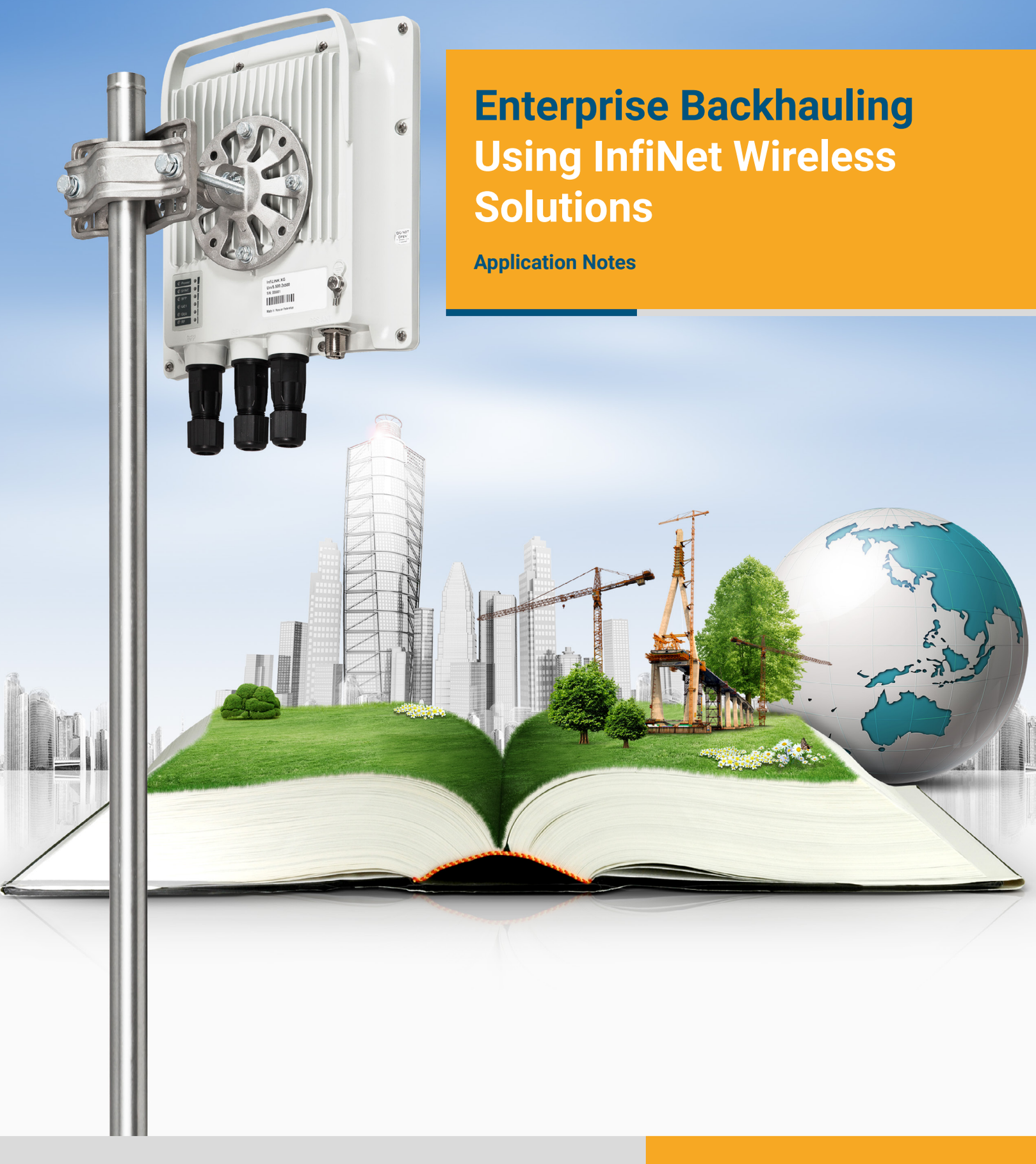
InfiNet wireless

# Enterprise Backhauling Using InfiNet Wireless Solutions

## Application Notes



# Introduction

The network elements of the Enterprise architecture are represented by several operational centers, which are under the administration of a corporation. Whether being located in the headquarter or in a smaller branch, all employees need to access certain internal applications or common resources and need to be interconnected by means of different services like conferences and VoIP. The challenge for any company is to find a secure, performant and cost effective solution that can connect all its offices.

The scope of the current document is to explain the specific characteristics of the Enterprise wireless backhauling and to present the solution offered by InfiNet Wireless that distinguishes as a very suitable and efficient option. Connecting branches with HQ or different network segments with the core network implies a prior research about the available solutions in order to find the fittest candidate.

# General overview

When discussing about the Enterprise sector, a specific terminology and topology must be prior defined. A common topology for a regional business expansion is briefly illustrated in the picture below:

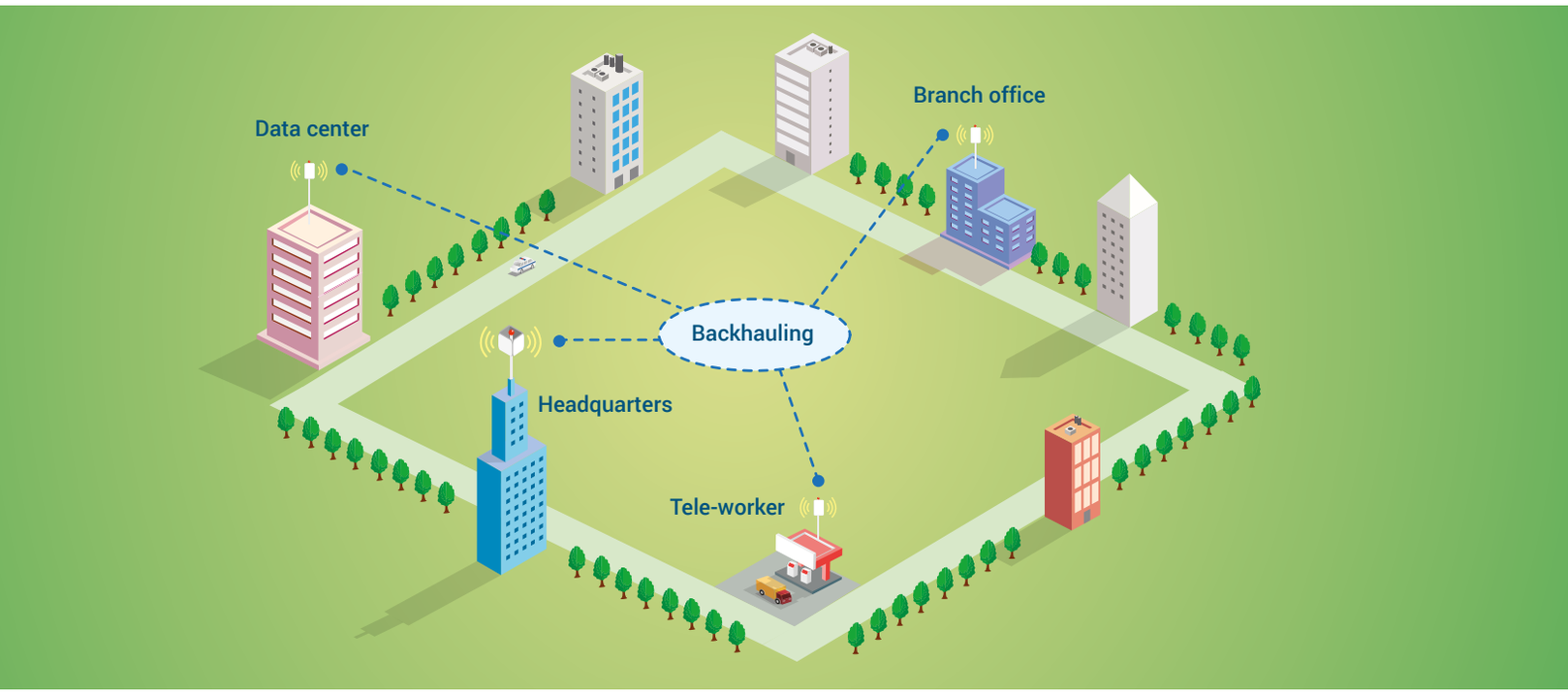



**Figure 1** Basic Enterprise architecture, regional expansion

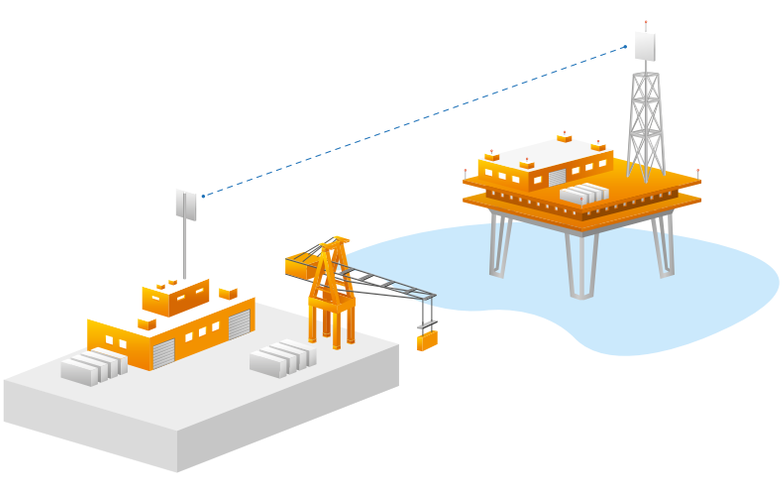
- The Headquarter represents the main office or the nucleus of the business and it is usually the largest office, with the biggest number of employees

- The Data center is the place where all the servers and company resources are stored. It can be also included in the headquarter premises and it must be accessed by all employees of the company at any time and with accurate speed

- The Branch offices represent smaller business centers that can spread from shorter regional distances to nation or world-wide distances

- There can be also employees that work from home, for example as remote workers/tele-workers

The backhaul represents the infrastructure that ensures the transmission of information between all the locations of a company. The scope is to connect the branch offices with the HQ and data center by ensuring the necessary quality of services (QoS) and the settled Service Layer agreements. This is valid for regional expansions between the different locations, as in case of longer distances the backhaul represents the connection from the local offices up to a high speed backbone (or core network) that can ensure a fast data transmission over large geographical areas. In addition to the typical Enterprise infrastructure, this document also addresses to corporations that operate in the energy and natural resources fields.



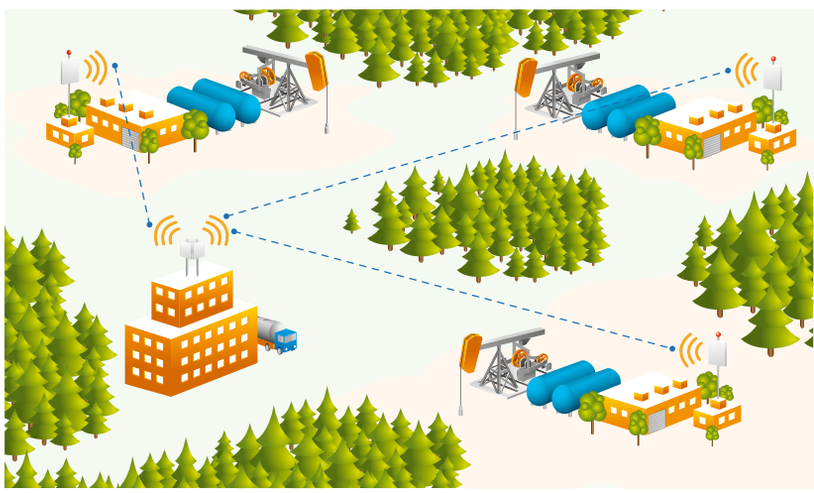


**Figure 2** Energy and natural resources infrastructures

The following solutions can be accommodated using InfiNet Wireless equipment:

- Over-the-water communication links to remote offshore platforms at distances about 50 km with transmission of voice, video, telemetry and data streams
- Backhaul for telemetry data acquisition from remote production field. The distances between the monitoring centers and the production fields can exceed 35 km and can be situated in extreme climates
- Telemetry data acquisition from sensors or other devices to the control center, together with real-time data transmission for CCTV if needed
- One last application field to be mentioned refers to the campus architecture. Schools or universities that are comprised of multiple learning centers require a backhauling interconnection solution as well

# Backhaul requirements

The variety of solutions available for the backhaul infrastructure can be confusing, but there are specific points of view to consider for each of them. The main options are:

- Using a public solution: connections over the Internet together with VPNs and/or MPLS are still popular because of the low costs and flexibility, but in order to increase security, availability and control over the backhaul, the private owned solutions have a more important role

- Using a private solution: one option would be the leased lines, which are easy to maintain, stable, but represent the most expensive solution with very limited expansion capabilities. Another option, more suitable, is represented by the wireless segment, which has developed into a very cost effective and high performance solution

The main requirements for an Enterprise backhaul will be discussed in more detail below.

## INSTALLATION AND OPERATIONAL EXPENSES

### Description

When opting for a particular solution, a balance must be achieved between the total costs involved and the offered performance. It is, of course, desirable to obtain the highest performance at the lowest costs, but in fact, the best solution actually translates into having small compromises depending on each company's needs.

### Solution

The backhauling options as presented above, imply different expenses. For example the leased lines may be easy to maintain, but they are very expensive to install and cannot keep up with the capacity demands. The better option for capacity reasons would be fiber optic connectivity, but this again implies very increased installation costs and complexity. Therefore, a suitable choice would be nowadays a wireless technology. The wireless segment has developed high end technologies, resulting into very performant equipment while maintaining low installation and operational costs.

### InfiNet Wireless solution

Among the wireless options available, InfiNet Wireless remarks itself by offering high end products at competitive prices. Additionally, the operational expenses of the units are minimal, being compatible with the concept of "install and forget"

## INSTALLATIONANDMAINTENANCECOMPLEXITY

### Description

Another important aspect to consider is the complexity of the installation and maintenance. A wireless option, besides being less expensive it also features fast deployment and flexibility in choosing the location for installation. Implementing a wired solution on the other hand will imply months of hard work and will have constraints in what concerns its location. There are places like campuses, historical buildings, crowded urban areas and industrial platforms where cabling isn't even an option. Another plus for a wireless technology would be the support for NLOS, by operating in a sub-7 GHz bandwidth, which brings more flexibility when installing in difficult, obstructed areas. The devices are also desirable to be close to the plug-and-play mode and easy to maintain by only one person from a centralized location, which is usually valid in the case of the wireless equipment.

### Solution

The backhauling options as presented above, imply different expenses. For example the leased lines may be easy to maintain, but they are very expensive to install and cannot keep up with the capacity demands. The better option for capacity reasons would be fiber optic connectivity, but this again implies very increased installation costs and complexity. Therefore, a suitable choice would be nowadays a wireless technology. The wireless segment has developed high end technologies, resulting into very performant equipment while maintaining low installation and operational costs.

### InfiNet Wireless solution

Among the wireless options available, InfiNet Wireless remarks itself by offering high end products at competitive prices. Additionally, the operational expenses of the units are minimal, being compatible with the concept of "install and forget".

## SCALABILITY

### Description

Scalability from the Enterprise perspective reflects in two aspects. One is flexibility, as any business has a degree of dynamic changes, from moving on different floors to relocating in adjacent or new buildings. The other aspect refers to the expected growth of a company, which must be estimated over couple of months to couple of years. In every case, the scalability of the backhaul plays an important role as it can facilitate any change or expansion.

### Solution

It is desirable to adopt a backhauling solution with increased flexibility and this can be easily achieved using a wireless technology. Relocation and insertion of new equipment is very fast and efficient in this case.

### InfiNet Wireless solution

Being based on wireless technologies, the InfiNet Wireless products offer increased flexibility in case of relocation or network expansion. This translates into a small effort and time saving compared to a wired solution when it comes to inserting new equipment or changing the physical topology.

# CAPACITY

## Description

The demand for capacity nowadays has reached highly increased levels. Capacity translates into speed, precision, timely access to any internal application or data resource of the company. Also video conferences must be accurately served by the transmission network that connects the different offices of a company. Nevertheless, the capacity needs should be in advance evaluated and a suitable solution should be chosen. As high transfer rates imply higher costs there is no need to buy equipment or solutions that offer more capacity than necessary. Modular approaches and the capability to extend the capacity along with the company growth are in this case a plus. If on the other hand, throughput is a strict requirement, performant solutions should be chosen from the beginning in order to sustain the demands.

## Solution

Leased lines can offer reduced capacity but easy maintenance, on the other hand they are among the most expensive to install. At the opposite side concerning capacity is the optical fiber which can provide the highest speeds, but costs and flexibility represent a downside. A balanced solution comes from the wireless technologies that can offer speeds in the mid ranges to high ranges, along with flexibility and lower costs.

| | 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 |

## InfiNet Wireless solution

A modular approach characterizes the available InfiNet Wireless products, offering the possibility to choose the best solution, closest to the actual requirements. The capabilities of the products are as follows:

- **InfiLINK 2x2 series** consisting of two sub-families:
  - **InfiLINK 2x2 LITE:** cost effective, medium capacity of up to 180 Mbps at 40 MHz bandwidth;
  - **InfiLINK 2x2 PRO:** high performance series, with capacity of up to 280 Mbps at 40 MHz bandwidth.
    It can reach distances of 80 km in LOS scenarios using external antennas.
    The capacity is software upgradable, sustaining the “pay as you grow” concept

- **InfiLINK XG series:** high end product, specialized for increased data rates in a point-to-point topology, suitable for the aggregation backhauling; it can reach up to 500 Mbps net throughput using a 40 MHz bandwidth. It can sustain links of up to 100 km in LOS scenario using external antennas.

## AVAILABILITY

### Description

The availability is one of the key points for an Enterprise backhaul. Every business has to be operation 24/7 and no disruption is welcomed as unavailability means most of the time losing money and delaying important processes. It is therefore mandatory for the backhauling solution to ensure the business continuity.

### InfiNet Wireless solution

InfiNet Wireless products can ensure 99.999% availability over long distances of up to 30-40 km making them a suitable candidate for the Enterprise backhaul.

## SECURITY

### Description

As vital and private information is passed between any offices of a company, security is a mandatory feature. Whether it refers to logical separation of the users using VLANs, network protection against broadcast storms, information security using encryption, password protection, these all requirements must be met by the Enterprise backhauling solution. All the security features implemented on the end user side must be properly maintained over the transmission network.

### InfiNet Wireless solution

InfiNet Wireless products are designed with the following specific security features:advanced 128 bit over the air encryption; network storm and flood protection; password protection; SSH and HTTPS connectivity.

## SUPPORT FOR NETWORKING FEATURES

### Description

As the backhaul is likely to be integrated with different networking solutions and devices, support for networking features is mandatory. A proper Enterprise backhaul should include features like routing, switching, L2/L3 filtering, firewall and so on. The more complete is the networking feature set, the better is the backhauling solution.

### InfiNet Wireless solution

InfiNet Wireless products are equipped with a rich networking features set, making them suitable for seamless integration: Ethernet over IP, ARP, MAC/IP filtering, RIPv2, OSPFv2 and static routing, tunneling, L2/L3 Firewall, NAT(h.323-aware), DHCP client/server/relay, VLANs are among the networking functionalities supported.

# QoS

## Description

The data exchanged between the Enterprise nodes is among the most diverse: email, instant messaging, VoIP, videoconferences, internal applications and so on. As every application has its particular requirements for maintaining the quality of service, the backhaul must be aware of the traffic types passing by. Support for real time applications like video and voice is mandatory therefore delay, jitter and packet loss must be kept as low as possible. Also, the backhaul must be aware about the protocols for packet prioritization (for example IP ToS, DiffServ, etc) and to be able to implement its own rules in order to ensure the desired quality of service.

## InfiNet Wireless solution

The InfiNet Wireless products include advanced QoS features that can ensure a reliable connection at the highest quality. The units are capable to transfer simultaneous multi-protocol voice, video and data across the entire network ensuring the required quality of service.

The following QoS techniques are available:

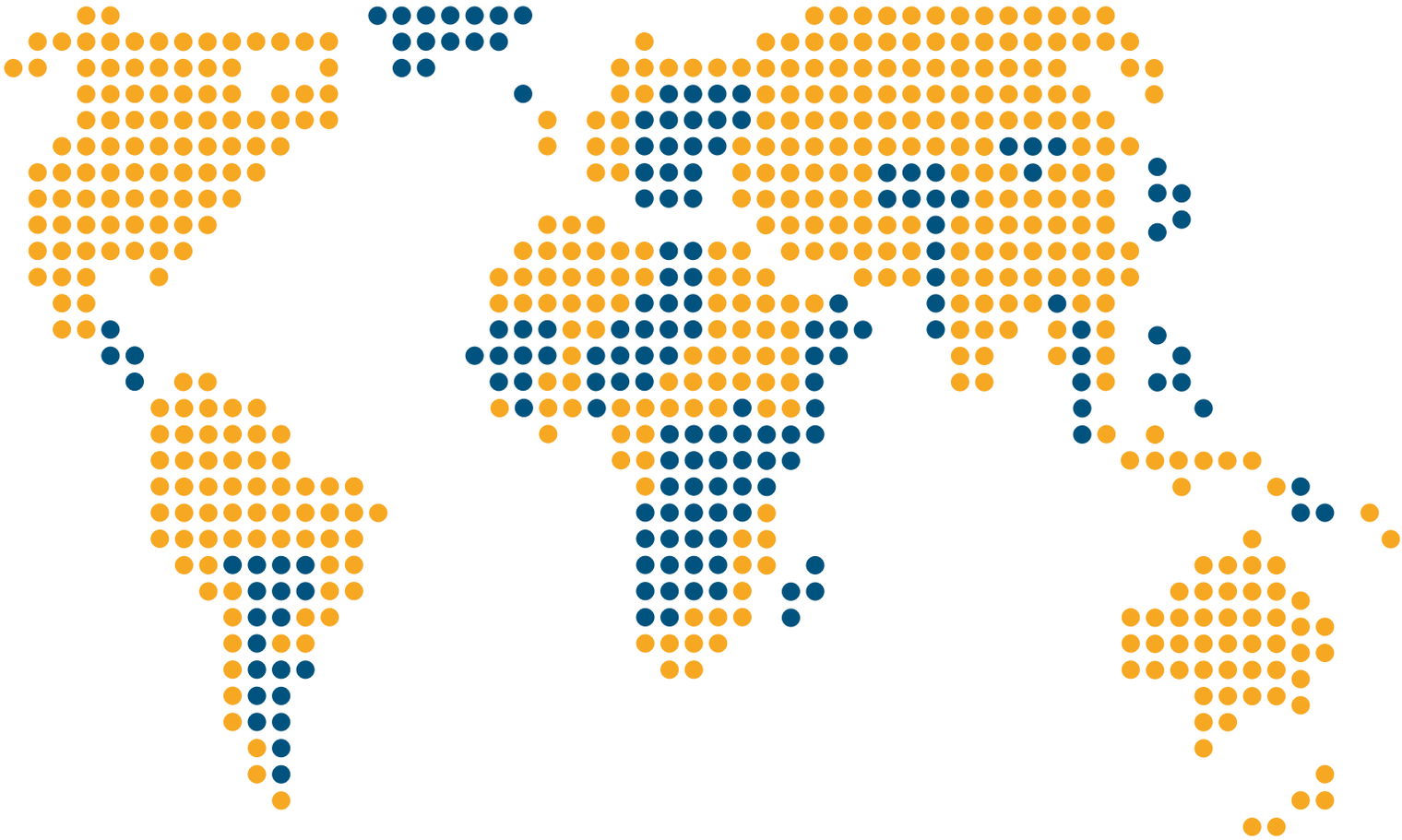
- **Traffic selection based on multiple criteria:** the InfiNet units are aware of the 802.1p, DSCP and TOS marked packets. The traffic filtering criteria include IP and MAC addresses, MPLS exp values, VLAN tags, TCP or UDP ports, custom PCAP expressions

- **Traffic prioritization:** the MINT proprietary protocol assigns a specific MINT priority in order to ensure the desired QoS

- **Traffic queuing and packet scheduling:** different queues are used for different traffic types.
  The scheduler further determines the order in which the packets shall exit the device. The QM module supports Strict Priority Queuing and Weighted Queuing (WFQ, WRR) scheduling algorithms

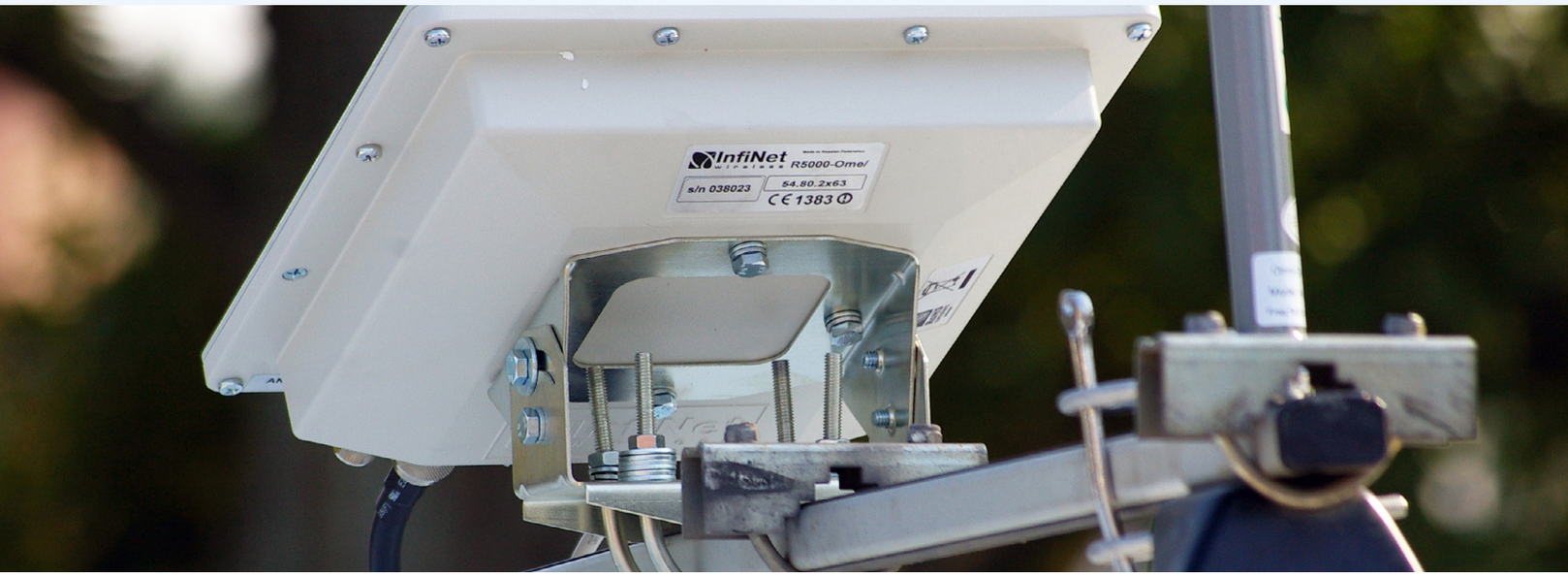
- **Traffic shaping:** it is responsible for buffering the excess packets and scheduling for later transmission in order to ensure a smooth output throughput. This way the delay a jitter can be better controlled and kept at very low levels.

Additionally, the units offer full voice support by being RTP aware and providing automatic prioritization for voice traffic. **InfiLINK XG** products feature an ultra-low consistent latency of 0.5 ms that can be achieved at any distance when using a short air frame duration. 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). For the **InfiLINK 2x2** products a constant end-to-end latency of 3-5 ms can be achieved.



# Practical Implementations

InfiNet Wireless has successfully supported the deployment of multiple Enterprise backhauling solutions. Some of these projects will be presented below as practical implementation references ►




## D-LINK Hungary

The development of private Enterprise, SME, Education and local government sectors in the Eastern Europe countries is accompanied by necessary investments in the networking and communications infrastructures. While in the Western Europe a legacy infrastructure exists, in Eastern Europe a generation is skipped by moving directly to an IP based network featuring the most modern technologies. D-Link has spotted this situation and decided to enter into the Enterprise and business solutions arena.

After testing a number of solutions available on the market, D-Link introduced the InfiLINK and InfiMAN products into his portfolio following the successful trials. The benefits of the InfiNet solution are listed below:

- Enabled SME and Enterprise businesses to connect wide-area networking applications where leased line availability is scarce
- Cost effective, high bandwidth link with unrivalled price-performance ratio
- High throughput across difficult non-line-of sight terrain and difficult environment conditions
- High reliability and availability for constant communication flow between the customer locations for IP, Ethernet, Storage area networking and VoIP traffic
- Rapid deployment was achieved in order to offer an end-to-end multisite IP networking solution
- Easy integration with the existing standard-based IP networking equipment
- D-Link is now partnering with InfiNet Wireless to offer the point-to-point and point-to-multipoint wireless solutions across its entire Eastern European region


## MONDELEZ INTERNATIONAL US

Mondelez International Inc, is a major US multinational confectionery, food and beverage conglomerate with more than 100 000 employees around the world. Following the changes in the regulations of Saudi Arabia, the company can now import products directly to the country, so in order to accommodate the new market entry, seven large warehouses were built across the Kingdom. A new infrastructure to connect the warehouses was implemented successfully using InfiNet Wireless products and the benefits of the solution are listed below:

- An InfiLINK 2x2wireless point-to-point solution was adopted, which combines high-speed capabilities with a rich set of best in class features
- The InfiNet Wireless units connect the warehouses to a number of ISPs so that the company can provide seamless connectivity to all its users via its global VPN network
- Quick deployment and easy maintenance. The employees appreciated the fast connectivity, allowing them to get on with their work across all of the sites using their usual back-office software tools and increase their productivity
- High capacity connectivity and increased availability; the business can operate at full capacity without any worry of system downtime
- The low latency demand was fully met
- Reliable operation in the most extreme temperatures was achieved

## LUKOIL Russia

Lukoil is a major international oil and gas company with exploration and production projects in 12 countries, being most active in Russia. In order to ensure that the latest industry ecological standards are met, Lukoil has to implement real-time control of its SCADA systems. Following the successful trials, the InfiNet Wireless solution proved to fully meet the requirements:

- A highly reliable, robust and secure communications system was implemented
- Due to the location of the base stations, Lukoil needed equipment that could operate in harsh environments, with temperature ranges between -40 °C to 60 °C
- The InfiMAN 2x2 technology (point to multipoint) ensured the capacity requirements over distances longer than 15 km for the remote sites, together with a quick and simple installation
- InfiLINK 2x2 long-range backhauling solution, with increased capacity and spectral efficiency, was able to connect the remote sites to its headquarters and enabled reliable real-time control of its SCADA systems
- Quality of Service assured the support for a variety of traffic types and the low latency requirement for the real-time interaction was fully met
- The solution proved to be cost efficient, low in maintenance while ensuring the necessary performance


## BANK OF CHINA China

Bank of China issued the requirement of linking a regional Head Office and 26 Branch Offices, across a wide geographical area and with support for different types of traffic at high rates. The solution offered by InfiNet Wireless proved to successfully meet all the objectives:

- Point-to-Multipoint InfiMAN Base Stations were connected to Point-to-Point InfiLINK elements for creating a modular backhaul, with bandwidths selected appropriate to the traffic to be transported
- The high security demand was accomplished using the advanced security features of the InfiNet Wireless units
- The different QoS levels were able to support various traffic types like voice, email, secure data and ATM traffic
- The high availability and high bandwidth requirements were fully met
- Seamless integration with the existing infrastructure took place, with the help of the rich set of networking features implemented by the InfiNet units.

# Conclusions

The decision a company has to make regarding the infrastructure connecting its offices is not an easy one. There are multiple technologies available, as well as multiple vendors and this can be confusing as a start point. Nevertheless, a first step is to distinguish between the need for a wired or a wireless solution. Wireless is nowadays far less expensive, very performant and offers increased flexibility for installation. Among the wireless vendors, InfiNet Wireless has prevailed by its high end products at competitive prices, offering a very good price-quality balance. The InfiNet Wireless units are capable to sustain increased throughput, in a modular approach according to the needs and have advanced QoS, security and networking features implemented. It is therefore very easy to seamless integrate the InfiNet Wireless units with an existing networking infrastructure and to successfully carry out the different traffic types required by the Enterprise business sector. A summary of the InfiNet Wireless product capabilities can be found below:

| Key feature | InfiLINK XG | InfiLINK 2x2 PRO |
|---|---|---|
| Frequency range | 2.0 - 3.0 GHz<br>3.0 - 4.0 GHz<br>4.0 - 5.0 GHz<br>4.9 - 6.0 GHz<br>6.0 - 6.425 GHz | 3.1 - 4.0 GHz<br>4.9 - 6.0 GHz<br>6.0 - 6.4 GHz |
| Coverage | LOS and NLOS<br>Distance up to 100 km or more in LOS open areas | LOS and NLOS<br>Distance up to 80 km or more in LOS open areas |
| Tx power | Up to 27 dBm (500 mW) | Up to 27 dBm (500 mW) |
| Power | Up to 30 W consumption;<br>Proprietary PoE | Up to 20 W consumption;<br>Proprietary PoE |
| Performance | Up to 500 Mbps in 40 MHz | Up to 280 Mbps in 40 MHz |
| Spectral efficiency | Up to 14 bps/Hz | Up to 7 bps/Hz |
| TDD synchronization | Built in GLONASS/GPS receiver | Via external synchronization hub |
| QoS | 4 priority queues<br>“Strict” and “weighted” modes<br>802.1p | 17 priority queues<br>“Strict” and “weighted” modes<br>802.1p, IP ToS, DiffServ, custom L2/L3-based rules<br>Traffic shaping<br>Voice/RTP aware |
| Latency | 0.5 - 3 ms (depends on air frame) | Average 3 ms |
| Robustness and Reliability | Dust and moisture protection, IP66/IP67 compliant; lightning protection incorporated | |
| | -40 °C to +60 °C temperature range | -55 °C to +60 °C temperature range |
| Security | Storm and flood protection, password protected, SSH, HTTPS | |