InfiNet wireless

Wireless Internet Service Providers

Application Notes

Abstract

This document presents the results encountered in a laboratory simulation for a common scenario of a WISP network segment deployment (“Point-to-Multipoint” sector) with InfiNet Wireless units.

Introduction

Whether from businesses or consumers, high-bandwidth availability is always a demand for running voice, video and data services faster and with higher quality. Like any Internet Service Provider (ISP), Wireless Internet Service Providers (WISP) face great challenges when it comes to network expansion (increasing the existing network coverage) in order to add more subscribers into the network, to provide better services (higher speed, higher network reliability, latency-free customer experience, etc.), to offer attractive prices, etc. WISPs have to do even more to differentiate their services, as the competition is highly growing (with LTE networks, satellite service providers, etc.).

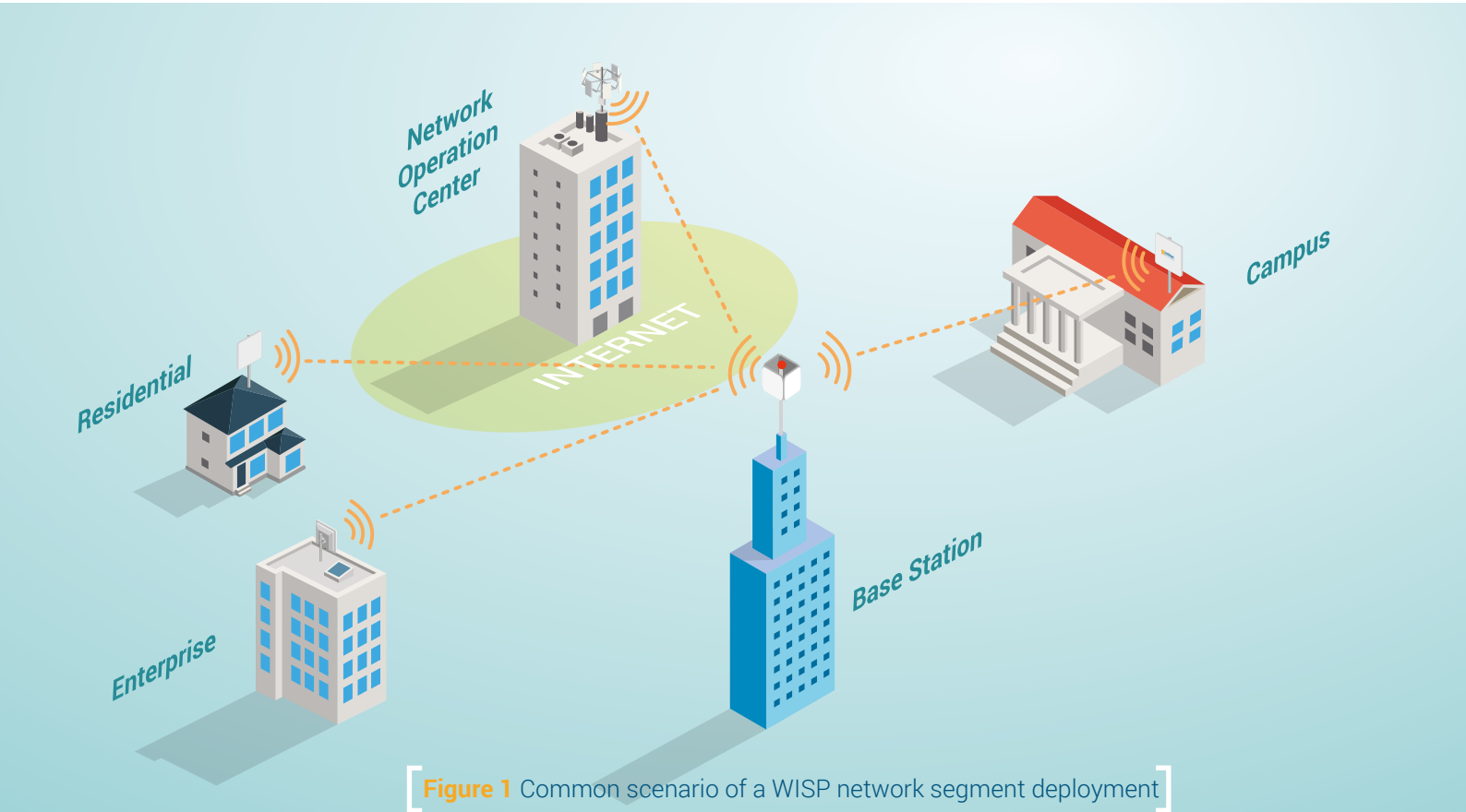

Figure 1 Common scenario of a WISP network segment deployment

In most of the cases, WISPs networks operate over open bands between 900 MHz and 5.8 GHz and consist in “Point-to-Multipoint” deployments for the distribution and access to the customer premises and in “Point-to-Point” deployments for backhauling (with the NOC, for instance), delivering network services to fixed locations, in limited areas, to businesses, schools, hospitals and residents in rural or remote communities.

Performance in WISPs network

In order to effectively address the challenges mentioned above, the performance component of the access segment of the wireless network is treated with maximum attention by the service providers.

When talking about the wireless units and network performance, it’s mandatory to mention that in outdoor deployments a poor RF planning and an incorrect outdoor units installation leads to serious network performance degradation and that wireless units capabilities are useless as long as over the air there’s a bottleneck in transferring data.

OVERSUBSCRIPTION RATIO

The oversubscription is utilized by WISPs for the distribution and access network segments in order to streamline the profitability of their wireless network. Based on the statistical data for the network usage, different oversubscription ratios are utilized. When usage patterns change, the old calculations that produced the acceptable oversubscription ratio are no longer valid and the service provider must review it and if it goes down, it means that more capacity must be added.

As a rough example, let’s consider 20 customers and 10 Mbps traffic provisioned for all; 20:1 oversubscription ratio means that one of the 20 customers can run traffic at 10 Mbps only when the other 19 customers are idle. Except the situations where traffic is contractually guaranteed, the

oversubscription is commonly used by the service providers. The users are not 24/7 concurrently connected, pushing UL and DL to the max.

UL/DL RATIO

Even though the key business for WISPs is to provide reliable broadband service to the customers (and this means downlink network structure predominantly), in many situations there's a need for high-capacity uplink or even mixed scenarios where there's no strict dominance of uplink or downlink. Unlike InfiNet Wireless technology, many wireless technologies (specifically "Point-to-Multipoint") are tailored to downlink and this creates a serious limitation for operators which are forced to search for alternative solutions to provide services which require mixed/flexible UL/DL ratio or UL only.

SIMULATED DEPLOYMENT SCENARIO FOR A WISP NETWORK SEGMENT (PtMP SECTOR)

In order to highlight the capabilities of InfiNet Wireless units in terms of performance and flexibility in DL/UL configuration, the application we have built in the laboratory simulates a real-life WISP "Point-to-Multipoint" sector deployment scenario with 15 CPEs.

The RF segments were calibrated so that:

- 5 of the CPEs work with 16 QAM 3⁄4 modulation (104 Mbps bitrate)
- 5 with 16 QAM 1⁄2 modulation (78 Mbps bitrate)
- 5 with QPSK 3⁄4 modulation (52 Mbps bitrate)

These modulation levels were selected in order to emphasize the performance capabilities of InfiNet Wireless units in common real-life scenarios and not in best case scenarios, for the highest modulation levels. The UL/DL ratio was set to 66% for DL and 33% for UL and the bandwidth was set to 20 MHz for all CPEs.

Just as a point of comparison, in a WISP network that serves residential and business customers in southern Pennsylvania - US, the bulk figures for one of the tiers are as follows: download speed at the

low end, up to 1 Mbps with speed bursts of up to 3 Mbps and upload speed below 0.5 Mbps. At the high end, the download speed is up to 15 Mbps, with bursts up to 30 Mbps and the upload speed of up to 3 Mbps.

In the schemas below we have recorded the throughput values (in case of no packet loss) obtained in different situations, with one CPE of up to all CPEs active in the sector.

In a real-life scenario, depending on the RF link quality, not all CPEs work at the highest modulation level. This is why we ran the performance test grouping the 15 CPEs into three categories by the modulation level.

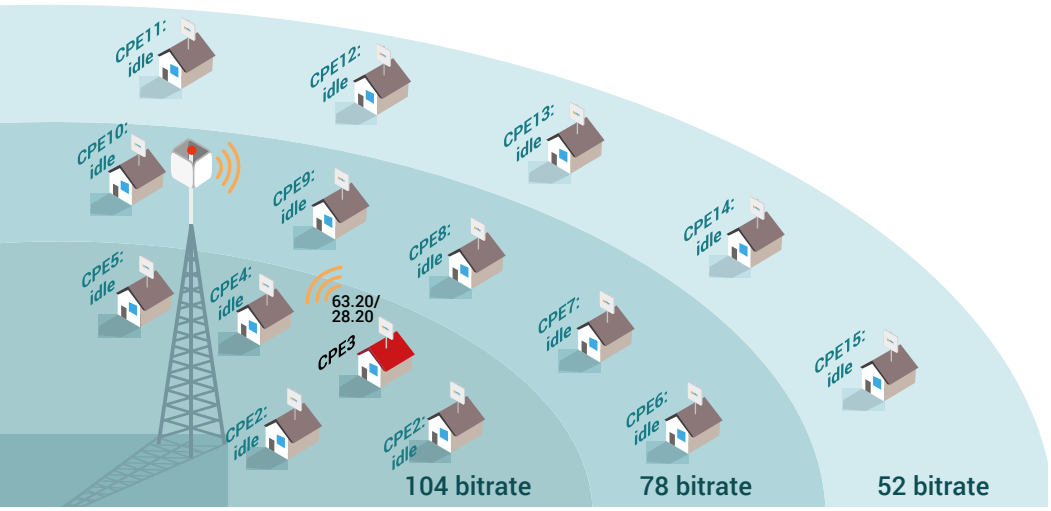

Figure 2 CPE3 active

In Figure 2 only CPE3 is active with recorded transfer capacity 63.2 Mbps in downlink direction and 28.2 Mbps in uplink direction (according to the fixed DL/UL ratio). In this case we are talking about full available capacity for each of the CPEs that can work at 16QAM 3⁄4 when the rest of 14 CPEs within the sector are in idle mode (high end situation).

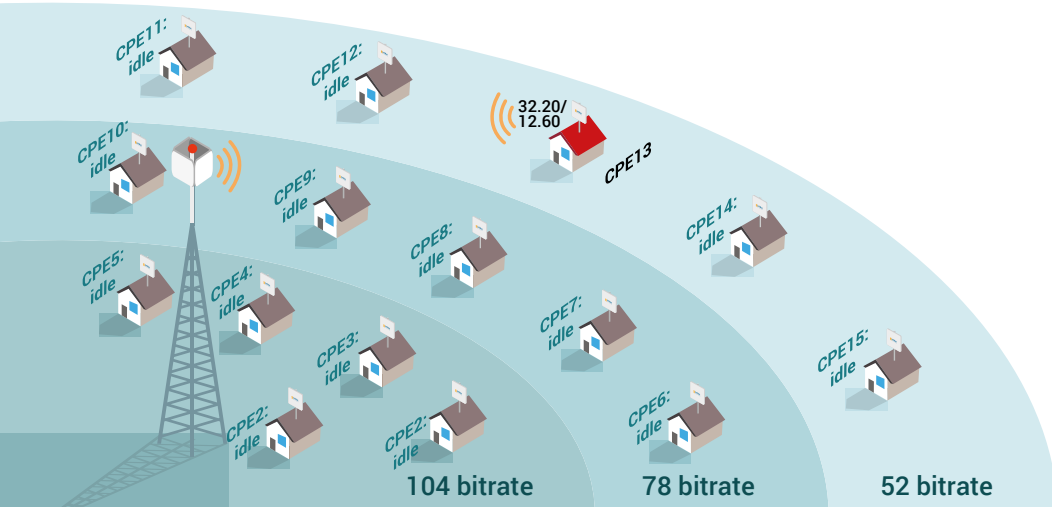

Figure 3 CPE13 active

In Figure 3 CPE13 is the only CPE active in the whole sector, but the recorded transfer capacity is 32.2 Mbps in downlink direction and 12.6 Mbps in uplink direction (according to the fixed DL/UL ratio). Due to lower modulation level (QPSK 3⁄4), CPE13 cannot benefit from the full sector capacity even when the rest of 14 CPEs are idle.

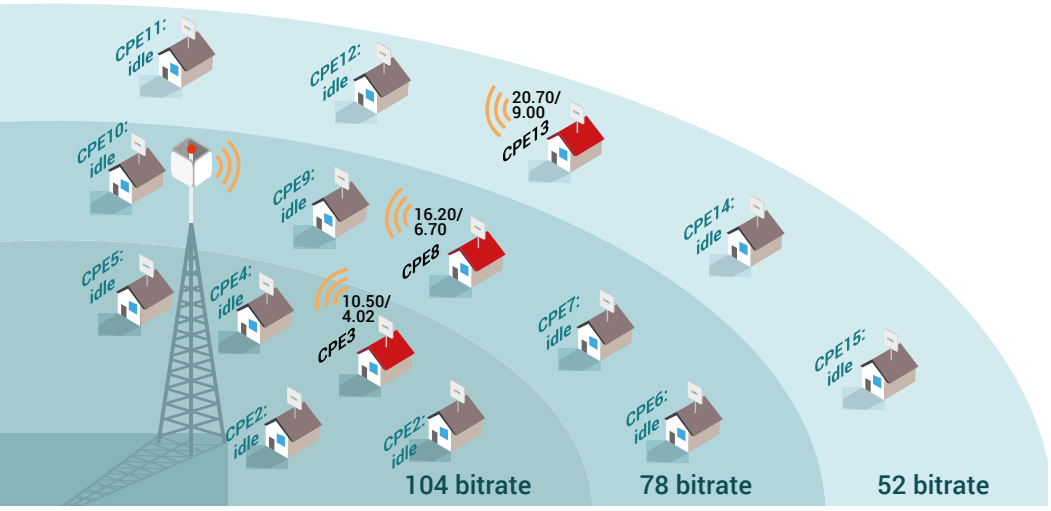

Figure 4 CPE3, CPE8 and CPE13 active

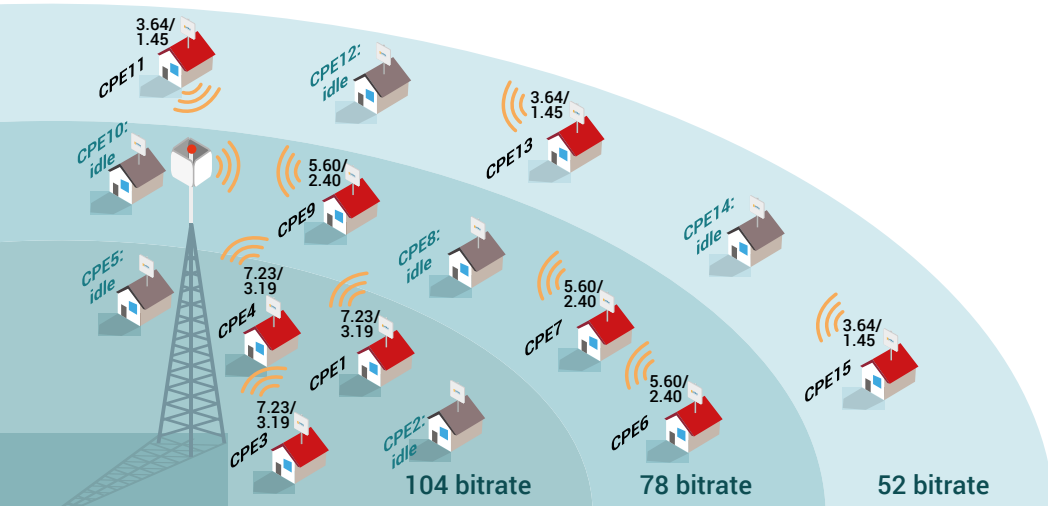

Figure 5 9 CPEs are active

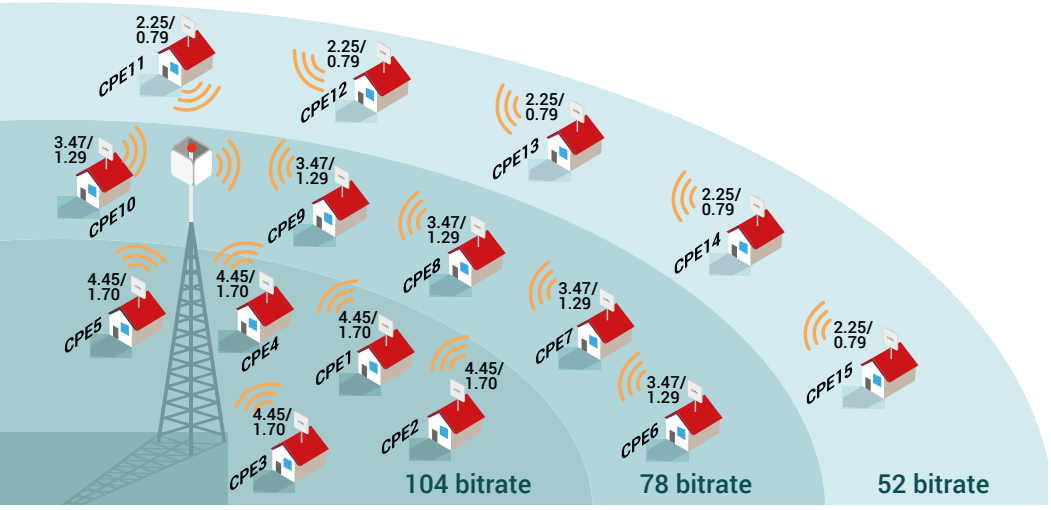

Figure 6 All CPEs are active

In Figure 4 CPE3, CPE8 and CPE 13 are the only active CPEs in the sector but, because each of them use different modulation levels, the transfer DL and UL capacity is different for each of them (see the values recorded in the figure).

Please note that CPE3 reaches to 10.5 Mbps in DL and to 4.02 Mbps in UL, compared to 63.2 Mbps in DL and 28.2 Mbps in UL in the case presented in Figure 2. That's because the full sector capacity is divided equally to the number of active CPEs in the sector as in case all of them would run at the highest bitrate.

In Figure 5 there are 3 CPEs active within each bitrate level. The transfer capacity for each of them is recorded in the figure.

Let's take an example in which the WISP sells to the customers in the area with bitrate 104, the DL data transfer rate of 20 Mbps, not guaranteed - in the high-end situations. Analyzing all capacity results presented in the table at the end of the document, we can notice that the DL data transfer of 20 Mbps is achieved by the CPEs from the area where they can

run traffic at 16QAM 3⁄4, only when maximum 3 CPEs are active in the sector. If more than 3 CPEs are active (running traffic concurrently), the network is oversubscribed and the lowest DL capacity for the CPEs that can run at bitrate 104 is 4.45 Mbps, meet when all 15 CPEs in the sector are active concurrently (see figure 6).

The full set of capacity results for all 15 CPEs is recorded in the table below. The values are expressed in Mbps and represent, in each row, the transfer rate for each active CPE within the sector:

104 Bitrate									
CPE 1		CPE 2		CPE 3		CPE 4		CPE 5	
DL	UL	DL	UL	DL	UL	DL	UL	DL	UL
63.20	28.20								
20.70	9.00								
10.90	4.79	10.90	4.79						
7.23	3.19	7.23	3.19	7.23	3.19				
5.40	2.33	5.40	2.33	5.40	2.33	5.40	2.33		
4.45	1.70	4.45	1.70	4.45	1.70	4.45	1.70	4.45	1.70

78 Bitrate									
CPE 1		CPE 2		CPE 3		CPE 4		CPE 5	
DL	UL	DL	UL	DL	UL	DL	UL	DL	UL
49.50	21.20								
16.70	6.70								
8.45	3.58	8.45	3.58						
5.60	2.40	5.60	2.40	5.60	2.40				
4.20	1.77	4.20	1.77	4.20	1.77	4.20	1.77		
3.47	1.29	3.47	1.29	3.47	1.29	3.47	1.29	3.47	1.29

52 Bitrate									
CPE 1		CPE 2		CPE 3		CPE 4		CPE 5	
DL	UL	DL	UL	DL	UL	DL	UL	DL	UL
32.20	12.60								
10.50	4.02								
5.45	2.12	5.45	2.12						
3.64	1.45	3.64	1.45	3.64	1.45				
2.80	1.07	2.80	1.07	2.80	1.07	2.80	1.07		
2.25	0.79	2.25	0.79	2.25	0.79	2.25	0.79	2.25	0.79

Table1 Full set of throughput results for WISPs network scenario

Conclusions

The results measured in the simulated real-life scenario demonstrate that InfiNet's wireless equipment can be used not only for building partial or complete backbone networks but also for implementing cellular or micro-cellular structures within the framework of metropolitan area and corporate networks

Many operators have integrated our diverse range of wireless router technologies with their legacy networks and have successfully migrated, with our help, from legacy WLAN devices to true broadband solutions.