Wireless Plant Extension: Case Studies

Danny Castellano
Vice President Engineering

Arcwave Inc, Campbell, CA

ABSTRACT

In recent years, Multiple System Operators (MSOs) and independent cable operators have increasingly adopted wireless technology to quickly and economically extend the reach of their existing coaxial cable plants. One such technology, DOCSIS™ compatible wireless plant extension (WPE), is readily available to expand the cable plant's reach to address the growing Small and Medium Business (SMB) market's demand for high speed internet service. WPE technology is gaining rapid adoption and has proven to be a key method to quickly add high margin commercial customers onto the operator's networks. For those interested in learning more about this technology and who are considering deploying it, case studies of actual deployments provide a valuable way to understand the practical aspects of this exciting new MSO tool.

INTRODUCTION

Over the past few years, MSOs have increasingly deployed wireless technology to quickly and economically extend their existing RF cable plants. Specifically, wireless DOCSIS equipment has been progressively used to offer High Speed Data (HSD) service to SMBs. This technology has shown tremendous acceptance as it has proven to be a key enabler for adding high margin commercial customers onto MSO's networks.

For MSOs who have yet to deploy this technology, yet are interested in what has been done, this paper looks at case studies of actual WPE deployments. It is intended to aid in understanding the process, from qualifying a potential end customer to ongoing maintenance. It also identifies differences between servicing an SMB via standard cable plant and WPE technology. This information can be used as an aid to create a playbook by which to quickly and successfully qualify, deploy and economically service new customers via WPE technology.

It covers:

- the type of service enabled by WPE to the end user
- preparation and planning
- resources and effort needed for installation,
- provisioning, maintenance and monitoring systems
- end user pricing model
- "lessons learned" for minimizing problems in new installations

Three case studies described below address different installations at three different MSOs. In Case #1, one Hub links to one customer premise equipment (CPE) which in turn services one business. Case #2 one Hub links to one CPE which in turn provides service to two (2) businesses. Case #3 describes one Hub linking to six (6) CPEs, each CPE servicing one customer. These case studies describe these MSOs initial efforts at deploying WPE equipment with live customers.

CASE STUDY #1 - POINT TO POINT LINK

This deployment took place September 2004 in the northwest. This MSO (MSO#1) had been approached by an SMB in need of broadband high speed data (HSD) to provide a 24/7 VPN to another of their office

buildings. The only other HSD servicing alternative that this SMB had was to get T1 service from Qwest at a monthly charge of $700 per month.

While doing the preliminary survey, MSO#1 concluded that the distance was too great to allow for an aerial cable connection. The cost for an underground connection would not allow a reasonable payback within MSO#1's ROI target time frame. Therefore, a wireless DOCSIS plant extension was considered the ideal access solution to reach this facility.

Planning and Site Survey

To start the process, MSO#1 pulled the location of the potential customer on systems maps to see which node the wireless Hub could be located at to service this customer. After selecting the best node location, the coaxial plant layout of trunk and feeder lines were researched for the best possible tie-in point. Then monitoring software was accessed to determine how much available capacity the node had for supporting additional internet activity. The concern was the potential of over-saturating the node's ability to supply suitable DOCSIS bandwidth without having to split the node to support the projected bandwidth usage.

As the next step in the process, a more in-depth site survey was conducted to assess in-building access and to ensure there was line of sight to the coaxial plant. Using GPS, the MSO#1 plotted the distance from the customer site back to the best possible line of sight into the coaxial plant. It was determined that three different locations on the aerial strand could be used to strand mount the wireless Hub and still achieve line of sight and be within the WPE specified maximum distance for 64QAM downstream modulation.

However, while MSO#1 was currently using 64QAM downstream modulation, they needed to plan for the cable plant's transition to 256QAM scheduled within 6 to 9 months. Since the maximum wireless link distance would decrease when this transition occurred, a particular location on the node was selected that was close enough to this customer to support both 64 and 256QAM. From the GPS coordinates the distance between the CPE and the Hub location is 0.61 mile.

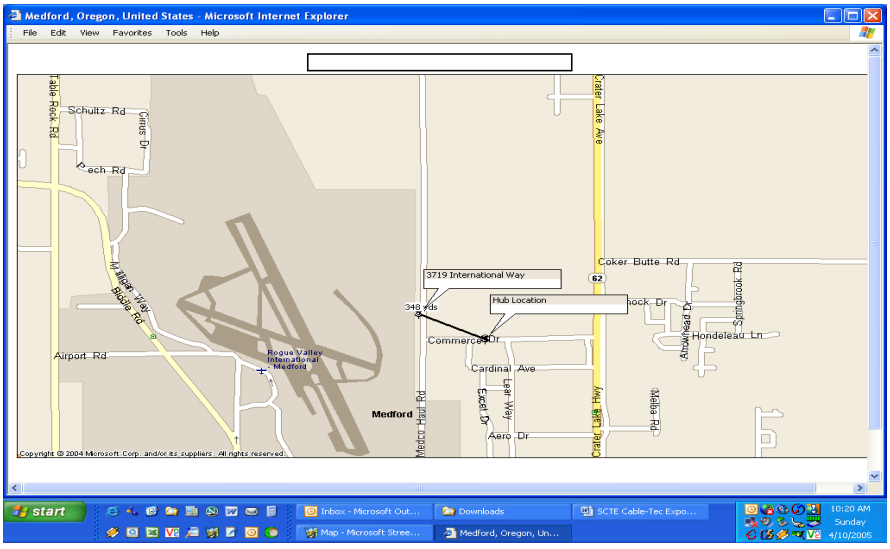

Figure 1 – Map of Point to Point Link

Installation and Provisioning

The actual installation took 5½ hours to complete (Note: Subsequent wireless installs in this market average 3½ hours). Other than the CPE mount, nothing special was required beyond the tools the Line Techs had readily available. The number of people required for installation was two, one being a Data Technician for modem provisioning, setup and assisting the Line Tech in aligning the CPE with the strand mount Hub.

Customer premise challenges were how and where to mount the CPE. Finding a stand-off and mast mount for attaching the CPE took coordination and additional time. Right of Entry (ROE) was not a major issue as the landlord had granted permission for the CPE installation.

As this was a business customer, a special Ambit modem was required that supported 4 static IP's. These Ambit modems require a special setup versus residential cable modems. This was a new change to the normal Data Tech install as he had to wait for this modem to be provisioned. Knowing the system and node that this modem would operate was new information that was needed by the provisioning team. This process has been refined for future installations of wireless or non-wireless business accounts.

Maintenance / Reliability

Reliability of this install was initially not satisfactory. The customer would regularly lose connection early in the morning. A component was identified within the CPE that was sensitive to temperature changes. This problem was corrected by the vendor and since then reliability has been fine.

Maintenance has not been issue. A firmware upgrade of the Hub occurred 2 months after the initial install. This task was performed remotely using a TFTP server to upload the new code.

Special Notes and Lessons Learned

Provisioning and set up of the Ambit modem ahead of time would have saved an hour at the customer premise. Checking the over-the-air spectrum for an interference free channel greatly speeds up pre- and post-installation. This was not done in this first deployment.

Installing the strand mount Hub was a learning experience. Initially the Line Tech tried to attach it to a bridge amplifier. The Hub was initially not receiving the plant's AC power. This was due to the coupler not passing AC. Once this installation issue was corrected, the Hub worked fine.

Summary Case #1

The overall customer satisfaction is high. The downstream (DS) provisioned speed is 3Mbps, and the measured speed was 2.86Mbps. This first customer is being charged $299 monthly for this service.

Since this initial deployment, a second customer has been added that is serviced by the same Hub, improving the ROI model. Since this installation, this market has added four (4) additional SMBs that are being serviced by WPEs.

CASE STUDY #2 - POINT TO POINT TO MULTI-POINT

This deployment occurred March 2005. This is a unique temporary application. One state's Department of Transportation (DOT) and a local construction company each have a trailer located at the intersection of 2 major freeways. Both are involved in major road-widening construction project. They require internet and access to their central databases for downloading maps and other multi-megabyte work documents. There are approximately 3-4 people in each trailer who each require use of an HSD connection for 1-2 hours per day.

Both companies had been using analog (Telco dial-up) connections that resulted in lengthy download times and frequent failed downloads which affected their work schedules. A traditional coaxial connection would have been too expensive, taken too long to implement, required many permits, and would have required crossing a major highway to reach these 2 trailers. MSO#2's "last mile" WPE proposal, with its reasonable construction and monthly recurring costs, was enthusiastically accepted.

Planning and Site Survey

A field technician surveyed the outdoor cable plant. The Hub connection to the cable plant required the insertion of a power passing tap. Possible Hub locations were reviewed and two different locations were selected. The final decision was made based on (a) the available capacity of the two different nodes and (b) the possibility of moving of the temporary trailers to another location that would still be within access of one of the Hubs. Because of the RF link crossing a major expressway, the WPE height above the road was crucial. The correct location for the CPE equipment was determined by physical survey and review of the

new construction design. No permits or right of way approvals were needed based on using the current distribution strand mounted already in place along the frontage road across the expressway from the customer location.

Installation and Provisioning
Technicians were in a bucket truck installing the Hub when an unexpected snow squall reduced visibility to nearly zero. Even with the inclement weather, they were able to mount the Hub and CPE in five hours. The CPE mast needed to be extended to over eight feet and mounted to the top of a multi-purpose electrical shack to ensure sufficient height to clear potential interference caused by passing tractor trailers. The output of the CPE was split to feed the two trailers.

The bandwidth provided to each of these trailers is 3Mbps for DS and 512kbps for US. 64QAM and 16QAM modulation was used for DS and US respectively. The distances from the Hub to CPEs are approx 150-200 ft. There were no provisioning issues. These customers were assigned static IP addresses.

Maintenance / Reliability
CPE did not perform adequately upon initial installation. Due to the long length of the coaxial cable between the WPE CPE and the cable modems, it was found a different AC to DC adapter was needed to supply a higher DC voltage to overcome the cable loss. The WPE supplier has since made this a permanent product change.

Special Notes and Lessons Learned
Installation issues were minor. Per the construction crew, this installation was easier and simpler than a traditional coax install. This install was completed by installation personnel with wireless background. Limited phone support by the vendor was requested by the MSO. A Data Technician was on site to oversee the installation of the Hub. The distance between the two temporary buildings was an initial concern. A fall back plan, which was not required, was to install a second CPE on the second temporary trailer if necessary.

Summary Case #2
Both end customers are very satisfied with their HSD service. They were charged a one-time construction charge of $3000 and a monthly price of $334 for both customers. The operator is planning that when this temporary WPE installation no longer is required; that by simply rotating the Hub 180 degrees they can offer service to other SMBs that are unreachable by the cable plant.

CASE STUDY #3 - POINT TO MULTI-POINT LINK

This WPE deployment by this MSO (MSO#3) occurred in the Midwest in December 2004. As opposed to Case Study #1 which started as a point to point deployment and later evolved to point to multi-point, the initial installation began as point to multi-point deployment. Specifically one Hub was installed to service 6 CPEs, each servicing an SMB customer. This industrial area did not offer DSL, so the SMB's only alternative access method for receiving internet service was via dial up phone service.

Planning and Site Survey
The cost for reaching these business customers via standard coax connection was deemed too expensive to make financial sense. Since one Hub would be servicing multiple CPEs that are all in different directions from the Hub (refer to Figure 2) a Hub was chosen that offered a wide 90 degree field of view to ensure adequate over-the-air signal strength to all CPEs. The distance from the Hub to the farthest CPE is 4000 ft.

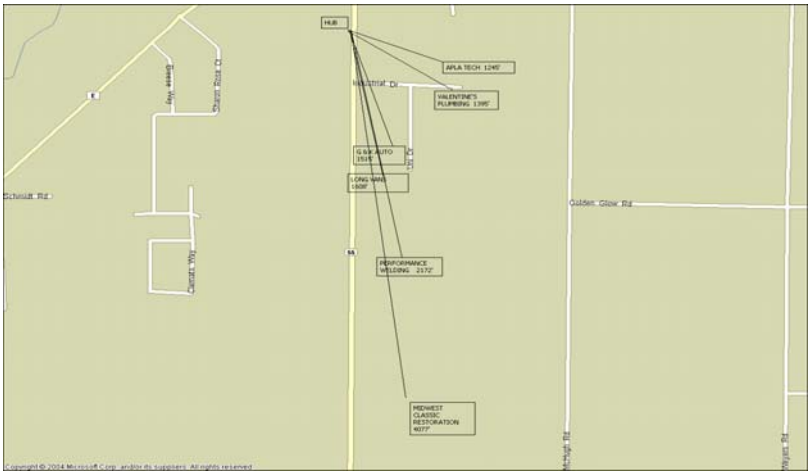

Figure 2 - Map of Point to Multipoint Links

Installation and Provisioning

This was MSO#3 first experience in installing a WPE system. MSO#3's cable plant supported 64QAM downstream and 16QAM upstream. Initially the packet loss to the CPEs was higher than expected. After some troubleshooting, it was found that there was interference in the DS over the air frequency originally chosen. Changing the Hub's DS frequency improved the link performance to acceptable levels. The CPE nearest to the Hub did not have line of sight due to trees, however due to the short distance the packet loss was not an issue. Also, in one of the customer locations the packet loss was high. It was found that the length of the coaxial cable between the CPE and the cable modem exceeded the WPE vendor specification. Once this was corrected, the packet loss was reduced to an acceptable level.

A non-standard provisioning effort was required to modify the billing system to easily identify customers being serviced by this WPE.

	DS (Mbps)/US (kbps) Speed	Provisioning Options	Monthly Charge
Business #1	1 / 768	None	$79.95
Business #2	1 / 768	None	$79.95
Business #4	1 / 768	None	$79.95
Business #3	1 / 768	Static IPs	$109.95
Business #5	1 / 768	Web Hosting	$109.95
Business #6	1 / 768	Managed Storage and Firewall	$129.95

Figure 3 - Hub Installation (In middle of picture)

To ensure a proper installation, it is important to monitor the status information available from the WPE equipment (refer to Figure 4).

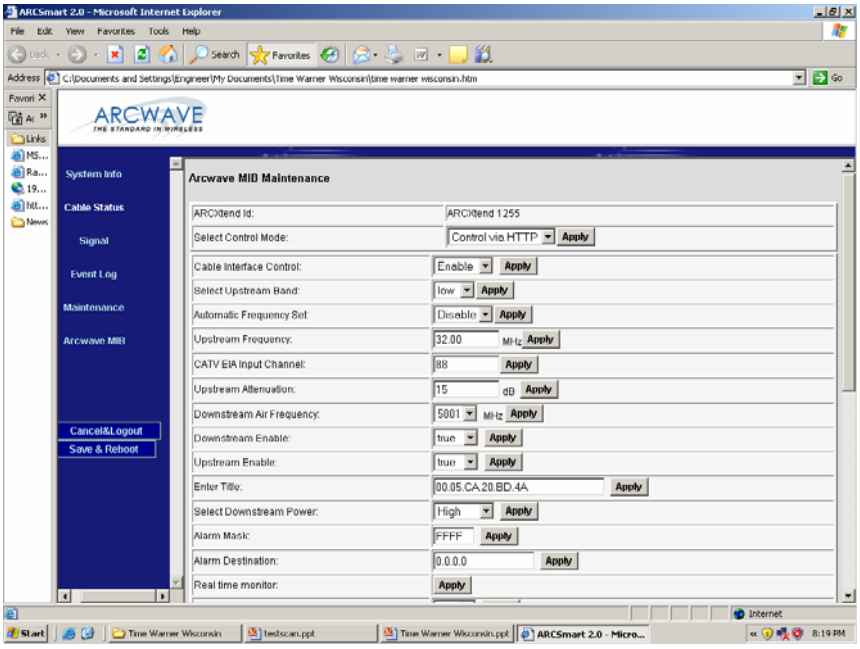

Figure 4 - Hub Monitoring and Diagnostics

Having the proper downstream MER out of the WPE equipment into the cable modem is critical for quality operation. Per Figure 5, the MER was 34.3dB out of one of the CPEs. To support 64QAM, 27dB MER is recommended. The minimum MER required to support 256QAM is 32dB. In this case, the MER is sufficiently high to provide quality service for both 64 and 256QAM.

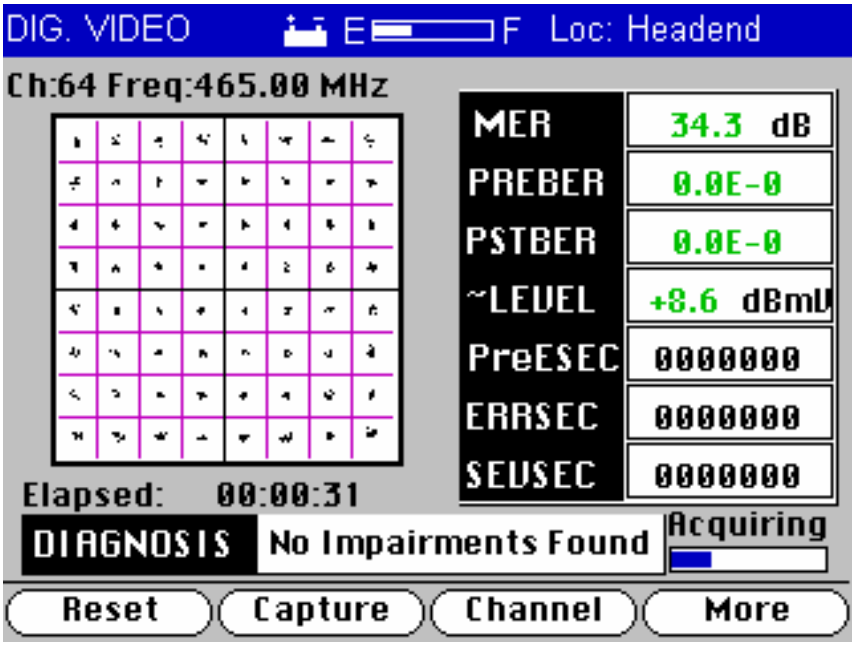

Figure 5 – Downstream constellation out of a CPE

Maintenance / Reliability
As mentioned earlier, trees are between the Hub and the closest CPE. This resulted in packet loss of 5% to 10% with occasional bursts up to 18%.

Summary Case #3
Though this installation took longer than the MSO planned due to the effort required to get all six (6) SMB locations optimized, the result is that these customers are very satisfied with their HSD service. The revenue from the 6 business customers totals $590 per month.

CONCLUSION

WPE provides MSOs a proven new tool to provide HSD service to the many SMB customers not currently reached by exiting coaxial cable plant. As these three cases demonstrate, there are many instances where WPE is the best choice to reach an SMB to quickly provide high margin service.

However, there are differences in the planning and deployment of WPE equipment compared to traditional cable plants installs. Understanding the subtleties and requirements for successfully deploying WPE equipment reduces the learning curve, minimizes the installation time, and ensures optimization of the site installations resulting in highly reliable service and satisfied customers.