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Network design considerations for wireless video surveillance

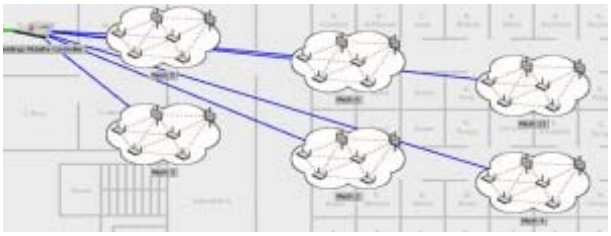
June 3, 2010 at 5:54 PM by Ksenia Coffman

My post Why Flexibility of Mesh Topology is Important for Video Surveillance drew an extended comment from Joe Wargo of AO Wireless, and I'm using it as a jumping off point to address some of the issues impacting network design for wireless security and surveillance. (Sections in italics are Joe's comments, with my commentary below each paragraph. Headings are mine.)

Point-to-Point, Point-to-Multipoint, and mesh play a role in wireless video surveillance

"As an outdoor wireless integrator that specializes in video backhaul solutions, I would like to comment on this conversation. Wireless mesh products do have a great fit in large video deployments. As well does point to multipoint and point to point backhauls. Each has their fit and their limitations. In a deployment that covers a large geographic area (e.g. a city wide deployment) the best design will more than likely utilize all three topologies. Obviously one of the key requirements of video backhaul is bandwidth and latency. Consideration for what type of video the end user is trying to capture is also an important factor."

Agree completely: one topology cannot address all of the needs of a deployment. Further, Firetide's mesh for large scale deployments is never a single 'monster' mesh; that would be impractical from network management and bandwidth/latency standpoint.



The best practice for video security network design is multi-mesh, interconnected by wired or wireless backhaul. Fiber often plays a role as a backhaul, when fiber is available and accessible. To illustrate my point on how these networks are built out, here are a few examples citing Firetide deployments.

- Dallas PD project is a multi-mesh design with point-to-point wireless backhaul, utilizing mesh for street-level connectivity, and BridgeWave wireless links for backhaul. Dallas PD wanted a network independent from any other city infrastructure (not sure if it was not available or could not provide enough capacity), therefore they opted for a 100% wireless solution.
- Chicago OEMC video install is a multi-mesh design with fiber backhaul. The city already had a lot of fiber installed, so wireless mesh fills in the 'fiber gaps.'
- Los Angeles County Sheriff's Department is expanding their wireless video security network using Firetide MIMO mesh nodes in point-to-point configuration (dual-radio bonded) as an alternative to dedicated point-to-point backhaul. Los Angeles lacks the extensive fiber infrastructure of Chicago, hence the decision to utilize 100% wireless connections.

Requirements for video quality depend on situation

> *"Too often we see deployments that are not optimized because the end user doesn't truly understand the fundamentals of video surveillance and their networking requirements. For example, often a end user will say they need 30fps for both viewing and recording. From a video perspective this is not best practices. There is very little difference that the human eye can capture from 15fps from 30fps. Recording should be what is needed (e.g record on event or a few fps). It does depend on the requirement of course."*

Our public safety deployments can be anywhere from 12 fps to 30 fps, most often with the same stream being used for recording and viewing. In one of our deployments, where the customer did have a requirement for separate viewing vs recording, the recording is done at 30 fps and viewing is at 7 fps. Law enforcement agencies often city 'evidence-grade' video requirements for forensic investigations and prosecutions, when they specify 30 fps/4CIF. This is indeed best for areas with fast motion such as intersections. But in most case 15-20 fps works just as well.

Ironic but true: wireless mesh is sometimes not "true mesh"

> *"Too often the end user is putting more video over the network than should be required. Bandwidth and latency becomes an issue. Second issue is that most do little or very poor RF planning. Too often we see installations that people are using the wrong technology in the wrong situation. Wireless mesh devices help with getting around obstacles. Too often through we see mesh not really meshing at all, but used as repeaters in a chain fashion. A great advantage of many mesh devices is they have that flexibility. Problem is that they are not utilizing their full functionality. There aren't many applications that require "true mesh" capabilities in a fixed camera environment. But they work well with bringing multiple cameras together. Problem though becomes latency if too many nodes are used before a*

backhaul (using PtMP or PtP).”

True, the ability of mesh to repeat the signal is one of the key advantages of this type of topology. And indeed, even though we say ‘mesh’ to describe what we do, the actual deployment topologies in the field vary greatly, even when using 100% Firetide gear. Most often the end result is a ‘partial mesh’: some redundant links, some PtP and PtMP, and some ‘linear mesh’ (mesh nodes strung together to reach into a neighborhoods or go alongside a key thoroughfare; mostly when the budget does not allow for 100% coverage of a given area).

The flexibility of mesh allows to easily add additional nodes and fill in the mesh gaps in the next phases of the deployment. We’ve even deployed Firetide in circulate mesh – 5 remote facilities linked in a daisy chain by mesh nodes. As an aside, even with a linear mesh you can build in redundancy: if you have a gateway node at each end of the daisy chain, if something should happen to an intermediary node, the traffic will be automatically rerouted to the ‘backup’ gateway node, without an interruption in a video stream. But the system needs to be designed with that in mind.

“Wi-Fi mesh” and “infrastructure mesh” are vastly different

> *“Newer 802.11n (Atheros) based chip sets are providing more throughput but also require more spectrum and are more susceptible to interference in the unlicensed bands . The worst thing possible is deploying a lot of devices on omni-directional antennas in a small geographic area. Mesh radio in fixed installations should use directional antennas and controlled RF. I understand that manufactures market the full capabilities of their radios, but too often over market the true field performance in a real world environment.”*

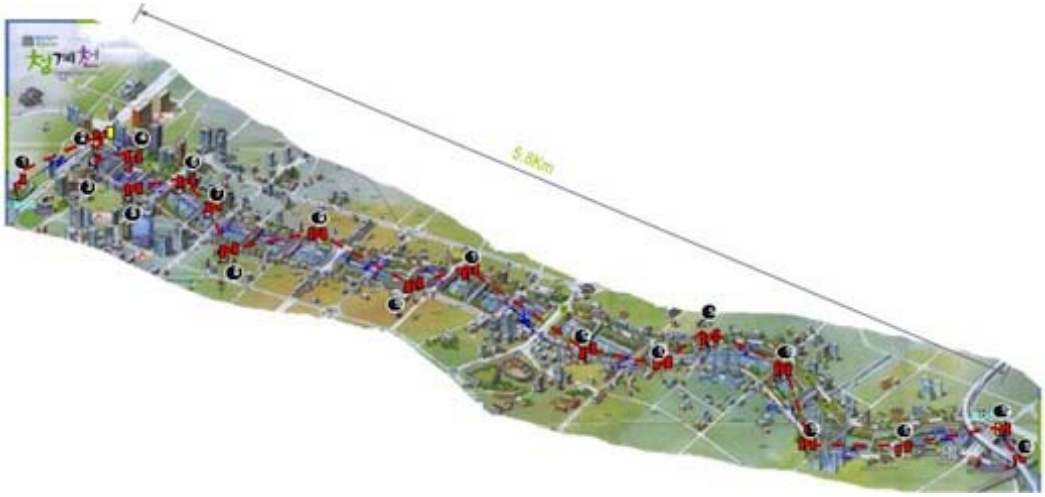
Could not agree more on the antenna choices. Firetide is not “Wi-Fi mesh” as defined by other vendors (of the past and even today – see The Many Interpretations of ‘Wireless Mesh’): for them, mesh is omni-directional, radiating signal in each and every direction and hence it has “a problem with video.” Omni-directional antennas have advantages for mobility applications – the antennas should be omni-directional, so that the mobile mesh node can pick up the best available signal. you can use omni-directional antennas in fixed deployments – if and when mesh nodes are at the same elevation and the RF environment is relatively clean. See what happens when an integrator tries to use omnis for video outside these ideal parameters.

We consider mesh APs to be “Wi-Fi mesh”: devices with omni-directional antennas, often with an AP built in for client access; these devices were designed with low-bandwidth data in mind. We call what Firetide does “infrastructure mesh”: dual-radio IP infrastructure designed from the ground up for real-time high-bandwidth applications: voice, video and data. Hence trying to fit mesh APs in a video surveillance space (which they were not built for) is often a recipe for disaster, or requires many more mesh nodes in a given area, expensive wireless or wired backhaul and more complex network design and management.

RF and IP knowledge key to successful wireless video surveillance deployments

> *We have been extremely successful deploying video backhaul applications using PtMP, PtMP and Mesh together, etc. The one thing that should be stated with mesh is that after a few nodes there should be a backhaul in order to control latency. Last thing to note is that not all video cameras work the same over wireless. We have done a lot of testing with various cameras and over various wireless radio systems. Research should be done by the buyer prior to choosing the right camera with the right wireless systems. And as always, always, always, consult an RF professional to design and install the network correctly.*

Agree with the part that all of the topologies are important for video. But do not 100% agree that backhaul is needed for every few mesh nodes – it depends on a particular vendor, or rather the technology they use (and definitely does not apply to Firetide's mesh). What you said is true for single radio mesh nodes, as the throughput is reduced by 50% with each hop, because the mesh has to both receive and send on this single radio. The limitation of 'backhaul for every few nodes' also applies to mesh APs because of the introduced latency, jitter and best-effort QoS inherent to standards-based Wi-Fi access points.



linear mesh topology at cheonggye waterway

With Firetide's dual-radio mesh nodes and proprietary routing protocol that runs within the mesh, the multi-hop has limited impact on performance, both in terms of capacity and latency. We have many deployments with multiple hops, such as Seoul's Cheonggye Waterway project, with 10 hops each in two directions from a central point. (And that was done with our previous generation of product using 802.11a/b/g radios, with 1.5 ms of latency per hop. Our new MIMO product line reduced latency even further – to .9 ms per hop. So even with 10 hops you are still only at 9 ms aggregate latency, and able to maintain 80-90% of the original throughput.

We can recommend IP cameras that we know to work well over Firetide's wireless infrastructure, two prime examples being our official solution partners Axis Communications and Sony Electronics, and many others. We've also been deployed with analog cameras, connected to the IP network via encoders – and have numerous deployments with this setup (people still like analog cameras). Theoretically, any IP camera or IP encoder should work as Firetide is purely an IP transport. However, some camera vendor's implementation of IP may introduce certain quirks that you should know about before making a selection.

On the last point – agree completely: mesh, or any wireless, is specialized expertise, and requires both IP networking and RF knowledge. The biggest issue we are seeing with deployments coming in into our tech support is the lack of professional site survey done prior to deployment, and hence RF network design issues. Plug: Firetide provides professional services, including on-site engineering site surveys, to our channel through a network of vetted professional services partners. These services are transparent to the end-user; they do not need to know who's performing the work, as long as the integrator is billing the customer, so the channel is protected. With professional services, even integrators who are new to wireless can have successful deployments, while learning on the job. It does not take rocket scientists to successfully deploy these systems, but you need to know what you are doing.

* * * * *

About the author

Ksenia Coffman is the marketing manager at Firetide, a wireless infrastructure mesh company. She is responsible for Firetide's marketing strategy and technology solution partnerships. She writes the blog, Mesh Without Wires.

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