

The Best Wireless Mesh for Large-Scale Video Surveillance Networks

BelAir Networks is the mesh market share leader by a long shot, and for good reason

When the 35 W bridge collapsed in Minneapolis in what Governor Tim Pawlenty described as “a catastrophe of historic proportions for Minnesota”, real-time, high resolution video transmitted from the disaster site to the Emergency Operations Center (EOC) using the city’s wireless network – built with BelAir Networks gear – gave emergency personnel the detailed and comprehensive visibility needed to make critical planning and resource decisions.

With port security as their principal concern, the Port of Richmond, northern California’s most diversified cargo handler, deployed a state of the art IP video surveillance system utilizing advanced analytics and enabling remote monitoring and storage. To network almost a hundred cameras over the port’s 15 square miles, they needed a wireless network that is both high performance and scalable. They chose BelAir Networks.

When a world-leading telecommunications company entered into a public/private partnership with the city of Riverside, CA to deploy a 54 square mile citywide wireless network supporting both 4.9 GHz for public safety – including video surveillance camera networking, in-car video, and other public safety applications – and Wi-Fi access for the public, they halted the deployment in progress and chose instead to deploy BelAir Networks.

BelAir Networks is the trusted brand of the world’s most demanding customers.

The trust we have earned by successfully deploying large-scale public safety networks has helped make us the mesh node market share leader in 2008 and for the last 7 quarters.

In fact, in the first quarter of 2009, BelAir Networks market share is more than double the nearest competitor (see Figure 1.)

BelAir Networks, the mesh market leader, delivers:

- Highest reliability: robust gear that’s literally bulletproof and proven in the most extreme climates, mean time between failure of better than 50 years
- Highest performance: highest capacity, lowest latency and jitter ensures quality video transmission
- Best scalability: proven in North America’s largest mesh networks
- Most cost-effective: product mix cost-effectively addresses all sizes of video surveillance networks
- Unmatched experience: more than 60,000 radios deployed worldwide including North America’s largest Wi-Fi and 4.9 GHz public safety networks

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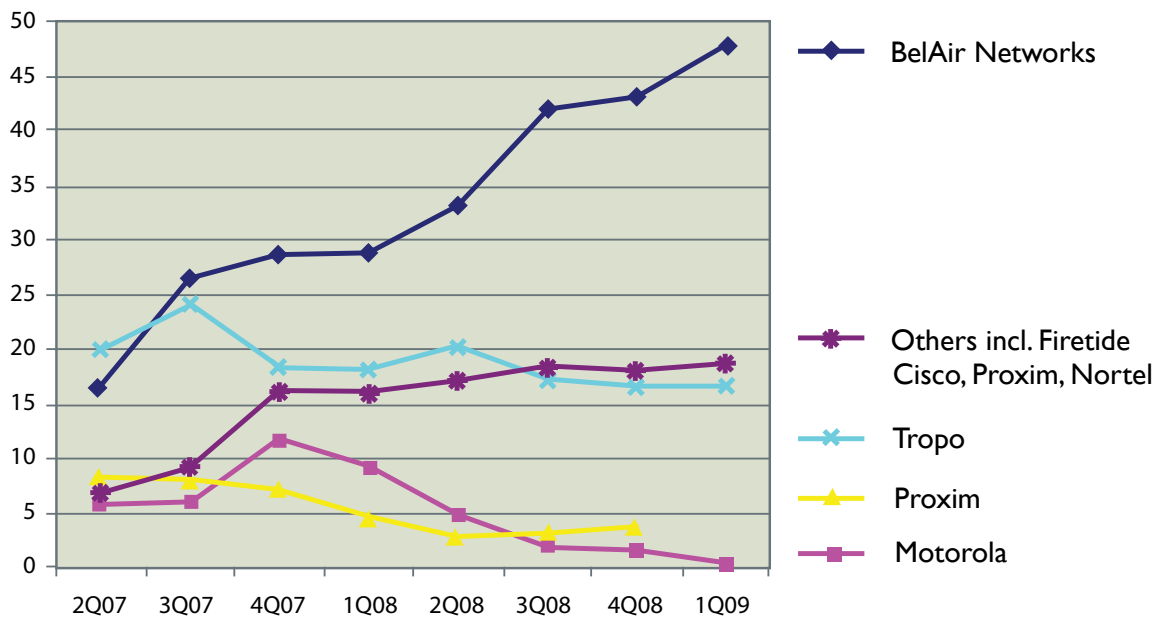


Figure 1. BelAir Networks has earned more than double the market share of its nearest competitor. Source: Dell'Oro Wireless LAN Report 1Q09, Mesh Nodes

Why is BelAir Networks so much better?

Everybody knows that wireless mesh technology can provide a number of benefits over wiring, including:

- **Cost-effectiveness and installation speed:** Wiring requires trenching whereas wireless mesh nodes are quickly and conveniently co-located – and connected via ethernet – with the cameras they support.
- **Resiliency:** Wireline failure will often result in lost video transmissions, while wireless mesh enables continued transmission even in the event of a node failure.
- **Flexibility:** Without the limitations imposed by a wired network, cameras can be set up anywhere and moved as and when required.

However, to fully realize these benefits, a careful investigation of various mesh architectures is required. While any wireless mesh network can theoretically support video, wireless mesh nodes equipped with either single or dual radios will be limited in their ability to scale without degrading performance. Scalability may not be an issue in small or temporary video surveillance networks (eg. for conventions or special events) or where there's lots of wireline egress ready available. However, for large-scale wireless video surveillance networks and any networks that may need to be expanded, scalability is a technical issue that must be addressed upfront.

What are the scaling limitations of single and dual radio wireless mesh nodes?

More than 60,000 BelAir Networks radios have been deployed in networks worldwide, with proven reliability that has resulted in a mean-time between failure (MTBF) of better than 50 years. BelAir Networks has a full portfolio of indoor and outdoor mesh nodes available in single, dual, tri and quad radio configurations (see Figure 2). Because of our extensive experience and comprehensive portfolio, we are able to provide the right solution for each customer's needs – not just try to convince them to buy what we have. So, while we do offer single and dual radio nodes, we believe that if you're planning

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to deploy a wireless network to support video security cameras, it is important to understand the technical limitations of single and dual radio nodes, regardless of algorithms used to optimize their video delivery capabilities.



Figure 2. BelAir Networks portfolio of indoor and outdoor wireless mesh products feature single, dual, tri and quad radio configurations – all driven by the BelAir OS operating system and easy to use BelView Network Management

Single radio nodes will generally lack the bandwidth required to effectively support video surveillance networks. Where bandwidth is sufficient, it only retains its capacity when used in a point to point configuration – and a single point to point connection is inherently non-resilient. In order to provide resiliency, nodes must be meshed or interconnected with other neighboring nodes on the same channel of the same wireless frequency. When meshed, the available bandwidth is shared among all nodes simultaneously, limiting the available capacity and creating high and unpredictable latency and jitter as traffic grows. This performance is unsuitable for video surveillance networks which require high capacity and low latency and jitter to maintain the quality of the video.

Dual radio nodes improve this situation somewhat. They can be deployed in what may be described as a linear fashion, with each radio in the node dedicated to a separate channel and only interconnecting with radios on that same channel in adjacent nodes – effectively doubling the capacity available on a single radio node when used in point to point mode. While this reduces the contention in the network to make more bandwidth available, it also results in a network of non-resilient links (see Figure 3). Effectively you end up with the same lack of resiliency associated with a single radio point-to-point or even a traditional

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wireline network. And, you've eliminated one of the main benefits of a mesh network. Alternatively, dual radio nodes can be deployed such that the radios are combined and meshed to the neighboring nodes, effectively operating like a single radio node in mesh mode but with twice the bandwidth (see Figure 4). But while the bandwidth is greater, it is still shared among all of the neighboring nodes, which limits its available capacity and increases latency and jitter as traffics grow, resulting again in performance unsuitable for quality video delivery. There's a workaround for that, too. Just limit the size of the mesh cluster and provide more wireline or high-capacity point to point wireless egress for additional capacity injection – of course, that will result in higher deployment and operational costs associated with the network and reduce flexibility in where nodes are deployed. No matter how you configure dual radio nodes, their inherent lack of scalability reduces the cost-effectiveness and flexibility as the video surveillance network grows.

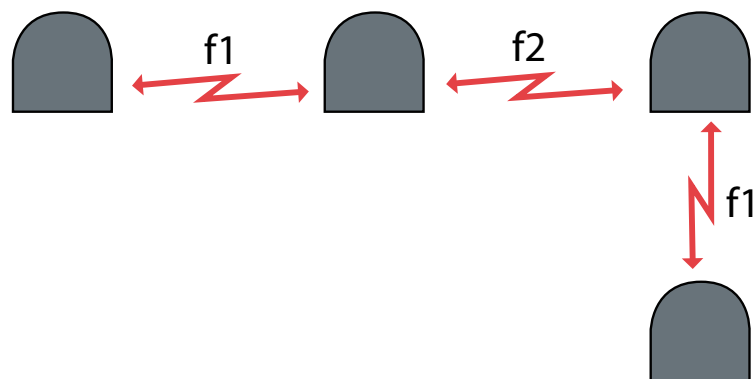


Figure 3. Dual radio nodes deployed in a linear mode result in a network of non-resilient links.

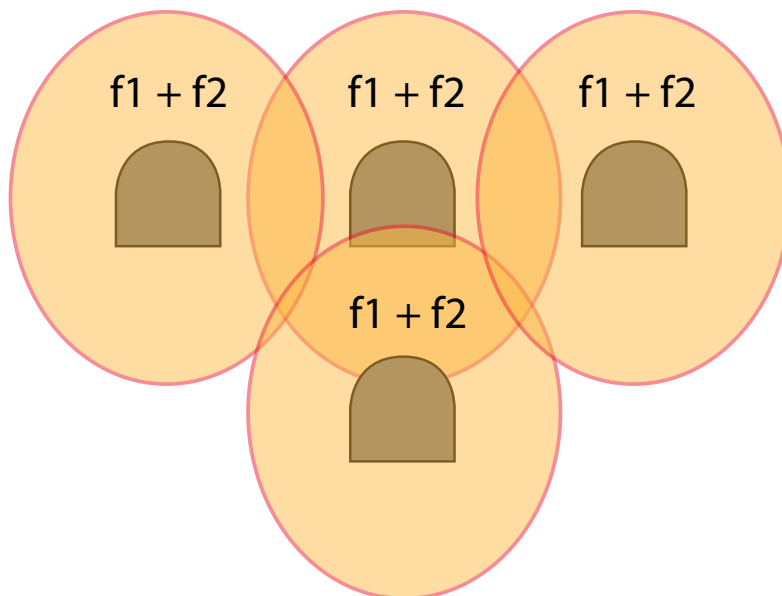


Figure 4. Dual radio nodes operating with both radios combined or bonded suffer from reduced performance (lower capacity, higher latency and jitter) as more nodes are added to the cluster, due to contention in the network.

Bringing scalability to the video surveillance network

So, the question is: How do you realize and not compromise the benefits of wireless mesh technology – resiliency, flexibility, cost-effectiveness, installation speed – when you deploy large-scale video surveillance networks or plan for networks that will need to be able to grow?

In contrast to single and dual radio mesh nodes discussed above, BelAir's patented switched architecture (see Figure 5) supports diverse paths between nodes through multiple dedicated and isolated point-to-point connections. Available bandwidth of each separate channel is dedicated to the link to the neighboring node, so total bandwidth is the sum of bandwidth of each link. Each link is on a separate channel so forwarded traffic doesn't use bandwidth from another link. This enables the network to effectively scale, delivering and maintaining much higher capacities and transmission rates and lower latency and jitter than other mesh nodes. The network also retains its resiliency, cost-effectiveness and flexibility, making the switched architecture an ideal solution for large-scale video surveillance networks – or those that may need to be expanded.

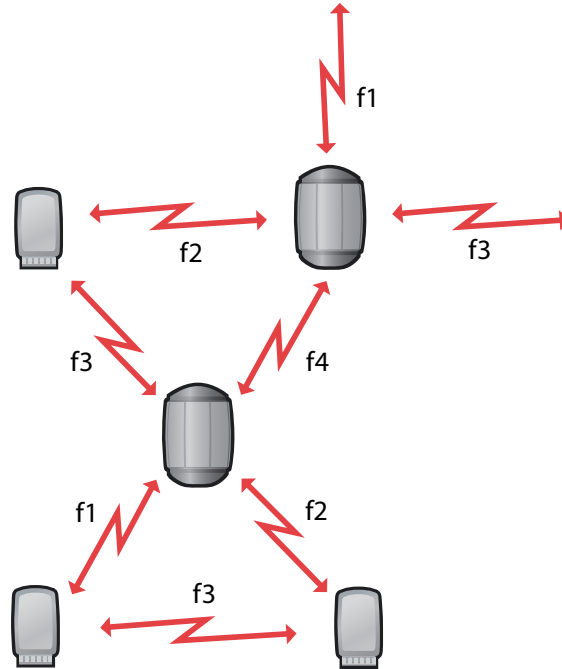


Figure 5. BelAir Networks patented switched architecture uses a cost-effective mix of dual, tri and quad radio nodes, and retains its resiliency, high capacity, and low latency/jitter as the network grows.

More than video surveillance... and vehicular-speed mobility, too!

This switched architecture, combined with other advanced networking features uniquely enabled through the BelAirOS operating system, such as QoS and traffic prioritization, enables you to take advantage of that same mesh network to enable police or security personnel to remotely access and monitor video (real-time or recorded) throughout the coverage area. In fact, a whole host of WLAN applications, including high-quality VoWLAN, can be supported on that same network.

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Mass transit vehicles and the associated stops, stations, road and trackside areas represent critical infrastructure requiring the protection afforded by video surveillance that supports public safety and defends national security. These video surveillance systems require high-performance mesh capable of maintaining seamless, high capacity connectivity at speed of up to 150 miles/hour. BelAir Networks offers mobile mesh nodes designed for vehicular installations (including buses, trains, and police cars) and provides mobile broadband connectivity to trackside/roadside infrastructure using 5 GHz, WiMAX, 4.9GHz Public Safety, or 5.9GHz Intelligent Transportation Services (ITS) bands. Offering true standards-based seamless mobility, BelAir Networks employs 'make before break' handover to ensure uninterrupted broadband connectivity for video surveillance cameras and other WLAN applications.



BelAir Networks high performance wireless dual, tri and quad radio nodes support video surveillance networks throughout cities and ports.

BelAir
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