A Pragmatic Look at AVB Deployment

Some 20 years ago my working life began as an IT & network administrator for a large university. Looking back I can appreciate the broad education provided by an environment that included equipment from just about every major vendor coupled with an expectation that it all should work together as a system.

Life has a habit of repeating itself. Then, as now, new protocols and standards vie for adoption and system designers need to make choices. Migration from existing systems to new solutions presents particular challenges, especially when network infrastructure is involved. New protocols that cannot use old infrastructure face extra deployment hurdles since around 80% of AV system deployments use upgrades to existing building facilities.

This article reviews historical deployment experience for two Ethernet protocols that changed large amounts of network infrastructure. The lessons learned can be applied to the deployment of new AV networking technologies.

Historical examples

Two examples from the past strike me as illustrative: Ethernet Virtual LANs (VLANs) and Ethernet Jumbograms. Both involve increasing the maximum size of an Ethernet packet, which as you can imagine, is not something you can easily change in existing equipment.

Figure 1 802.1Q Ethernet header

Let's start with the VLAN (802.1Q) standard. Figure 1 shows how VLANs add an extra 4 bytes into the packet header. This seems simple enough, but it has some far reaching consequences. To be backwardly compatible with existing Ethernet equipment it was important to retain support for payloads up to 1500 bytes, but that meant the maximum Ethernet packet size also had to increase by 4 bytes. Unfortunately, existing equipment wasn't designed to receive these larger frames and often it just didn't work. If you had an old switch in your network, it divided the VLAN-capable parts of the network into islands since the 802.1Q Ethernet frames couldn't pass through. Even though switch replacement was expensive and disruptive, VLAN support rapidly became commonplace in Ethernet networks.

Ethernet Jumbograms provide a slightly different example. Jumbograms were intended to reduce packet processing overhead in computers and work by increasing the maximum Ethernet payload from 1500 bytes to 9000 bytes. Smart hardware designers had learned from the 802.1Q experience and were better prepared to increase the maximum packet size yet again. Once again, all switches in the network had to support jumbo-sized packets. Interestingly, Ethernet Jumbograms were never formally standardized and while many switches support them, they are not widely used.

What drives deployment of new standards? Ultimately it is a cost/benefit calculation made by the system designer or end user. Deployment of the 802.1Q standard had a high cost but that was more than offset by significant savings and benefits in network management. In the case of VLANs, it was worth it. Jumbograms on the other hand benefit a fairly small class of applications, so there was little incentive to deploy them generally. Today, Jumbogram support is generally available but rarely used. Switch manufacturers support them because it doesn't cost them a lot to do so.

AVB deployment

Over the last few years there has been a lot of buzz around the new IEEE Audio Video Bridging (AVB) standards. The core technologies in AVB Ethernet switches are:

- Clock sync (802.1AS)
- Quality of Service (802.1Qat and 802.1Qav)

Specialized hardware is required to support AVB in Ethernet switches (e.g. packet time-stamping support for clock synchronization).

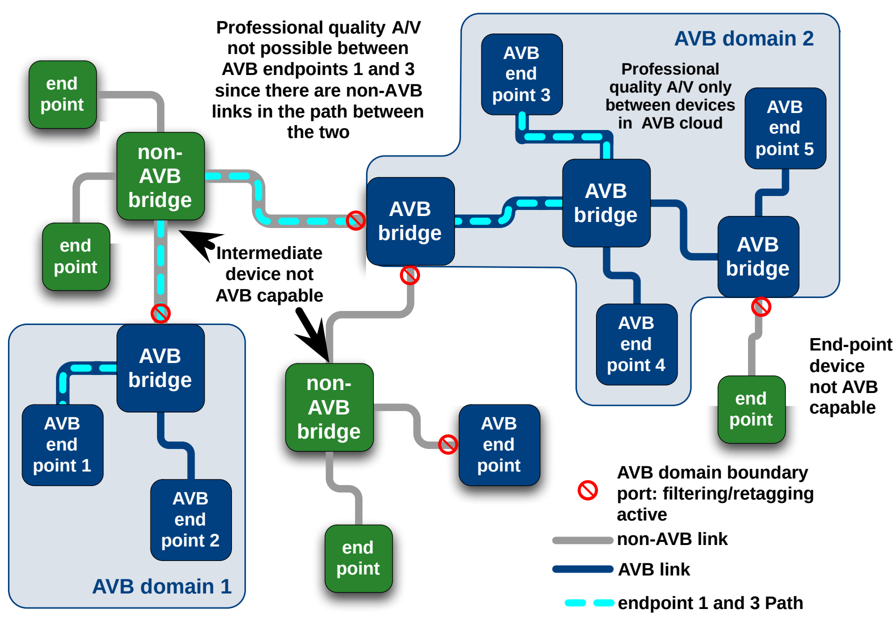

Figure 2 AVB network domains

As Figure 2 shows, all switches in a path must support AVB otherwise the clock sync and QoS features cannot be used. The situation is similar to 802.1Q VLAN deployment, where the network is segmented by switches that don't support the new standard. As with VLANs, deployment costs are high if switches need to be replaced or if separate specialized AVB networks need to constructed.

For AVB switches to be widely deployed, the *value* of the AVB technologies must offset or exceed the added deployment costs. AVB clock sync offers sub-microsecond synchronization accuracy, but that is overkill for most use cases and existing gigabit networks can achieve microsecond sync accuracy without specialized switch hardware. While some use cases might call for AVB-style resource reservation and QoS guarantees, the techniques used to build mission critical Voice Over IP (VoIP) networks can be used to provide QoS guarantees with non-AVB network equipment.

Alternatively, if switch manufacturers can include AVB support for little additional cost (as is the case for Ethernet Jumbograms) AVB may gradually diffuse throughout the industry and become available in a wide variety of network equipment.

So where are we?

A significant economic benefit offered by digital media networking is converged infrastructure for media, control and data. IT managers will have a bigger influence on network considerations in a converged network and considering that the majority of AV installs are upgrades or refurbished systems, system designers will need solutions that can be deployed on existing non-AVB network switches. Not only will this approach be economically expedient to the end-user, it also reduces long-term cost of ownership by requiring fewer network switches and benefits from common spares, support, and network management tools.

There’s no doubt that AVB switches are taking longer than expected to become available. At Audinate, we don’t feel we can solely rely on AVB functionality becoming ubiquitous in network infrastructure for at least a few years yet.

AV system integrators and design consultants will take a pragmatic view when considering new networking standards. According to industry research conducted by IDC and Dell’Oro Group, approximately $80 billion worth of Layer 2/Layer 3 Ethernet switching infrastructure has been sold over the last 4 years. Much of this equipment does not currently support AVB and designers will need to provide practical solutions that can be deployed over the installed networks.

Biography: Aidan Williams, Chief Technology Officer

Aidan is the CTO of Audinate, which he co-founded in 2006 as a spin-out from National ICT Australia (NICTA). At NICTA, he was a principal research engineer and the driving force behind the Digital Audio Networking project that developed the core technology behind "Dante" - the media networking solution commercialised by Audinate.

He participates in several standards bodies and industry alliances, including the AVnu Alliance and the Internet Engineering Task Force (IETF). In the IETF he has authored several IETF documents specificying the interaction between the IETF Real-time Transport Protocol (RTP) and the IEEE Audio/Video Bridging (AVB) synchronisation and QoS services.

Aidan holds a BSc in Computer Science and a BEng (Hons I) in Electrical Engineering from the University of New South Wales (UNSW), Australia.