



## **“Overcoming the challenges of video-over-IP transport”**

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## ABSTRACT

*Many telecommunication operators have set the strategy to converge their infrastructure towards packet-centric networks, which will impose new requirements on the transport of media services. As reliable SDH type of connections will be more difficult to obtain or will be priced at a high level, IP-interfaced transport is likely to become a dominant means to carry video and audio signals. The operational benefits of transporting all traffic over a common IP network can be large. However, for media services it is critical to select an IP transport solution that delivers the required quality of service and manageability with a minimum of complexity so that the overall operational savings will not disappear.*

*This paper examines the quality of service issues of IP/MPLS transport and describes Net Insight's unique approach to overcome these challenges. The renowned Nimbra platform has been equipped with a truly channelized IP trunk interface providing exceptional timing and synchronization characteristics. IP media networks implementing the Nimbra transport solution will deliver guaranteed quality of service together with superior manageability, allowing operators to reclaim control of their end-customer traffic. The solution can be extended across different network technologies, enabling a seamless migration from legacy PDH and SDH environments to a converged IP/MPLS infrastructure.*

## Introduction

Telecommunications is shifting towards IP-based solutions and many operators are consolidating their infrastructure towards packet-centric networks. As reliable SDH-type of connections will be more difficult to obtain or will be priced at a high level, IP/Ethernet transport is also becoming a more widespread way of carrying media services.

In parallel with the operators' drive towards a converged IP-based infrastructure, the media industry is becoming more networked. The move from simple point-to-point links to larger feature-rich and resilient media networks is also increasing the demand for end-to-end service monitoring and enhanced network manageability.

The operational benefits of transporting all traffic over a common IP/MPLS network can be large. However, for media services it is critical to select an IP transport solution that delivers the required quality of service and manageability with a minimum of complexity so that the overall operational savings will not disappear.

## QoS challenges

In IP networks, packets are transported using resources (such as communication links and buffer space in switches and routers) that are statistically shared with traffic from other sources through the network, giving a flexible utilization of the network resources. However, since the resources are shared, it is quite difficult to guarantee the transport.

Service priority schemes such as DiffServ and IEEE 802.1p are fairly easy to introduce. Even though this may work fine for prioritizing e.g. a small number of IP-telephony calls over a large amount of best-effort traffic, a fundamental problem with this method becomes obvious when video traffic starts to dominate the bandwidth spectrum. The QoS problem also accumulates with the number of hops and number of ports in the network.

One solution is then to apply over provisioning of bandwidth, i.e. high-priority media traffic is only allowed to occupy a certain percentage of the total IP/Ethernet bandwidth. However, over provisioning is normally a very costly way of addressing the issue, since a substantial cost of a network is the optical infrastructure and low utilization means that more fibers/wavelengths and more ports are needed.

Another common approach to the QoS issue is to apply forward error correction (FEC) as defined e.g. in the SMPTE 2022 standard. By adding checksums per column and/or per row in a matrix of transmitted IP packets, lost packets may be recovered by the receiver to a certain extent. The FEC checksums will add significant overhead to the bit stream though and the network still has to be engineered to an acceptable packet loss level for the FEC to deliver the required quality for media services.

## Net Insight's Nimbra solution

For years Net Insight's Nimbra platform has been the preferred choice of telco operators and broadcasters to provide flexible transport of media services with guaranteed 100% QoS in optical networks. Upon request from these network operators and to meet the increasing demand for IP transport, the Nimbra platform was further developed to also carry media services in an IP environment with guaranteed quality and carrier-class network management features.

The channelization of bandwidth successfully employed for Nimbra SDH and PDH trunk interfaces has also been applied to IP trunk interfaces, see Figure 1. Whereas in traditional IP networking all traffic is sent over a single large pipe and services are treated and routed in order of priority, Net Insight's channelized IP trunk interface strictly reserves the bandwidth needed for a certain service, with any mix and any size of channels allowed. It is also possible to combine strict QoS pipes for media traffic with best-effort pipes for aggregation of low-priority traffic.

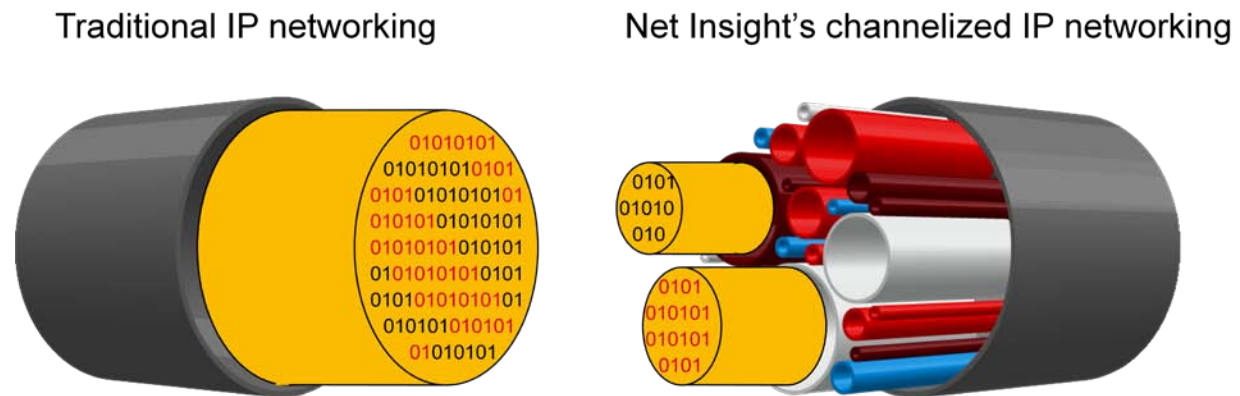


Figure 1. Net Insight's channelized IP trunk interface allows strict reservation of bandwidth for media services.

Since the same channelization technology is used regardless of the type of trunk interface, the Nimbra platform enables a unified media transport solution over any network infrastructure. Services, either unicast or multicast, can be provisioned seamlessly end to end across a mix of IP/Ethernet/SDH/PDH/WDM networks, see Figure 2. In case of network failures, services will be automatically rerouted or protection-switched across infrastructure boundaries. Performance monitoring is available both per service end to end as well as per link to support SLA validation and fast fault location.

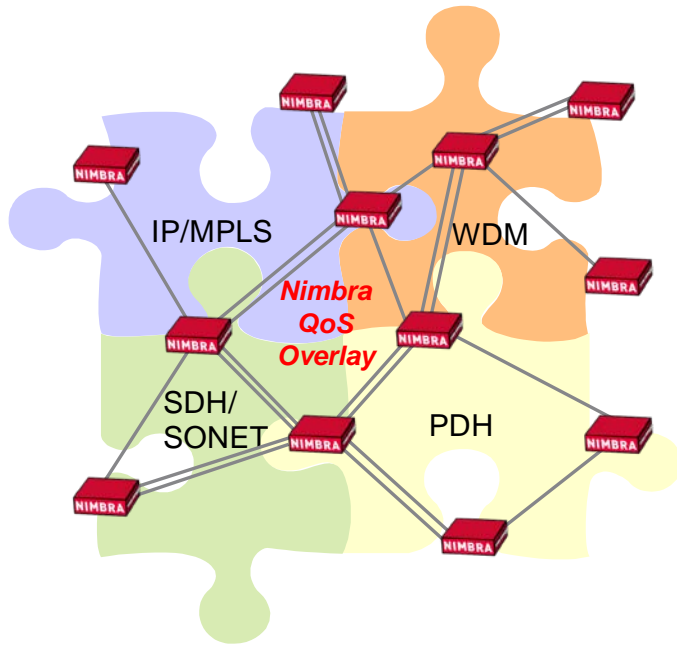


Figure 2. The Nimbra platform enables a unified media solution over any network infrastructure and any topology.

The traditional approach to video-over-IP transport is to put network adapters at the edge of the IP network and then rely on IP/MPLS routers to deliver sufficient quality. In larger networks this has proven to be unsuccessful in many cases. With Net Insight's solution, Nimbra switches are placed not only at the edge but also at strategic locations within the IP cloud, see Figure 3. This provides several benefits both in terms of QoS and network control. Effectively a synchronous overlay for QoS-demanding services is implemented on top of the IP/MPLS network, with the same deterministic and well-known QoS properties as in SDH/SONET networks but with IP as bearer.

Each intermediate Nimbra node will recover the clock signal and regenerate the traffic in the TDM domain. By deploying Nimbra switches within the IP cloud, there will be less packet hops between Nimbra regeneration points and the probability of packet loss therefore significantly reduced. The IP trunk interface implements best-in-breed clock generation for lowest jitter and wander. For lower-quality IP links it is also possible to use an external clock reference for traffic regeneration.

Forward error correction is available to recover lost packets if necessary. Unlike the traditional approach with video adapters at the edge where FEC is applied end to end across the network, the forward error correction of the Nimbra IP trunk interface is applied on a link-by-link basis between intermediate nodes. Since the packet loss ratio will be lower per individual link, this means that less overhead is needed for the FEC matrix and bandwidth utilization is increased.

Together with a set of network design guidelines for the IP network connections, the unique QoS characteristics of Net Insight's video-over-IP solution will enable operators to guarantee highest-grade SLAs for their end customers.

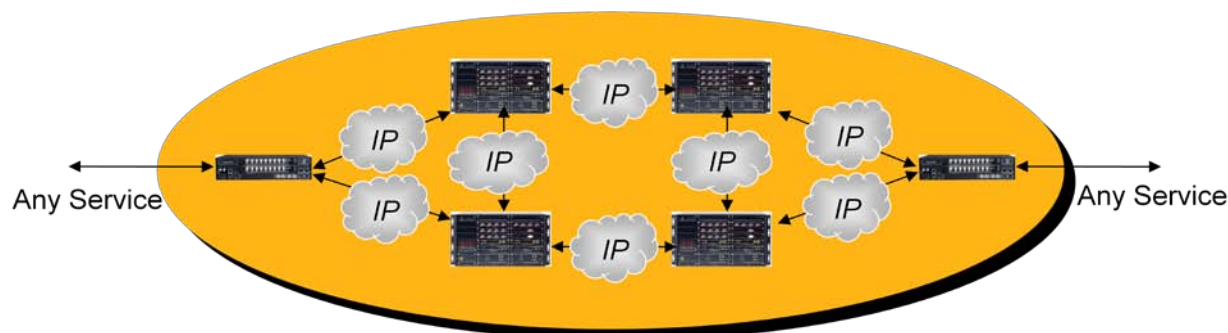


Figure 3. Net Insight's switched IP network provides a unique QoS solution and allows the operator to reclaim traffic control.

Engineering the IP/MPLS network connections to deliver the required packet loss, jitter, wander and delay characteristics for video can be quite a time-consuming task requiring special IP/MPLS competence. With the Nimbra overlay solution, this traffic engineering only has to be performed once and after that the IP network can be left 'untouched'. Occasional-use media services are quickly provisioned end to end over the IP trunk pipes using the connectivity of the Nimbra switches. Fast network protection and service restoration schemes are also available in the Nimbra layer, without having to rely on underlying IP rerouting.

## Operator deployments

Net Insight's IP trunk solution has been deployed by several major operators in Europe, Asia and North America. In Asia the solution was initially deployed by telcos in Hong Kong, Singapore and India. Typically IP trunking has been implemented in the last-mile access network between the operator core site/PoP and customer premises, while the core media network for interconnection of cities is still SDH-based in many cases.

In Sweden, media operator Teracom uses the Nimbra IP trunk interface to implement the world's first all-IP DVB-T2 distribution network. Here the TV streams as well as the backbone and the last-mile network infrastructure to the transmitter sites are all IP/Ethernet based. The Nimbra platform in this case brings added value not only in terms of guaranteed QoS and superior manageability, but also through its scalable multicasting and the unique integrated time transfer of the synchronization signals needed for SFN networks.

## Summary

Net Insight has overcome the challenges of video-over-IP transport by equipping the renowned Nimbra platform with a truly channelized IP trunk interface providing unique timing and synchronization characteristics. IP media networks implementing the Nimbra transport solution will deliver guaranteed Quality of Service together with superior manageability, allowing operators to reclaim control of their end-customer traffic. The solution can be extended across different network technologies, enabling a seamless migration from legacy PDH and SDH environments to a converged IP/MPLS infrastructure.