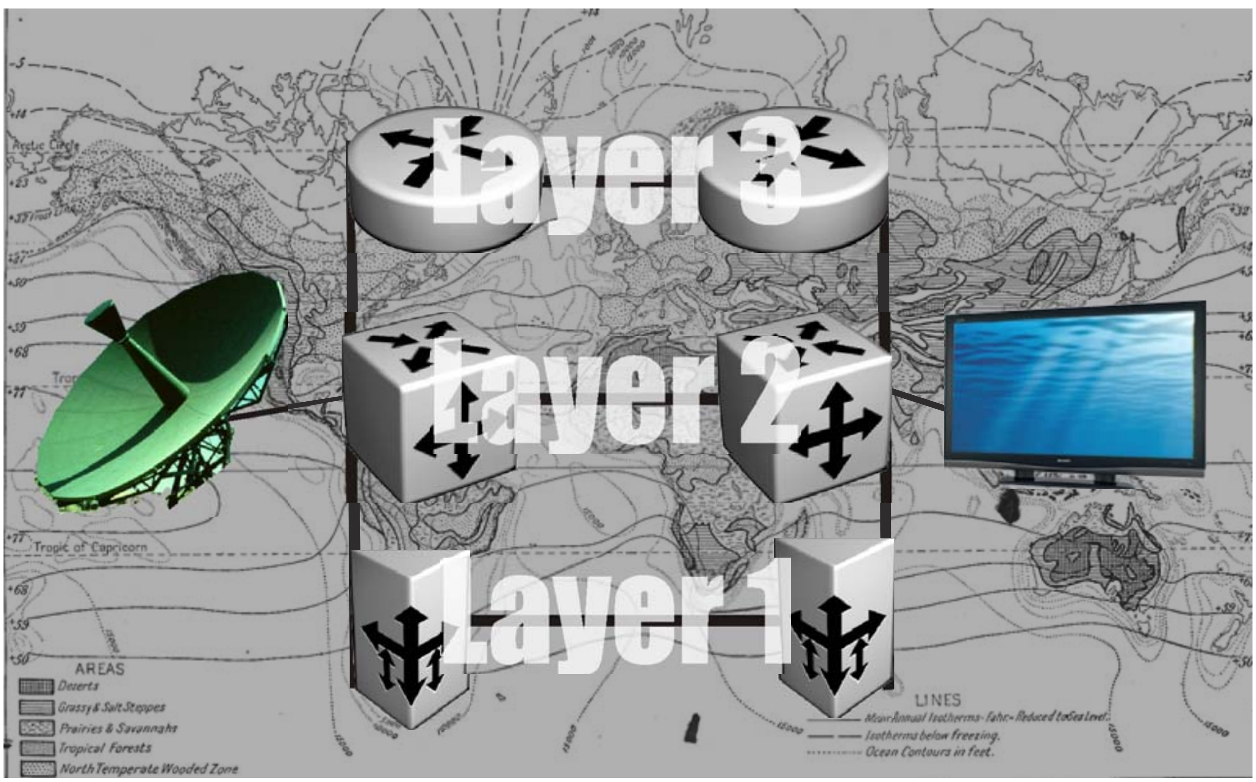
TelecomView
information, opinion, analysis

TelcoTV Networking

Networking Strategies for TelcoTV Services

Understanding how metro aggregation networks should be structured to carry TelcoTV traffic.

TelcoTV services will put an increasingly large traffic load on the metro aggregation networks that connect the video headend with the access systems. This report describes the technologies that are available along with strategies for applying them.



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1 Summary

TelcoTV service providers will need to change their network strategies as the popularity of these services increases and as the nature of these services changes. These networks use Layer 3 IP or Layer 2 Ethernet or MPLS architectures today. However, the evolution of these networks to provide personalized, on demand services will change the nature of the traffic carried on these networks from the data traffic that they were designed for to video traffic with very different requirements.

It will not take a significant increase in the personalization of TelcoTV services and adoption of video on demand techniques before video traffic will dominate these networks. Video traffic is deterministic with high constant bit rates and stringent quality requirements. This video traffic is quite different than data traffic, which is statistical in nature need high bit rates for short periods of time but having low average rates and is tolerant of errors and delays. The Layer 2 and Layer 3 networks architectures used today support this statistical, bursty error tolerant traffic are not well suited to carrying video traffic.

Consequently, the networks that support TelcoTV services will migrate to Layer 1 optical networks. Layer 1 architectures are the least costly method for providing a fixed amount of bandwidth. After all, both Layer 2 and Layer 3 networks require a Layer 1 optical network to provide the physical links between the Layer 2 switches or the Layer 3 IP routers. Removing expensive Layer 2 switches or Layer 3 IP routers from the network significantly lowers the cost of the network.

A Layer 1 approach makes a non blocking architecture feasible. A non blocking Layer 1 network provides enough bandwidth that an individual video stream can be sent each TV supported by the service simultaneously. Today's Layer 2 and Layer 3 networks cannot do this. These Layer 2 and Layer 3 approaches rely on a single shared data stream for each broadcast channel viewed with a limited number of individual video on demand streams. Consequently, a Layer 1 non blocking approach eliminates the possibility that viewers will not be able to receive requested content due to limitations of network capacity.

2 Network Requirements

TelcoTV services are now a significant factor in the telecommunications industry. There are hundreds of telcos globally offering or testing a TelcoTV service and the number of subscribers is growing at a strong rate.

At the same time, the nature of these services is changing. They are moving from a broadcast model where large groups of viewers watch the same channel to a personalized model where viewers choose what they want to watch and when they want to watch it. This trend is important to making TelcoTV services more attractive, but it is also significantly increasing the traffic load on networks supporting TelcoTV services.

TelcoTV also has stringent quality requirements – much tougher than the standards for data or voice. People will be more tolerant of delays and hiccups in their Internet service and even in their voice over IP (VoIP) services than their TV service. In fact HDTV has ratcheted up viewer expectations to a new level of video quality and video fidelity.

All of this adds up to a difficult set of requirements for networks as they start carrying TelcoTV traffic. This section lays these requirements out in order to provide a context for the following sections that discuss Layer 3 IP, Layer 2 Ethernet, and Layer 1 optical network strategies and provides a basis for the evaluations that follow.

TelcoTV offerings generally include the following kinds of service. The list below describes them in order of increasing impact on the network:

- **Broadcast Services** provide standard broadcast channels to the viewer. These **Broadcast Services** are carried across the network using multicast techniques that make efficient use of network resources by sending only one set of packets across each network link for each channel viewed and are shared by all viewers.

- **Video On Demand Services** provide access to films, TV programs, and other content at any time the viewer wants to watch it. These **Video On Demand Services** use unicast techniques that send a separate stream of packets to each viewer. Consequently these unicast **Video On Demand Services** require significantly more resources than the multicast **Broadcast Services**.

- **Network PVR Services (NPVR)** record the broadcast programming that they receive and provide the ability for viewers to play these programs back on an on demand basis. **NPVR** uses unicast technologies. They are likely to generate heavier traffic loads than **Video On Demand Services** since it is likely that viewers will watch programs through the **NPVR** service rather than the **Broadcast** service.

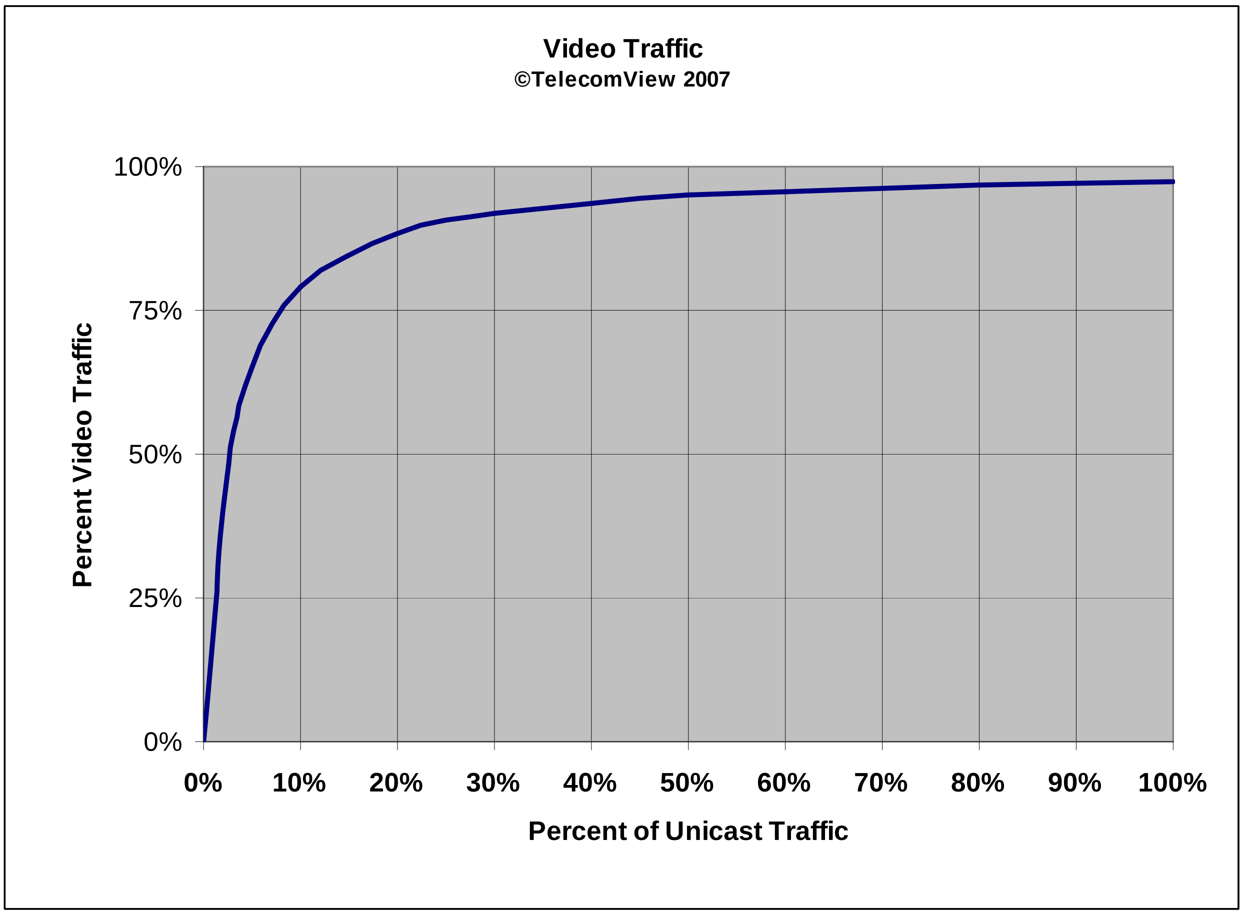
- **Advanced Advertising Services** includes new forms of personalized advertising that are quite likely to be delivered using on demand multicast technologies. In fact these new techniques may well require that all content, including broadcast content, be delivered using unicast technologies in order to facilitate ad insertion.

3 Evaluating Network Strategies

3.1 TelcoTV Network Traffic

A major issue in evaluating network architectures for TelcoTV networks is the percentage of video traffic on the network. The question is how much video traffic will there be on the network as the amount of unicast traffic grows? Figure 3-1 shows that the proportion of video traffic grows much more rapidly than the portion of unicast traffic on the network.

Figure 3-1: Video Traffic Loading



Source: TelecomView, 2007

This is significant because the lower priority Internet traffic provides the buffer of traffic to be discarded when congestion occurs in order to maintain the quality of service for video traffic. With only 10 percent low priority traffic in the mix, any significant congestion is likely to cause the loss of video packets.

3.2 Traffic Management on a TelcoTV Network

Multicast traffic is relatively straightforward to manage. The amount of bandwidth required is a function of the number of channels watched and not the number of subscribers. The largest services in the U.S. offer 300 to 400 channels. Services outside the U.S. typically offer 100 channels or so.

A single gigabit Ethernet channel can hold 250 or more multicast channels. Dedicating a gigabit of traffic to multicast video channels means dedicating 10 percent of the 10 Gbps available on the typical link on a network supporting a TelcoTV service. This is well below the 80 to 90 percent level that can be achieved in a unicast network as described in the previous section.

Video on demand services add unicast traffic to the mix. The amount of network traffic can be reduced using a distributed video on demand network architecture, which can significantly reduce the unicast load in a network with a large video on demand load. It involves collocating video on demand servers with the access systems. These distributed video on demand servers would be fed using a mix of deterministic and statistical caching methods from a centralized library system. This caching method would strive to insure that the content that is viewed most often locally is sent to each distributed server.

Moving from a centralized architecture to a distributed architecture will permit a network supporting a TelcoTV service to support the anticipated growth that may come from video on demand services, even as the penetration of the TelcoTV service grows to include most or all broadband subscribers.

However, this distributed video on demand network architecture will be stressed when NPVR services and advanced advertising strategies unless virtually all of the NPVR content and the advanced advertising content is pushed out to the distributed servers. This does not seem to be a practical approach. It is very likely that TelcoTV service providers will abandon these distributed video on demand architectures and convert back to centralized video on demand architectures and Layer 1 optical networks as they offer NPVR and advanced advertising services.

3.3 Layer 2 and Layer 3 TelcoTV Network Strategies

Both Layer 2 and Layer 3 architectures use packet based statistical multiplexing techniques to manage TelcoTV video traffic. This video traffic does not fit packet networks well because it requires constant high bit rates and is deterministic rather than bursty or statistical in nature.

These Layer 2 and Layer 3 network architectures support multicast techniques well and are good architectures for broadcast only services. These architectures start to break down as the amount of unicast and consequently the percentage of video traffic increases on these networks. The network resources available to this video traffic must be carefully limited to levels that make enough resources available to lower priority data services.

Adopting a distributed video on demand architecture can enable these Layer 3 architectures to support video on demand services even as the penetration of the TelcoTV service grows. Layer 3 architectures will be challenged to support NPVR and advanced advertising strategies.

Layer 2 and Layer 3 networks use expensive sets of packet switching or routing systems to manage traffic using statistical multiplexing techniques. Consequently, it does not appear that Layer 2 or Layer 3 architectures will be appropriate for networks supporting TelcoTV services as these services mature and add NPVR and advanced advertising services.

3.4 Layer 1 TelcoTV Network Strategies

The Layer 1 architectures provide the simplest and most direct method for creating non-blocking unicast video networks. Relatively inexpensive point-to-point optical links can be created between Layer 2 switches or Layer 3 routers in the video serving office and the access network. These optical links will provide deterministic performance as a video transport network.

This architecture will also work well with a centralized video on demand system located in the video serving office. There will not be any need to implement a complex content distribution and caching system.

The cost of the increased optical capacity that is likely to be used in this architecture will be offset by eliminating the switches in a Layer 2 transport network or the routers in a Layer 3 transport network. The simplicity of this approach will also have reduced operational costs compared to a Layer 2 or Layer 3 approach.

3.5 Building a TelcoTV Network

The following are the general conclusions from this analysis:

- Layer 2 or Layer 3 networks are the most appropriate architectures for TelcoTV services that support only broadcast services.
- Layer 2 or Layer 3 architectures together with a distributed video on demand architecture will support a TelcoTV service well with broadcast and simple video on demand services.
- As the amount of on demand traffic grows in networks supporting Telco TV services, Layer 1 approaches will become more attractive.
- It is likely that nearly all of the TelcoTV services will follow the evolution outlined in this report toward unicast services. This means that Layer 1 network architectures will become the best approach for most networks supporting TelcoTV services over time.

Nearly all service providers are using Layer 2 or Layer 3 architectures for the networks that support their TelcoTV services. Most of these same service providers will find it necessary to convert to Layer 1 optical approaches over time. They can accomplish this in a stepwise fashion suing the MPLS, VPLS, or PBT tools that they are using manage the video traffic in their TelcoTV networks. These tools along with subscriber counts can indicate to them which paths across their Layer 2 or Layer 3 networks can be most profitably replaced with optical paths. This approach permits the service provider to convert to a Layer 1 optical network over time rather than all at once.

4 Appendix I: Companies in this Report

The following companies were consulted or profiled for this report.

Table 4-1: Companies Consulted for this Report

Company	Description	Layer 1 Systems	Layer 2 Systems	Layer 3 Systems
Alcatel-Lucent	Telecom systems company	Yes	Yes	No
Ciena	Optical systems company	Yes	No	No
Cisco	IP networking company	Yes	Yes	Yes
ECI Telecom	Telecom systems company	Yes	Yes	No
Juniper Networks	IP routing company	No	No	Yes
Net Insight	Optical systems company	Yes	No	No
Nokia Siemens Networks	Telecom systems company	Yes	Yes	No
Nortel	Telecom systems company	Yes	Yes	No
Sun Microsystems	Computer systems company	Yes	No	No

Source: TelecomView 2007

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6 Appendix II: Glossary

The following terms and organizations have been referred to in the text.

Acronym	Definition
AAA	Authentication, Authorization and Accounting
ABC	American Broadcasting Company
API	Application Program Interface
ARPU	Average Revenue per User (Usually monthly)
ATCA	Advanced Telecom Computing Architecture
ATIS	Alliance for Telecommunications Industry Solutions
ATV	Asia Television Limited
Billion	1,000,000,000 (1,000 Million)
BRAS	Broadband Remote Access Server
BT	British Telecom
CAPEX	Capital Expenditure
CNBC	Consumer News and Business Channel
CNN	Cable News Network
CNO	Cable Network Operator (See also MSO)
CPE	Customer Premise Equipment
CPGA	Cost per gross add
CSCF	Call Session Control Function
DS3	NA transmission standard for wideband communications
DSL	Digital Subscriber Line
EBU	European Broadcasting Union
ESPN	Entertainment and Sports Programming Network
ETSI	European Telecommunications Standards Institute
EU	European Union
FA	Football Association
FCC	Federal Communications Commission
FNO	Fixed Network Operator
GHz	Giga Hertz
HBO	Home Box Office
HD	High Definition
Hz	Hertz
IDP	Intrusion Detection and Protection
IETF	Internet Engineering Task Force
IMS	IP Multimedia Subsystem
INO	Integrated Network Operator
IP	Internet Protocol
IP v 6	IP version 6
IP/MPLS	IP/ Multi Protocol Label Switching
IPDC	Internet Protocol Data Casting

Acronym	Definition
IPTV	Internet Protocol TeleVision
ISP	Internet Service Provider
ITN	Independent Television News
ITU	International Telecommunications Union
kbps	Kilo bits per second
KDDI	Japanese Mobile Operator
kHz	Kilo Hertz
km	Kilometer
kW	Kilowatt
L2CP	Layer 2 Control Protocol
LG	Lucky Goldstar
LLU	Local Loop Unbundling
MAC	Media Access Control
Mbps	Mega bits per second
MHz	Mega Hertz
Million	1,000,000
MPEG	Moving Picture Experts Group
MPLS	MultiProtocol Label Switching
MSNBC	Microsoft NBC network
MSO	Multimedia Services Operator (See also CNO)
MTV	Music Television
NGN	Next Generation Networks
NPV	Net Present Value
NPVR	Network Personal Video Recorder
NRA	National Regulatory Authority
NTT	Nippon Telegraph and Telephone Corporation
OPEX	Operating Expenditure
OSA	Open System Architecture
OSS/BSS	Operational Support System/Billing Support System
PATS	Publicly Available Telephone Service
PBX	Private Branch Exchange
PCCW	Pacific Century CyberWorks Limited
PDA	Personal Digital Assistant
PRD	Product Requirements Definition
PSTN	Public Switched Telephone Network
PTT	See PoC
PVR	Personal Video Recorder
QoE	Quality of Experience
QoS	Quality of Service
QVGA	Quarter Video Graphics Array
RAI	Radiotelevisione Italiani
RTE	Radio Telefís Éireann
SCCAN	Seamless Converged Communication Across Networks
SDH	Synchronous Digital Hierarchy
SHE	Super HeadEnd
SIP	Session Initiation Protocol

Acronym	Definition
SK Telecom	Korean mobile operator
SMS	Short Message Service
SONET	Synchronous Optical NETworking
SS7	Signaling System 7
TE	Traffic Engineering
TIM	Telecom Italia Mobile
TISPAN	See ETSI
TV	Television
UK	United Kingdom
US	United States
VCR	Video Cassette Recorder
VHO	Video Hub Office
VLAN	Virtual Local Area Network
VoD	Video on Demand
VoIP	Voice over Internet Protocol
VPLS	Virtual Private LAN System
VPN	Virtual Private Network
VSO	Video Serving Office
WACC	Weighted Average Cost of Capital
WAN	Wide Area Network
ZDF	Zweites Deutsches Fernsehen