Utilizing the IP Network as a Backplane

A RADVISION White Paper

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Introduction

Changing needs in the telecom market call for scalable and interoperable solutions that support packet networks. The growing numbers of optimized packet platforms that are replacing circuit-switched platforms clearly indicate that IP networks have become significant players in the telephony carrier market.

Currently, most telephony processing and switching equipment is based on TDM. The inherent properties of TDM hinder it from meeting the dynamic and evolving demands of modern data networks. Although the *synchronous* transmission of TDM telephony is well suited for reliable voice synchronization with no lag, this synchronous model also imposes restrictions that limit flexibility, expansion and growth.

The fundamental paradigm of packet networks is *asynchronous* transmission. This is a flexible model that lends itself to fast and cost-effective expansion and growth. IP is particularly appealing to Service Providers and Telcos. Media-rich IP for voice and video conferencing enable Service Providers and Telcos to offer a variety of features and services in less time to market and at a lower cost. As media-rich IP becomes the preferred way of delivering voice and video, IP devices such as switches, gateways, bridges and routers are deployed in increasing numbers.

This White Paper presents a new way of thinking about transmitting data across a backplane. We look at the pros and cons of TDM backplanes and offer an alternative IP backplane as a cost-effective, flexible and scalable solution that is suited to contemporary market requirements.

IP as a Backplane Benefits

Using the IP as a backplane greatly enhances the voice and videoconference experience such as:

- **A Better User Experience**—Media is delivered asynchronously in variable-sized packets. This is exactly what IP was designed to handle resulting in better images, better sound and a better user experience.
- **Reliability**—As an IP backplane does not require a matrix (through which all data has to traverse) there is no single point of failure and reliable services can be assured.
- **Continuous Service**—Since the IP backplane can be distributed between multiple locations, even if a card fails the service can continue. Similarly, if there is a failure somewhere in the network, the service can continue from a local server.
- **Scalability**—There is no longer the need to anticipate future growth. You can start small and add cards and boxes as required without impacting functionality or the user experience.
- **Smart Bandwidth Utilization**—The decentralized and open architecture of IP means smart bandwidth usage. This means that conference participants suffer less delay and less jitter and enjoy a true-to-life experience.

Traditional TDM Telephony

This section takes a brief look at traditional telephony and how media data is transmitted between processes in a chassis.

TDM Data Transmission

Traditional telephony systems are designed and built to enable the synchronous transmission of data from a source to a destination. Switches and processing entities are the part of telephone networks that enables this transmission to occur. Most telephone networks consist of a trunk (physical line) between devices and switching and processing entities that transmit the data.

In a TDM Network each trunk (physical line) has a fixed number of slots, divided by time. This is also true for the output of the switch/processing entity. The TDM defines the source and the destination by addressing the trunk and the slot number in the trunk.

The transmission is dependent on the number of input ports, the number of output ports, and the number of slots or processing boards. In a TDM chassis there are a fixed number of slots and a fixed number of input and output ports. As the ports are fixed, you cannot add one kind of port without removing the other.

A TDM bus on the back panel of the chassis connects the boards in the chassis. Usually, buses are proprietary and are built specifically for TDM with fixed bandwidth and a fixed number of boards in the chassis. The bandwidth is fixed depending on the timing device and the width of the bus. The bandwidth determines the amount of data that can pass between the boards in the chassis.

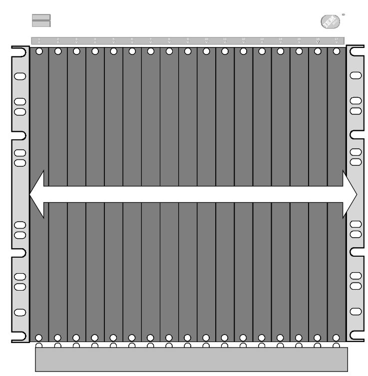

Figure 1: A TDM Backplane

As there are many different types of boards that perform many different functions with different bandwidths and different types of signaling and physical interfaces, the chassis has a management system that can identify the type and location of each board. On most TDM backplanes there is a management bus that works together with a system board. Because the management bus is on the backplane, all the boards are managed from a single external connection point.

Issues

TDM chassis are well suited for the processing of entities that have TDM inputs and outputs. The TDM chassis has a fixed backplane. This rigidity poses a challenge when change is required, sometimes necessitating complex and expensive upgrades.

Following are a number of considerations that influence the modification and upgrading of TDM chassis and backplanes:

Bandwidth

The total available bandwidth on a TDM bus is greater than the sum of the bandwidth of the input and output trunks. Consequently, bandwidth utilization is not one hundred percent efficient.

When a chassis is designed, the bandwidth on the TDM bus is based on scenarios of communication between the boards. These scenarios have different requirements. For example, the bus can be designed for overcapacity by taking the worst-case scenario into account. This means that most of the time bandwidth utilization will be much less than one hundred percent. Alternately, the bus can be designed to disregard the worst-case scenario. In this case the total bandwidth will not be able to cope when the worst-case scenario occurs.

Flexibility

Traffic between boards requires the fixed allocation of one or more slots for each information type. This may mean that even though some slots may be idle at certain times they will not be able to be used for other types of information resulting in a waste of resources.

Further, because the chassis and the bus are fixed, the number of time slots for each channel is fixed and the number of channels cannot be increased.

Chassis and Board Size

Communication devices support varying loads of network traffic. As network traffic increases, the load on the bus increases. One of the ways to reduce this load is to use big boards. Big boards have more processing capacity and thus reduce the amount of data that passes between the processing boards.

Communication systems may also require many types of processing. As there are no satisfactory inter-chassis TDM buses, all the boards needed to support the required types of processing are concentrated in one TDM chassis. This increases the size of the chassis.

Consequently, large chassis are built to hold many big boards. Both the big boards and the large chassis greatly increase the cost. Larger chassis also require stronger power supplies, more fans and other supporting elements, which further increase the costs.

Potential Point of Failure

Transmission is via a single bus. This means that there is a risk that the bus could be a potential point of failure. To prevent this, another bus can be added as an alternate (redundant) bus. This, too, increases the costs.

Scalability

No matter how careful and forward-looking a design is, market demands change and the device needs to be upgraded to support evolving and more powerful functions. This requires the boards to be more powerful. The bus can only support a limited board capacity and it cannot be upgraded. The bus is then no longer powerful enough to support the powerful boards and the result is a bottleneck. In some cases, the only workaround is to replace the entire chassis!

IP Network Telephony

IP networks carry packets of data. These packets have dynamic properties that can be applied to the transmission of telephony data from one processing entity to another.

The following section compares what it means to transmit telephony data over TDM and what it means to transmit telephony data over an IP network.

Packet Data Transmission

TDM data is transmitted synchronously in time slots of 64-kbits each. This works well with voice data as the voice streams are built in samples of 64-kbits. In IP, the data is asynchronous. Voice and video data is compressed and packet size is not fixed. There is no longer a correlation between the data and the 64-kbit requirement of TDM. Because the data no longer comprises “neat little packets” of 64-kbits but rather a variety of sizes, (depending on the compression/decompression algorithms that were used), a bus of fixed bandwidth is no longer as efficient as it was for TDM.

IP uses transport protocols where the source and destination of a packet are defined by address and not by the physical location on a TDM slot. Switches and routers in the IP network know how to route a given packet to its destination. The destination address is specified in the packet irrespective of the physical location of the destination. This means that you can send an IP packet from anywhere to anywhere and it will reach its destination.

Similarly, processing entities can be located anywhere in the IP network. They do not necessarily “belong” to a particular chassis. Each entity has an IP address and communication between the entities is between two IP addresses. The chassis acts simply as a provider of power to the boards in the chassis. Needless to say, the size of the boards and the size of the chassis do not affect the amount of data that can be transmitted.

The IP network can thus be regarded as a “flexible” environment through which telephony data can be transmitted from one entity to another and where the IP addresses identify the source of the data and the destination of the data.

Using IP as a Backplane

Consider two boards in a chassis connected to the IP network. Each board has an IP address. For example, assume one board is a gateway with a PRI connection and the other is a multipoint conference bridge. During a conference the media data comes in from the PRI line, gets converted by the gateway to IP packets and then needs to be transmitted to the bridge so that conference participants can receive the data.

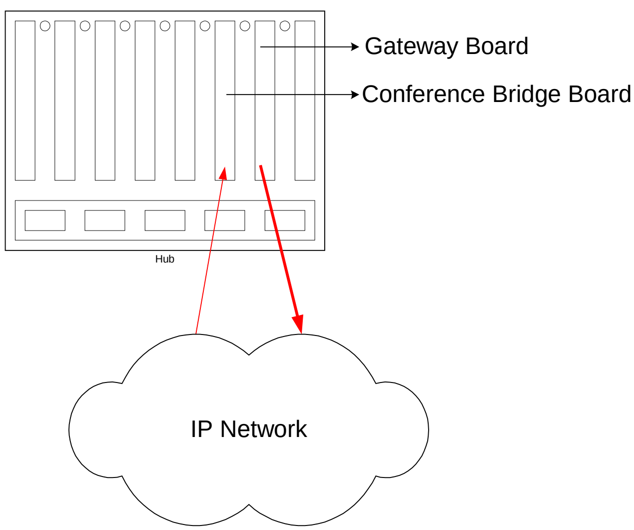

Figure 2: IP Network as a Backplane

The media data is transmitted from the gateway board to the IP network. As the bridge is also connected to the IP network, the data can now travel on the IP network to the bridge board. The IP network has performed exactly the same function as the bus in the TDM chassis described above.

It is worth noting that the solution works irrespective of whether the IP network is a part of the chassis (internal) or has an external IP connection to each board.

Benefits

Simple and intuitive as it may be, this solution provides a number of benefits, as follows:

Scalability

Because the IP network is not a fixed bus attached to the chassis, the size of the boards will not have any effect on the transmission of the data between one processing entity and another.

It is possible to upgrade the bandwidth of the bus by simply moving to faster technologies such as from 10Base-T to Switch 10Base-T, to 100Base-T, Switch 100Base-T, Full Duplex Switch 100Base-T and so on. With an appropriate design, this is true irrespective of whether the bus is inside or outside the chassis.

Distributed Solution

Processing entities can be distributed throughout the network. They do not need to be in the same physical location.

Redundancy

If a board does not function, another board with the same functionality can replace it without taking the bus into account or affecting ongoing operations.

Long Life

Because boards can be added when needed, the “shelf life” of the chassis is not dependent on specific boards or a fixed bus. Connectivity to other boards is sustained irrespective of the capacity or capabilities of the board, as long as the board has access to the IP network.

No Single Point of Failure

In the past if a bus failed then all the boards in a chassis were not operational. With IP as a backplane, connectivity no longer relies on one single physical bus so there is no single point of failure. If a board needs to be swapped it is simply removed and replaced without impacting the IP backplane.

Cost Effective at Entry Point and When Scaling Up

Entry point cost is low. There is no need to plan for the future. It is possible to start off with a small amount of boards of the right size (not big ones for future use) and with a chassis that suits the current requirements.

The life cycle of the chassis is longer as IP lends itself to change and growth. The solution is scalable at a lower cost than that of fixed TDM systems.

No Need to Develop Costly Proprietary Management Systems

SNMP is a standard for IP network management. Existing management systems based on SNMP can be used and there is no need to develop costly proprietary management systems.

Issues

As always, there is no "perfect" solution. Following are issues that should be considered even though under certain circumstances they can be solved:

- If the backplane has an external connection then every processing entity requires an IP address. This means that every processing entity needs a physical connection to the IP network. However, an internal IP backplane requires only one public IP connection.
- Because of the diversity and the decentralized deployment, management may be quite complex. This complexity is reduced with an internal IP backplane.

Real Solutions

The trend towards replacing circuit-switched communications by optimized packet platforms is supported by the PICMG® standard, PICMG 2.16. The specification is an extension to the PICMG 2.X family of specifications and defines how IP packets are passed across a backplane that connects multiple switching devices in a network equipment rack. CompactPCI/PSB moves data off the shared bus architecture of CompactPCI and onto a high availability, high speed, switched 10/100/1000 Ethernet based network topology. All slots within the chassis can be interconnected by a reliable and scalable embedded network based on established enterprise network industry standards/protocols.

Companies such as Motorola, Cisco, RadiSys, Force Computers and others are offering platforms that provide high data throughput, scalability, flexibility and connectivity to packet networks. For example, Motorola's Multi-Service Packet Transport Platform (MXP) is an open extensible platform that supports multiple protocols.

The RADVISION viaIP™ platform has fully implemented the IP backplane concept. Every viaIP board has an IP connection and all data (voice, video and data) is transmitted between processing boards using IP. The RADVISION viaIP platform is thus flexible and scalable. The platform offers a variety of chassis sizes—from small entry level "boxes" to large carrier-grade chassis. All chassis use one-size low-cost boards. Systems can scale up by connecting individual chassis to IP. The "boxes" can be in a central location or distributed throughout the network. Connectivity to other boards is sustained irrespective of the capacity or compatibility of the board. Installation is simple. Maintenance is low cost as a malfunctioning board can be simply removed and replaced.

Conclusion

Using the IP network as a backplane promotes openness, flexibility and scalability. With an IP network backplane, the relative location of the processing entities is of no consequence. The processing entities can be located anywhere in the IP network and are identified by their IP addresses. Transmission of data between two processing entities is simply the transmission of data between two IP addresses.

The restrictions of traditional backplane systems do not exist. The backplane no longer belongs to a particular chassis. The chassis is now merely a power provider to the boards and the size of the boards and the chassis is irrelevant.

This new way of thinking provides greater freedom and scalability and offers an exciting cost-effective way for Service Providers and Telcos to scale up with the market, to provide higher data throughput and to offer ever-improving, converging voice, video and data services.

Glossary of Terms

Abbreviation	Description
cPCI	CompactPCI
IP	The Internet Protocol
ISDN	Integrated services Digital Network
MXP	Motorola's Multi-Service Packet Transport Platform
PICMG®	PCI Industrial Computer Manufacturers Group is a consortium of over 700 companies who collaboratively develop specifications that adapt PCI technology for use in industrial and telecommunications applications.
PRI	Primary Rate Interface
PSTN	Public Switched Telephone Network
TDM	Time Division Multiplex

Contact RADVISION at:

USA/Americas
575 Corporate Drive
Mahwah, NJ USA 07430
Tel 201.529.4300
Fax 201.529.3516
info@radvision.com

Europe
24 Raul Wallenberg
Tel Aviv, Israel 69719
Tel +972.3.645.5220
Fax +972.3.647.6669
infointernational@radvision.com

United Kingdom/Middle East
Abbey House,
Wellington Way
Weybridge, Surrey
Tel +44.1932.268315
Fax +44.1932.268316
infoUK@radvision.com

Hong Kong
Suite F, 17/F
China Overseas Bldg.
139 Hennessy Road
Wanchai, Hong Kong
Tel +852.2801.4070
Fax +852.2801.4071
apacinfo@radvision.com

China
Beijing Representative Office
Unit 301, Tower B, COFCO Plaza
No. 8 Jianguomennei Avenue
Beijing 100005, China
Tel +86.10.65249484
Fax +86.10.65260794
apacinfo@radvision.com