

Welcome to the  
Case  
Communications  
May 2007 Newsletter

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The debate over the danger of radiation from Wi-Fi Networks continues

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An Overview of the Stream Control Transmission Protocols (SCTP)

Archives

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**Welcome,**

Welcome to our May 2007 Newsletter. this month we focus on Wireless and 3G rather more as they are both subjects which have been in the news recently.

We also announce the launch of our new range of Industrial Ethernet Switches and for the more technical among us we have an overview of the Stream Control Transmission protocol (SCTP).

If you would like to contribute any articles or have any feedback please don't hesitate to e-mail us. Our e-mail address is [marketing@casecomms.com](mailto:marketing@casecomms.com)

**Sony and BT have struck a deal to turn the PSP hit games console into a mobile and video phone**

Sony and BT are to work together to provide Mobile Phone services, Video Phone, and e-mail on the PSP.

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**Wireless Internet Access – Is 3G going to replace Wi-Max?**

Over the last few years. Wi-Fi has become the dominant wireless Internet access method, embedded in nearly every laptop sold today, but with the advent of 3G and Wimax which technology should we choose?

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**Case Communications launch their range of Industrial Ethernet Switches**

This week Case Communications announced the launch of their new range of Industrial Ethernet switches. Operating from -25 to Plus 60 degrees Centigrade these switches are suitable for the most gruelling conditions.

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**The debate over the danger of radiation from Wi-Fi Networks continues**

BBC programme Panorama found that radiation levels from wi-fi in one school was up to three times the level of mobile phone mast radiation. The readings were 600 times below the government's safety limits but there is ongoing debate about wi-fi use.

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**On 1 July, a fee will be introduced for customers who don't pay their 'blue-bill' by Direct Debit (DD) or Monthly Payment (MPP).**

On 1 July, a fee will be introduced for customers who don't pay their 'blue-bill' by Direct Debit (DD) or Monthly Payment (MPP). This will affect some 9,200 IPS customers. The changes will be communicated to these customers from 30 May, giving them time to act and to avoid the fee before it is imposed.

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**More than half of UK adults have broadband at home, according to recent figures.**

More than half of UK adults have broadband at home, according to recent figures. It follows a 39 per cent upturn since 2006 and a seven fold increase over the last four years, the telecoms regulator Ofcom said.

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**Two people cautioned for hijacking wireless broadband connection**

Two people have been cautioned for using wireless broadband connections without permission.

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**An Overview of the Stream Control Transmission Protocols (SCTP)**

In the field of computer networking the IETF Signaling Transport (SIGTRAN) working group defined the **Stream Control Transmission Protocol (SCTP)** as a transport layer protocol in 2000. RFC 2960 defines the protocol, with RFC 3286 providing an introductory text. Here we provide an overview of SCTP for the technically minded.

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## **Sony and BT have struck a deal to turn the PSP hit games console into a mobile and video phone**

The PSP, which has a 4.3 inch high-resolution colour screen, is already loaded with hardware that allows it to connect to the internet via a wireless link.

Now BT technology will allow it to become a mobile phone, video phone and email device through a wi-fi link to the internet.

The PSP was launched in the UK in August 2005 at a price of just under £180, however the consoles can now be bought for less than £130.

Since then, some two million have been sold in this country, plus six million across Europe, bringing total worldwide sales to 24 million.

The PSP is primarily a games console, however it can also show films, through special plug-in cartridges, ranging from Spiderman to more adult movies such as Dawn of the Dead and Seven.

While the PSP is popular with children, it has also achieved huge sales among young adults where it has become a rival to Apple's video iPod.

The upgraded version of the PSP will also be battling for sales against Apple's new iPhone, which is to be launched soon.

However, the limitations of the PSP's phone functions suggest it would not be in the same league.

Unlike the iPhone, the PSP's phone calls will operate via a wi-fi connection to the internet, rather than the mobile phone mast network.

It will work in the home, by connecting to a wireless internet hub, and via so-called wi-fi hot spots. However, these hot-spots are currently limited to major cities rather than offering national coverage.

There has also been some negative publicity recently suggesting potential harm linked to wi-fi signals.

People who want to take advantage of the PSP phone services will need to be signed up to a wireless network service provider, not necessarily BT.

They will then pay their wireless provider to use the PSP for voice and video calls. This is likely to be on the basis of a monthly subscription.

Initially, it will only be possible to make voice and video calls between PSPs and to PCs signed to BT's Broadband Talk service.

However, this will later be extended to allow calls to landlines and mobile phones. In future, it will be possible to make video calls to 3G mobile phones.

The PSP has a microphone and speaker built into it, which allows voice calls. People wanting to make video calls will need to buy a plug-in video camera, which is around £40.

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The BT technology, which emanates from its 21CN project, will be used to power the PSP's phone services across 102 countries.

BT's chief of Mobility and Convergence, Steve Andrews, said: "The PSP is an excellent device for both gaming and communications, because of its high quality screen and audio capabilities.

"With over eight million PSPs shipped across Europe, we are very excited by the opportunity to give customers a whole new communications experience, connecting and seeing friends across the world through BT's technology."

President of Sony Computer Entertainment Europe, David Reeves, said: "It is very exciting for us to be partnering with BT on such a unique project.

"The opportunity to combine our market leading expertise with BT's knowledge in communications opens up many possibilities and we look forward to bringing many exciting communication functions to PSP fans."

We still await the price of the phone service which is expected to go live in September 2007

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## Wireless Internet Access – Is 3G going to replace Wi-Max?

### Type of Connections

Notebooks, PDAs, smartphones and VoIP handsets can be connected to the Internet in a wide variety of ways. If we look at the most impractical method then Bluetooth can be ruled out, as while it is found in most smartphones, and new Notebooks its limited speed and range are not suited to Internet Access

While WiMAX is generating plenty of hype, mobile WiMAX services won't be available until 2009-2010. Satellite services such as Inmarsat BGAN are perfect for venues without infrastructure (e.g., disaster areas) but too expensive for general use, and the delays introduced by the satellites are not suitable to interactive multi-media or even telephone conversations. After narrowing the field, most road warriors have just two truly viable wireless Internet access alternatives: 3G and Wi-Fi.

3G includes capabilities and features such as:

- Enhanced multimedia (voice, data, video, and remote control).
- Usability on all popular modes (cellular telephone, e-mail, paging, fax, videoconferencing, and Web browsing).
- Broad bandwidth and high speed (upwards of 2 Mbps).
- Roaming capability throughout Europe, Japan, and North America.

While 3G is generally considered applicable mainly to mobile wireless, it is also relevant to fixed wireless and portable wireless. A 3G system should be operational from any location on, or over, the earth's surface, including use in homes, businesses, government offices, medical establishments, the military, personal and commercial land vehicles, private and commercial watercraft and marine craft, private and commercial aircraft (except where passenger use restrictions apply), portable (pedestrians, hikers, cyclists, campers), and space stations and spacecraft.

3G offers the potential to keep people connected at all times and in all places.

One of the big questions facing the 3G players is how much technology will consumers be willing to pay for. Another challenge faced by 3G services is competition from other high-speed wireless technologies, especially mobile WiMAX, and ability to roam between different kinds of wireless networks.

The current status of mobile wireless communications, as of June 2006, is a mix of 2nd and 3rd generation technologies

### Overview of WIMAX

WiMAX (Worldwide Interoperability for Microwave Access) is a

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wireless industry coalition whose members organized to advance IEEE 802.16 standards for broadband wireless access (BWA) networks. WiMAX 802.16 technology is expected to enable multimedia applications with wireless connections. WiMax also has a range of up to 30 miles, presenting provider networks with a viable wireless last mile solution.

WiMAX was formed in April 2001, in preparation for the original 802.16 specification published in December of that year. According to the WiMAX forum, the group's aim is to promote and certify compatibility and interoperability of devices based on the 802.16 specification, and to develop such devices for the marketplace. Members of the organization include Airspan, Alvarion, Analog Devices, Aperto Networks, Ensemble Communications, Fujitsu, Intel, Nokia, OFDM Forum, Proxim, and Wi-LAN.

In August of 2006, Sprint Nextel of the USA announced that it would be investing \$3 billion dollars over the following two years to build out its so-called "fourth generation" (4G) network. The proposed network may cover up to two miles from one base station and deliver speeds of up to 12 Mbps

### **Overview of WI-FI**

Wi-Fi (short for "wireless fidelity") is a term for certain types of wireless local area network (WLAN) that use specifications in the 802.11 family. The term Wi-Fi was created by an organization called the Wi-Fi Alliance, which oversees tests that certify product interoperability. A product that passes the alliance tests is given the label "Wi-Fi certified" (a registered trademark).

Originally, Wi-Fi certification was applicable only to products using the 802.11b standard. Today, Wi-Fi can apply to products that use any 802.11 standard. The 802.11 specifications are part of an evolving set of wireless network standards known as the 802.11 family. The particular specification under which a Wi-Fi network operates is called the "flavour" of the network. Wi-Fi has gained acceptance in many businesses, agencies, schools, and homes as an alternative to a wired LAN. Many airports, hotels, and fast-food facilities offer public access to Wi-Fi networks. These locations are known as hot spots. Many charge a daily or hourly rate for access, but some are free. An interconnected area of hot spots and network access points is known as a hot zone.

A Wi-Fi network can be susceptible to access by unauthorized users who use the access as a free Internet connection. The activity of locating and exploiting security-exposed wireless LANs is called war driving. An identifying iconography, called war chalking, has evolved. Any entity that has a wireless LAN should use security safeguards such as the Wired Equivalent Privacy (WEP) encryption standard, the more recent Wi-Fi Protected Access (WPA), Internet Protocol Security (IPSec) or a virtual private network (VPN).

### **Wireless coverage**

You will need to work out where your wireless Internet access will be required. Do you work inside or outside? Must you use the Internet while in motion? Such questions should be considered in choosing wireless service(s) that will help -- not hinder -- productivity.

According to JiWire, nearly 142,000 free and paid Wi-Fi hot spots exist in 132 countries, primarily in North America and Europe. The vast majority deliver indoor Internet access over 802.11b/g to confined areas such as lobbies, restaurants or meeting halls. Some hot spots are becoming "hot zones," using mesh networks or 802.11n to blanket entire airports and hotels. To serve commuters, a few trains, ferries and even planes offer Wi-Fi

service on board. Dozens of U.S. cities are also deploying metropolitan-area Wi-Fi networks. Nonetheless, Wi-Fi is still best for those users who don't need to leave the building or a designated coverage area while accessing the Internet.

On the other hand, 3G is better for those who must stay online while traversing the great outdoors.

Services currently offered in the USA are;

**AT&T** - now offers HSDPA in dozens of cities, backed by national EDGE coverage in 162 metro areas.

**Verizon Wireless** - offers EV-DO Revision A in 27 metro markets, downshifting to EV-DO Rev. 0 and 1xRTT (available in 242 metro areas).

**Sprint/Nextel** - delivers EV-DO Rev. A to 35 metro markets, with Rev. 0 and 1xRTT coverage that reaches 220 metro areas.

All three footprints are expanding rapidly, so check carrier-coverage maps for locations of importance to you. Individual experiences vary, but urban users can expect to enjoy HSDPA or EV-DO outdoors, with automatic fallback to EDGE or 1xRTT when working indoors, at home, or in less populous areas. Despite national network expansion, there are still many rural areas without any cellular data service. While domestic 2G/3G data service roaming is often available, international roaming is not.

### **Convenience**

While working from anywhere is convenient, convenience is also a matter of style. Some users cannot be bothered to switch from EV-DO outside to Wi-Fi indoors and prefer to stick with 3G everywhere -- even if that means perching by a window to get good signal. Others are comfortable carting a laptop to increasingly ubiquitous Wi-Fi hot spots but would find it tedious to read email on a 3G-enabled PDA or smartphone. Connection type plays a big role, but so does computing device and network adapter.

From a hardware perspective, Wi-Fi is very convenient. Your laptop probably already has an 802.11b/g Wi-Fi adapter. A growing number of PDAs now include Wi-Fi, and smartphones are expected to follow suit over the next two years, adding 802.11n to support VoIP. Numerous aftermarket Wi-Fi options exist, from mini SDIO cards to USB sticks to travel routers that enable Internet connection sharing with co-workers. In short, Wi-Fi enablement is easy -- but getting online is less so (see Cost).

3G hardware is less ubiquitous or flexible. Every smartphone -- and some PDAs and laptops -- offer embedded 3G, but those devices bind you to a carrier. Changing carriers or upgrading from EDGE to HSDPA means new hardware (e.g., adding a different card to your laptop, replacing your smartphone). Product selection is limited in part because 3G has not yet been commoditized to the same degree as Wi-Fi. As a result, going 3G requires planning and commitment; but once you make that leap, use will be simple.

### **Performance**

Performance is the key differentiator. 2G services were sufficient for low-bandwidth applications but frequently disappointed workers who exchange larger messages. Part of Wi-Fi's appeal has been support for common Internet applications -- email and Web -- at speeds similar to office Ethernet and residential broadband. At today's 802.11b/g hot spots, data rates range from 1 to 54 Mbps, shared with nearby users. This is fine for best-effort applications but supports only a few latency-sensitive or high-throughput

sessions. Over the next two years, 802.11e and 802.11n upgrades will help hot spots support more demanding applications such as VoIP and video.

EDGE and 1xRTT were far better than 2G for such applications as email, but users who were accustomed to broadband found surfing and downloads painfully slow. This is no longer true for 3G.

For EV-DO Rev. 0, Sprint claims 50-70 Kbps upstream and 400-700 Kbps downstream.

Rev. A boosts this to 350-500 Kbps up, 600-1400 Kbps down.

For HSDPA, AT&T claims 384 Kbps upload and 400-700 Kbps download throughput. This is slower than Wi-Fi, but many users find 3G comfortable for Web and business applications.

### **Security**

Many workers use Wi-Fi hot spots and 3G smartphones without corporate oversight, but spiraling costs and security concerns are driving some employers to change that.

For example, employees who use hot spots often leak clear text, including business fileshares. Even those who use VPNs can end up traversing a phony hot spot, exposing tunneled data to man-in-the-middle attackers. Many personal 3G smartphones used to check business email will be lost, along with stored messages and credentials. End users often lack the information to choose the most secure or economical access method.

One way to encourage workers to avoid risky Wi-Fi hot spots is to supply 3G on IT-managed devices. Why 3G rather than Wi-Fi? As a carrier service, coverage areas are larger, spoofing is unlikely, and everything over the air is sure to be encrypted. Some companies will go further, contracting their carrier to relay sessions to a corporate gateway or mobile application server. In fact, such IT-controlled arrangements are readily available for other Internet access methods -- including Wi-Fi hot spots.

### **Mix and match**

Ultimately, no single wireless internet access method can optimise availability, price and performance for all applications. According to Gartner, cellular (3G/4G) services will be dominant for truly mobile workers by 2010, but most remote workers will require multiple access technologies. Instead of choosing 3G or Wi-Fi, we may buy both and decide which to use at any given moment, based on availability, speed, cost and other policy attributes.

This can be done to some degree today. For example, in the USA you can purchase 3G and Wi-Fi services from AT&T, using the Cingular Connection Manager to manage both. The Connection Manager first tries to connect to an available Wi-Fi network, then to AT&T's cellular network. Multi-service wireless connection managers like this are currently available from carriers and roaming providers. Enterprises that purchase Internet access for their workforces should give serious consideration to services that support both 3G and Wi-Fi (and other methods for backup or international use). Doing so lets you change wireless network preferences for some or all users without changing providers.

Deciding which network to use is one thing; handing a session over without disruption is quite another. Unlicensed Mobile Access (UMA, a.k.a. GAN) lets a dual-mode handset maintain a voice call when roaming between a GSM cellular network and an unlicensed wireless network like a Wi-Fi hot spot. UMA trials have been conducted worldwide, including T-Mobile in the U.S.A .



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Case Communications have been designing and developing Rugged / Industrial Routers for the past 5 years, and are well known in the Industrial marketplace. This week Case Communications launched their new IES / IGS range of Industrial Ethernet switches

The Case Communications IES / IGS range of Ethernet switches operate from -25 to plus 60 degrees C and are supplied with auto detect 12-48vdc power supplies or the option of an AC power supply. They are installed on DIN rails or they can be wall mounted.

The IES / IGS switches are supplied with up to 10 ports which can be 10/100Tx 100FX and Gigabit Copper or Fibre, with Backplane rates to 16Gbps..

While the Switches maybe Industrial strength they are fully featured switches with QoS, CoS, VLAN support, Port Trunking with LACP and LLDP as well as having support for RADIUS Security services.

One of the greatest benefits of Case Communications Ethernet switches is the use of the X-Ring feature. This allow up to 20 switches to be configured in a ring and in the event of equipment or circuit failure the X-Ring will self heal in 300ms.

X-Ring is supplied in addition to Standard Spanning Tree (802.1d) and Rapid Spanning Tree (802.1w).

The switches are SNMP managed with web configuration tools and Telnet / CLI access.

For more information on Case Communications Industrial Ethernet Switches please follow the link or contact Case Communications marketing.

[http://www.casecomms.com/products/ethernetswitches/Ind-snmpp-managed\\_overview.htm](http://www.casecomms.com/products/ethernetswitches/Ind-snmpp-managed_overview.htm)

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Sir William Stewart, chairman of the Health Protection Agency, has said there needs to be a review of wi-fi.

He told the BBC Television programme Panorama that there was evidence that low-level radiation - from devices like mobile phones and wi-fi - did cause adverse health effects.

The press reported that an expert had stated 'Children should be discouraged from putting their laptops on their lap when using wireless Internet connections because of potential health risks'

Professor Lawrie Challis, who heads the committee on mobile phone safety research, told The Daily Telegraph, that youngsters should be monitored as public concern continues over emissions from Wi-Fi networks. Professor Lawrie Challis went on to say "until more research is carried out, children should keep a safe distance from the embedded antennas on Wi-Fi enabled laptops. With a desktop computer, the transmitter will be in the tower, which might be perhaps 20cms from your leg and the exposure would then be around one per cent of that from a mobile phone. But if a laptop was placed straight on the lap when using Wi-Fi, people could be around 2cm from the transmitter, and receiving comparable exposure to that from a mobile phone".

He added: "Since we advise that children should be discouraged from using mobile phones, we should also discourage children from placing their laptop on their lap when they are using Wi-Fi."

Prof Challis said the potential risk might be greater for children who were more sensitive than adults to some dangers, like UV radiation.

Jeff Hands, professor of imaging physics at Imperial College London, said: "If we are talking about health issues linked to localised heating of tissue then these will be insignificant at the power levels we are talking about here."

Alasdair Philips, director of consumer group Powerwatch, told the Telegraph it was not the heating of tissue that was the problem but the interference Wi-Fi radiation could cause to the electrical signals within a person's brain and nervous system.

But then we see Professor Challis being quoted by the BBC as saying "Wi-fi seems unlikely to pose any risk to health," said Professor Lawrie Challis, of Nottingham University. Prof Challis, went on to say: "Wi-fi exposures are usually very small - the transmitters are low power and some distance from the body.

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"They can be near to the body, however, when a laptop is on one's lap and my own view is that just as we encourage young children not to use mobile phones we should also encourage them to use their laptops on a table rather than their lap, if they are going online for a long time."

As part of its investigation, Panorama visited a school in Norwich, with more than 1,000 pupils, to compare the level of radiation from a typical mobile phone mast with that of wi-fi in the classroom.

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BT say that customers paying by DD or MPP will be entitled to a discount between 1 July 2007 and 30 December 2008. Some accounts will be exempt from the fee and the discount: users of OneBillPlus, separate Broadband bills (this fee will start on 1 October), separate Mobile bills and Service Provider Group customers

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It follows a 39 per cent upturn since 2006 and a seven fold increase over the last four years, the telecoms regulator Ofcom said.

Strong competition among broadband suppliers has led to falling prices.

Connections with speeds of up to 2Meg dropped to around £15 per month last year - down from £50 in 2003.

Ofcom's Digital Progress report on the broadband market says broadband customers are increasingly turning to "bundled" deals from their supplier.

Last year 40 per cent of home broadband customers took other services, such as phone or TV access, from the same firm.

But nearly half (48 per cent) of domestic consumers questioned for Ofcom's report last month were unaware of their broadband connection speed.

One fifth of adults questioned owned a wi-fi enabled laptop which could connect wirelessly to the internet.

The number of wi-fi hotspots around the UK hit 12,000 last September - up 32 per cent on the previous year.

By the end of last year, 10 per cent of UK adults were making phone calls over the internet - double the amount who did so the previous year.

And around half of all broadband users had accessed music or videos at least once.

Ofcom chief executive Ed Richards said: "With over half of UK adults now using broadband at home, we have reached a very significant milestone in the development of broadband Britain."

The regulator's report drew on a survey of 1,000 adults carried out in February plus additional data from Ofcom's ongoing survey of 9,000 UK adults

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## Two people cautioned for hijacking wireless broadband connection

Two people have been cautioned for using wireless broadband connections without permission.

Both were warned for dishonestly obtaining electronic telcoms with intent to avoid payment.

A spokesman for West Mercia Police said: 'Wireless networks don't stop at the walls of your home. Without protection, your neighbours may be able to connect to your network.'

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## An Overview of the Stream Control Transmission Protocols (SCTP)

As a transport protocol, SCTP operates analogously to TCP or UDP . Indeed it provides some similar services as TCP — ensuring reliable, in-sequence transport of messages with congestion control. (In the absence of native SCTP support, it may sometimes be desirable to tunnel SCTP Over UDP.

In the field of computer networking the IETF Signaling Transport (SIGTRAN) working group defined the Stream Control Transmission Protocol (SCTP) as a transport layer protocol in 2000.RFC 2960 defines the protocol, with RFC 3286 providing an introductory text.

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### Message-based multi-streaming

Whereas TCP transports a byte-stream , SCTP can transport multiple message-streams. All bytes sent in a TCP connection must be delivered in that order, which requires that a byte transmitted first must safely arrive at the destination before a second byte can be processed even if the second byte manages to arrive first.

If an arbitrary number of bytes are sent in one step and later some more bytes are sent, these bytes will be received in order, but the receiver can not distinguish which bytes were sent in which step. SCTP in contrast, conserves message boundaries by operating on whole messages instead of single bytes. That means if one message of several related bytes of information is sent in one step, exactly that message is received in one step.

The term "multi-streaming" refers to the capability of SCTP to transmit several independent streams of messages in parallel. For example, transmitting two images in a HTTP application in parallel over the same SCTP association. You might think of multi-streaming as bundling several TCP-connections in one SCTP-association operating with messages instead of bytes.

TCP ensures the correct order of bytes in the stream by conceptually assigning a sequence number to each byte sent and ordering these bytes based on that sequence number when they arrive. SCTP, on the other hand, assigns different sequence numbers to messages sent in a stream. This allows independent ordering of messages in different streams. However, message ordering is optional in SCTP. If the user application so desires, messages will be processed in the order they are received instead of the order they were sent, should these differ.

Signaling in Public Switched Telephone Networks (PSTN) requires message-based delivery.

Multi-Streaming also provides an advantage when used to transport PSTN services. If an SCTP connection is set up to carry, say, ten phone calls with one call per stream, then if a single message is lost in only one phone call, the other nine calls will not be affected. To handle ten phone

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calls in TCP, some form of multiplexing would be required to put all ten phone calls into a single byte-stream. If a single packet for phone call #3 is lost then all packets after that could not be processed until the missing bytes are retransmitted, thus causing unnecessary delays in the other calls.

### **Benefits**

The benefits of SCTP include:

- Multihoming support, where one (or both) endpoints of a connection can consist of more than one IP address, enabling transparent fail-over between hosts or network cards.
- Delivery of data in chunks within independent streams - this eliminates unnecessary head-of-line blocking as opposed to TCP byte-stream delivery.
- Path Selection and Monitoring - Selects a "primary" data transmission path and tests the connectivity of the transmission path.
- Validation and Acknowledgment mechanisms - Protects against flooding attacks and provides notification of duplicated or missing data chunks.
- Improved error detection suitable for jumbo Ethernet frames.

The designers of SCTP originally intended it for the transport of telephony (SS7) protocols over IP with the goal of duplicating some of the reliability attributes of the SS7 signaling network in IP. This IETF effort is known as SIGTRAN . In the meantime, other uses have been proposed, for example the DIAMETER protocol and Reliable Server Pooling (RSerPool)

### **Motivations**

Transmission Control Protocol (TCP) has provided the primary means to transfer data across the Internet in a reliable way. However, TCP has imposed limitations on several applications. From RFC 2960:

- TCP provides both reliable data transfer and strict order-of-transmission delivery of data. Some applications need reliable transfer without sequence maintenance, while others would be satisfied with partial ordering of the data. In both of these cases the head-of-line blocking offered by TCP causes unnecessary delay.
- The stream-oriented nature of TCP is often an inconvenience. Applications must add their own record marking to delineate their messages, and must make explicit use of the push facility (PSH) to ensure that a complete message is transferred in a reasonable time.
- The limited scope of TCP sockets complicates the task of providing highly-available data transfer capability using multi-homed hosts.
- TCP is relatively vulnerable to denial of service attacks, such as SYN attacks

All these limitations affect the performance of IP over the public switched telephone network.

### **Implementations**

**The following Operating Systems implement SCTP:**

- Linux 2.4/2.6
- Sun Solaris 10
- BSD with external patch at KAME project
- QNX Neutrino Realtime OS
- AIX Version 5
- Cisco IOS12

Various third-party implementations implement SCTP for other operating systems.

1. The *common header*, which occupies the first 12 bytes and is highlighted in blue, and
2. The *data chunks*, which occupy the remaining portion of the packet. The first chunk is highlighted in green, and the last of *N* chunks (Chunk *N*) is highlighted in red.

Bits	Bits 0 - 7	8 - 15	16 - 23	24 - 31
+0	Source port		Destination port	
32	Verification tag			
64	Checksum			
96	Chunk 1 type	Chunk 1 flags	Chunk 1 length	
128	Chunk 1 data			
...	...			
...	Chunk N type	Chunk N flags	Chunk N length	
...	Chunk N data			

Each chunk has a type identifier that is one byte long yielding, at most, 255 different chunk types. RFC 2960 defines a list of chunk types and there are currently 15 types defined. The remainder of the chunk is a two byte length (maximum size of 65,535 bytes) and the data. If the chunk does not form a multiple of 4 bytes (i.e., the length is a multiple of 4) then it is implicitly padded with zeros which are not included in the chunk length