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# Offload of Dial-Up Internet Traffic from the PSTN/ISDN

***Internet customer growth has risen rapidly in the past few years. A significant portion of users are connected to Internet service providers (ISPs) using the public switched telephone network (PSTN)/integrated services digital network (ISDN) for access. As Internet traffic is data traffic with longer average holding times than voice calls, this traffic may adversely affect other traffic in the network. Internet traffic itself may also experience congestion, and cause complaints to service providers.***

***In the long-term, switch suppliers plan to provide integrated offload technology as part of the core or remote subscriber unit. This will allow Internet traffic to be diverted directly into a data network at the earliest possible point before entering the PSTN.***

***In the short-term, a number of Internet traffic offload measures will be required by operators to prevent problems arising in their PSTN/ISDN networks. This paper presents the results of a study conducted by Telecom Eireann to determine the most suitable Internet traffic offload strategies to adopt and technologies available in order to address this short-term problem.***

## Introduction

Internet usage and Internet traffic is growing at a rapid rate due to a combination of many factors. As most customers access their Internet service providers over the PSTN, which was engineered for short holding time voice calls (three minute average) rather than the long holding time Internet data calls (15 minute average), this poses several short-term problems and challenges for network planners. The principal ones are:

- to provide effective quality of service for Internet users without degrading the quality of service of the fixed voice network;
- to optimise routing between the sources of Internet traffic and the Internet service providers' (ISPs) points-of-presence (POPs); and
- the need to phase in new Internet offload technology to help avoid future PSTN congestion.

Adding to the problem is the introduction of 'pay-as-you-go', low tariff, or absolutely free Internet services. These services drive forward the market for the Internet, leading to further growth in dial-up Internet traffic on the PSTN. Some users will migrate up the value chain to asymmetric digital subscriber line (ADSL)/very-high bit-rate digital subscriber line (VDSL), asynchronous transfer mode (ATM) and other broadband services which will modify growth slightly. However, the composition of forces is such that it continues to drive forward growth, and this will require technical answers in the short to medium term. Carriers have to invest more in their local networks to handle the strain of the increased dial-up Internet traffic.

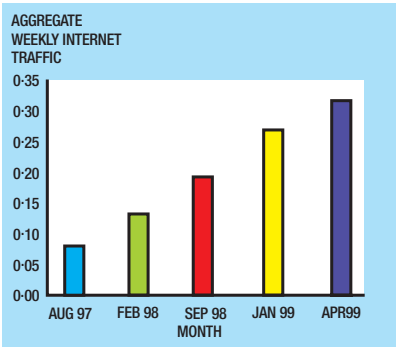
## Internet Traffic Statistics

Internet traffic statistics reflect the latest growth trends. Internet traffic data for all ISPs in Ireland was recorded for the week ending 29 April 1999, as well as local PSTN traffic for the same week. Data was recorded in hourly intervals over the 24-hour period and included ISP, date and hour, number of calls and average call durations in the hour.

### Growth in traffic

Figure 1 shows the growth in aggregate weekly Internet traffic hours from August 1997 to April 1999. This shows the underlying growth has increased four-fold in this 20-month period.

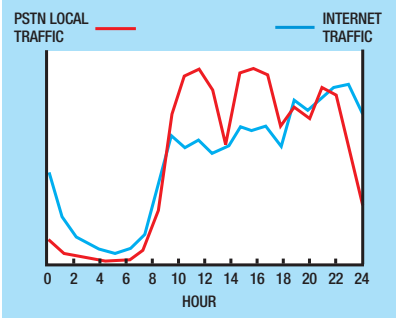
*Figure 1—Weekly Internet traffic 1997–1999*




### Internet versus PSTN—daily traffic profile

The daily traffic profile of all Internet compared to PSTN traffic for Friday 23 April 1999 is shown in Figure 2. The large morning and afternoon PSTN traffic peaks are mirrored by very slight morning and afternoon Internet peaks. Internet traffic displays the highest peaks in

*Figure 2—Internet versus PSTN traffic*

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the evening from 2000–2100, and from 1800-1900 when tariffs are lower and PSTN traffic has tailed off.

### Average holding times

A comparison of Internet and PSTN average holding times for a weekday (Fri 23/4/99) is shown in Figure 3. The average Internet call holding times during business hours is about 11 minutes, but rises sharply after 18.00 hours, and can average over 20 minutes during off-peak times. This trend shows that when Internet tariffs are low at off-peak times, Internet call holding times rise significantly, which increases pressure on local networks.

### Trend in proportion of Internet to PSTN local traffic

The average proportion of Internet to local PSTN traffic is now 13·5%. The trend in growth is shown in Figure 4 (September 1998 was lower due to seasonal factors.)[1]

### Statistics trends

These statistics show growing Internet traffic, a growing proportion of Internet to PSTN traffic in the local network, the likelihood of longer holding times as low cost or free Internet services become available. These statistics confirm a growing short-to-medium-term problem exists, unless significant Internet traffic offload measures are taken.

*Figure 3—Average holding times*

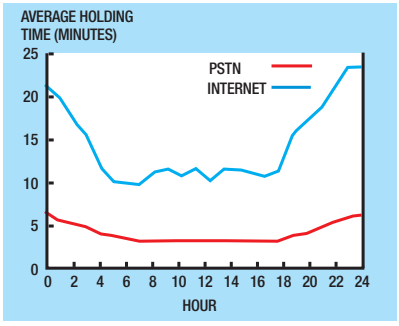
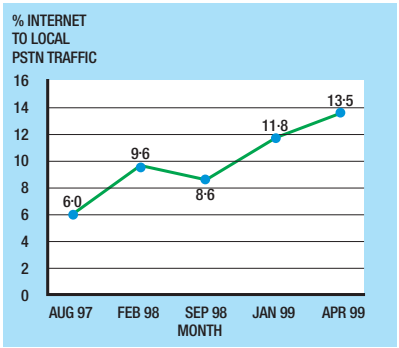



*Figure 4—Trend in Internet traffic*



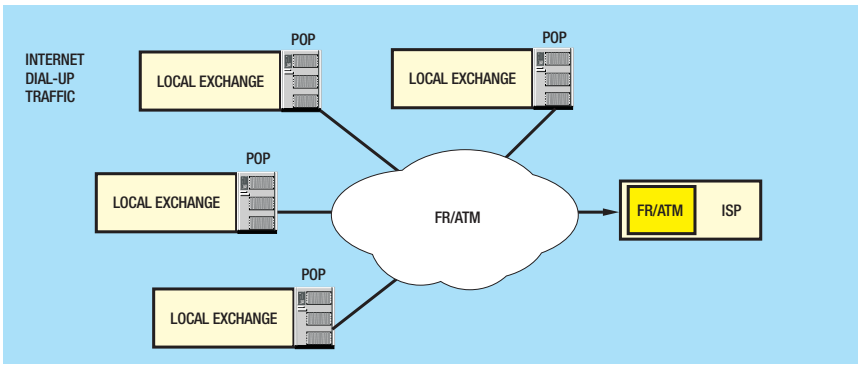




*Figure 5—Decentralised POPs*

## Internet Traffic Offload Options

Options available to offload Internet traffic include:

- long-haul out-of-area primary rate accesses (PRAs) to ISP POPs;
- decentralising POPs by locating at tandem or local exchanges;
- Signalling System No. 7 (SS7) gateway solutions;
- switch supplier solutions; and
- xDSL and ATM.

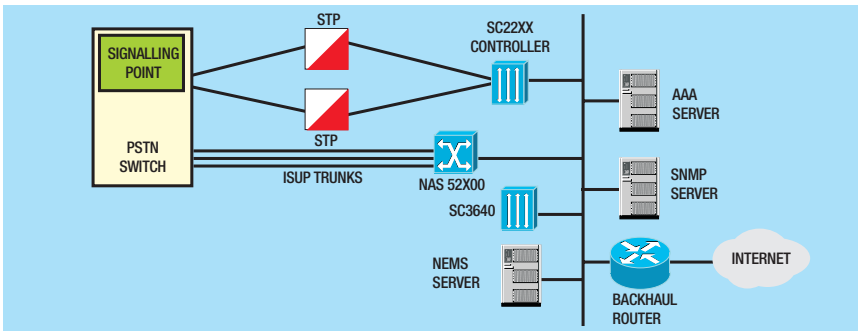
### Decentralising POPs

POPs could be located at local/tandem switches showing the highest Internet traffic, or at all local switches, with access to the ISP over frame relay, ATM or other data networks as shown in Figure 5.

### SS7 signalling gateway

An SS7 signalling gateway solution has advantages[2, 3], and is favoured by ISPs. Internet traffic can be carried on a trunk instead of ISDN primary-rate interfaces, which are costly, while signalling and call management is done over the existing SS7 network. Cisco, Nortel[4], Ascend, and Stratus now offer SS7 signalling gateway products. Figure 6 shows the Cisco SS7 gateway based on an SC22XX signalling controller working together with NAS 5X00 access servers[5]. The signalling controller provides connection to the SS7 network and network access servers (NASs) while the NASs terminate the integrated services user part (ISUP) trunks. Network event monitors (NEMs) manage the signalling controllers SS7 functionality, and authorisation, authentication and accounting (AAA) and simple network management protocol (SNMP) servers provide security and network management. A backhaul router provides connection to the ISP backbone.

*Figure 6—Cisco SS7 Gateway solution*




### Switch supplier Internet offload solution

Ericsson now offer an Internet offload solution based on an ACC Tigris Internet access server[6] shown in Figure 7. This is a pre-switch solution where the access server is connected directly to the AXE group switch. IP traffic is offloaded to a data network before calls enter the PSTN. An access server for local/transit switches, but not for remote switching units, is available.

#### *Issues*

POPs or Internet access servers can be located at local and tandem switches allowing diversion of IP traffic to a data network at this point. This limits the problem to the local switch. Remote subscriber units (RSUs) are still a problem, as offload technology for RSUs is not currently available. With the high percentage of IP traffic on many RSU links, these

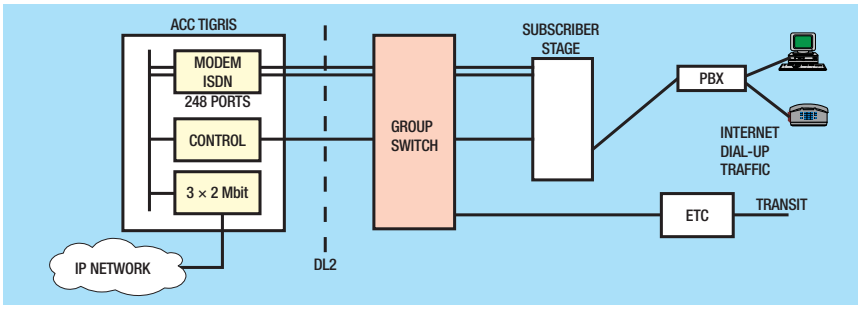



*Figure7—AXE Internet offload access server*

*Figure 8—ATM multiservice network*

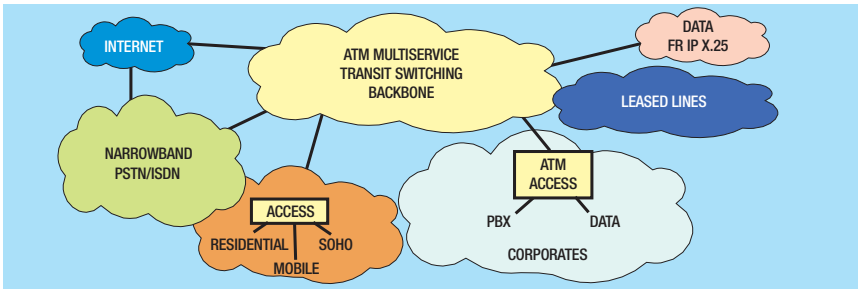



*Figure 9—IP only network: Internet access*

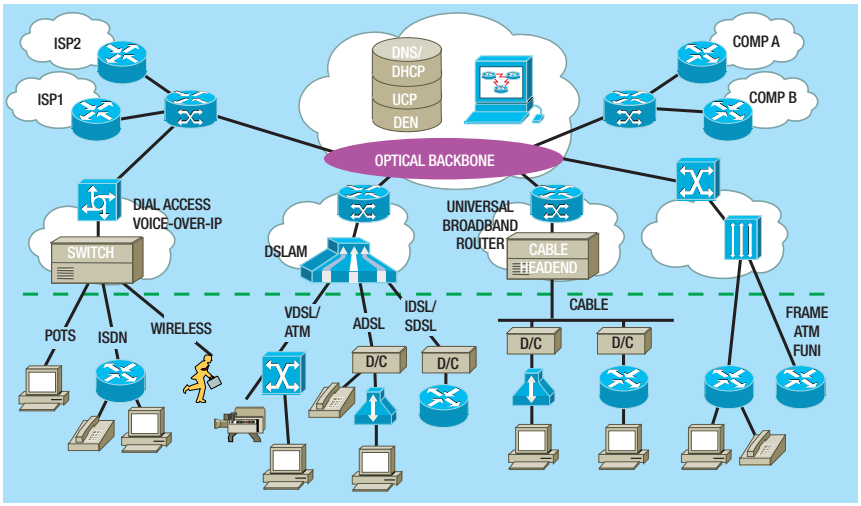
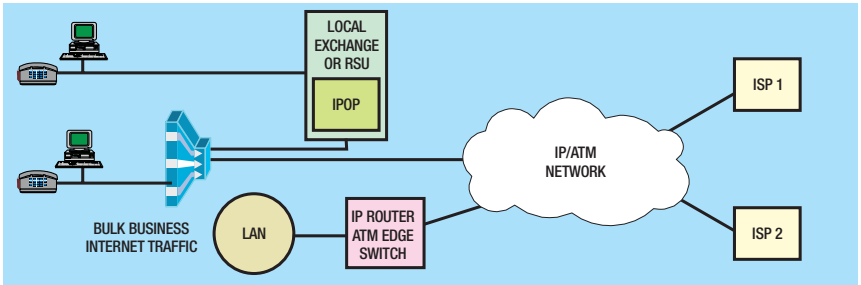



*Figure 10—Future Internet access*




links will become quickly congested. An offload solution for RSU to local switch links is urgently required.

The cost implications of the different network offload options need to be studied, to find the optimum for the network topology. Telecom Eireann are planning to conduct such a cost study.

### ADSL/ATM and cable modem technologies

Broadband access technologies such as ADSL, ADSL Lite, SDSL, and VDSL as well as ATM to the desktop will enable cheap always-on connection to the Internet. ADSL/ATM and cable modem Internet customers will access the ISP POP directly via a data network, and avoid the PSTN. Internet customer numbers using these technologies are likely to be limited in the short-term, and will not have any great impact on the dial-up Internet traffic problem. In the long-term however, the impact of these technologies is likely to be significant.

## Future Vision

Network offload of Internet traffic is unlikely to be necessary in the future, as the networks envisaged will solve the problem. Strategists predict a universal routing/switching protocol supporting a vast range of services over a multiplicity of end-user terminals, with distributed intelligence across nodes, and an all-optical transport core. There are two main visions:

- *ATM multiservice network* for high quality end-to-end connectivity is ideal for corporate virtual private networks (Figure 8). This would use ATM edge and core switches, and provide IP switching over ATM.
- *IP-only network* (Figure 9) could be used to offer low grade, cheap connectivity, bulk dial-up traffic for cheap IP public services[7]. This would use IP edge routers and terabit routers directly on an optical transport layer. QoS would be provided by MPLS or Diffserv.

A hybrid ATM/IP network is likely to emerge, with ATM switches having a connected IP-terabit router.

If the hybrid ATM/IP network vision emerges, and ATM/IP switches provide the network core, Internet traffic would be carried as shown in Figure 10. Bulk business Internet traffic from corporate LANs would be connected by router or ATM edge switch into the ATM/IP network via the local exchange. Local exchanges will require either integrated POPs, data gateways, or upgrading to voice/ATM-IP nodes. Network-wide implementation of this vision is several years away yet, but it will solve the Internet offload problem.

## Conclusion

Dial-up Internet traffic is causing a short-term network problem for the switched voice network. Statistics indicate rapid Internet traffic growth, and the forces driving growth such as low cost or free Internet service are fuelling higher

Internet traffic and longer holding times. Future solutions such as the hybrid ATM/IP network with combined voice and ATM/IP switches will solve the problem but are some years away, leaving us with a short-term problem. The general strategy is to offload IP traffic at the earliest possible point, and transfer it to a data network. The main offload technologies for the short-term include: remote PRAs, POPs or RASs at local exchanges connected by FR/ATM to ISPs, SS7 signalling gateway solutions, and supplier offload solutions. Telecom Eireann has started to locate POPs at the busiest Internet local exchanges, and connect remote PRAs to these. This Internet traffic is desirable in that it will generate future revenues. However carriers must be prepared to invest in their local networks which were designed for a different purpose, so they are able to handle this new surge in IP traffic. Detailed Internet traffic analysis, and careful cost modelling of the choice of Internet offload technologies will be needed to provide an optimum solution.

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6 AXE Internet Access Server. Ericsson Datacomms/IP Product Information.

7 SHREVE P. Building the New World. Cisco Systems Inc., 1998.


## *Glossary*

**ADSL** Asymmetric digital subscriber line
**ATM** Asynchronous transfer mode
**ETC** Exchange terminal circuit
**FR** Frame relay
**IAS** Internet access server
**ICR** Internet call routing node
**IFC** Internet frame concentration
**IPOP** Integrated point of presence
**ISDN** Integrated services digital network
**ISP** Internet service provider
**ISUP** Internet services user part
**NAS** Network access server
**NEM** Network event monitor
**PDU** Protocol data unit
**PMO** Present mode of operation
**PSTN** Public switched telephone network
**POP** Point of presence
**PRA** Primary rate access (ISDN)
**RAS** Remote access server
**RSU** Remote subscriber unit
**SDSL** Synchronous digital subscriber line
**SS7** Signalling System No. 7
**STP** Signalling transfer point
**VDSL** Very-high bit-rate digital subscriber line
**xDSL** the range of digital subscriber line technologies

## *Biography*

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David Blair is an executive engineer in the Network Strategy and Planning Department at Telecom Eireann. He graduated in 1979 with a B.Sc. (Hons) from University College Dublin, and received an M.Sc in Electronics and Microelectronics from Trinity College Dublin in 1981. After a period lecturing in the Dublin Institute Technology he joined Telecom Eireann in 1983. He worked in the Switching Department on switched network management, and SS7 signalling. From 1990 he has worked in the Strategy and Planning Department on switched network and SS7 signalling development, the introduction of ATM, and is currently working on switched aspects of Internet traffic routing.