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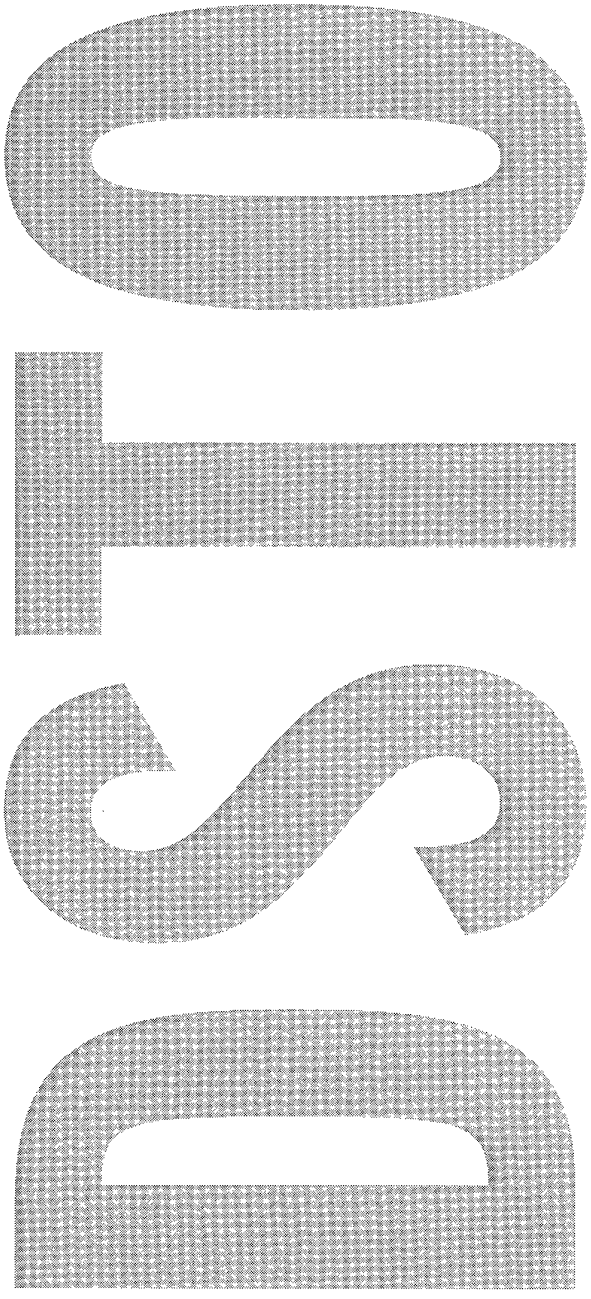

IP Convergence in Global Telecommunications

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Introduction to Report Series and Key Issues

Peter Shoubridge

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ABSTRACT

With data services rapidly becoming the dominant traffic type carried by global telecommunication networks, telecommunication companies must now consider their strategies for implementing next generation networks. This document introduces a series of reports that discuss the issues impacting the nature and direction of these next generation networks and services.

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1. Introduction

Global telecommunication networks are changing from their traditional role of providing voice services to one of data service provisioning as well. This has primarily been driven by Internet commercialisation (e.g. e-commerce) and the productivity gains achieved through corporate intranets. As a result, the strategic direction and future network architectures of telecommunication service providers are also changing.

Service providers have been anticipating the rise of new services other than voice for some time. Architectures based on narrowband Integrated Services Digital Network (ISDN) and Broadband ISDN using Asynchronous Transfer Mode (ATM) technology have emerged for this purpose. However, user demand for data services based on Internet Protocol (IP), being much cheaper to implement end-to-end, has exceeded expectations. To satisfy this increasing demand, network service providers are now considering the development of carrier grade IP networks to support their data and voice services in a single network. With emerging IP switching technology capable of carrier grade switching loads and the promise of guaranteed high quality voice communications over IP, service providers see IP as the best business solution for converging their voice and data services.

Clearly there are very many complex issues and uncertainties regarding technologies, market and business forces influencing this new use of IP in telecommunications for service convergence. It is difficult to predict final outcomes, however, general trends are definitely emerging and the more likely network architectures worth considering. As a result, a collection of reports have been produced by DSTO providing an overview of these new trends and where possible speculating on likely approaches to IP convergence.

2. Reports and Issues Raised

The report series, IP Convergence in Global Telecommunications, aims to describe the general plans and developments of telecommunication companies in supporting data services in their next generation networks. The business case in today's telecommunications environment is leading service providers towards converging their voice and data services at the Internet Protocol (IP) layer. That is, networks will be developed based on IP packet switching architectures for the dominating IP data services, with voice carried over this IP network. Discussions of the issues and current developments are presented in the following seven reports.

1. Wilksch, D. and Shoubridge, P., ``IP Convergence in Global Telecommunications - New Telecommunication Network Architectures For Integrated Services,'' DSTO Technical Report, DSTO-TR-1046 - considers the technology, business and market forces influencing the next generation network architectures, and identifies likely

new architectures and migration strategies. The higher than expected growth in demand for data services (in particular IP) has led network providers to reconsider their plans for data service provisioning. To handle the predicted high volumes of IP traffic, carrier grade IP wide area networks promise the most cost effective solution. However, other services such as voice, will require specialised treatment to ensure service quality is met. Continuing improvements to IP switching and optical networking are likely to address these problems in future, although other technologies (such as ATM) will be required in the network core to manage quality of service (QoS) until these new improvements become available.

2. Zahorujko, I., Reynolds, A.B. and Blair, W.D., ``IP Convergence in Global Telecommunications - Voice over Internet Protocol (VoIP)'' DSTO Technical Report, DSTO-TR-1039 - examines the competing standards and technologies being developed to provide carrier grade voice services in IP wide area networks. Standard H.323 is currently the dominant signalling specification for supporting VoIP call control, this is primarily due to the large installed base of H.323 clients. Competing with H.323 is the signalling standard SIP. SIP is gaining support with developers because it is a simpler protocol and easy to integrate with computer applications. In addition to supporting basic voice calls, caller identification and conference calls, SIP will readily enable access to new services such as Web based call centres. As yet it is unclear which standard will dominate VoIP call signalling in the future.

3. Dong, L. and Lee, C., ``IP Convergence in Global Telecommunications - The New Switching and Traffic Control Protocols for IP Networks'' DSTO Technical Report, in publication - discusses new IP router designs and the various protocols that are currently being developed within standards bodies to ensure carrier grade service quality for both voice and data communications in next generation IP wide area networks. Different types of traffic carried within a network can be tagged using an open standard approach called DiffServ (Differentiated Services). This enables routers the ability to readily identify a specific traffic class and allocate resources as appropriate to that class's QoS agreement. Other approaches, such as Multi-Protocol Label Switching (MPLS), enable traffic engineering through explicit routing. A new Internet Protocol, IP version 6, offers policy based route selection capabilities, further aiding QoS management.

4. George, P. and Kwiatkowski, M., ``IP Convergence in Global Telecommunications - New Approaches to Network Management and Service Provision'' DSTO Technical Report, DSTO-TR-1075 - explores new trends in distributed network and service management, and the implications associated with recent moves towards carrier grade IP networks. These new trends require the development of management architectures that are highly flexible and potentially highly automated. This issue is being addressed through the use of middle-ware, active network and Web based technologies. The ever growing demand for new sophisticated services involving

various types of media, and at the same time the need for rapid service provisioning, have resulted in a service centric approach to network management. One important feature of this new trend is the provision of more service control to end users. This, together with service provisioning by third parties, have triggered intensive research and standardisation efforts on new service management architectures. Some of the more promising approaches are described in this report.

5. Jayasinghe, S., ``IP Convergence in Global Telecommunications - Mobility in IP Networks'' DSTO Technical Report, in publication - considers the trends and developments in mobile computing. In particular, issues associated with Mobile IP and its standardisation within IETF for portable computing, as well as new approaches being adopted by cellular mobile network developers. Mobile IP is aimed at portable computing, providing personal mobility within IP networks. Terminal mobility can also be provided through the use of wireless local area network technology. Such approaches support high data rate services. Alternatively, cellular mobile network developers are also working towards the provisioning of data services using packet switching technologies such as GPRS (a packet switching overlay to GSM) and Cellular IP. These techniques are based on existing mobility management architectures, as used in today's cellular networks, and support fast handover strategies for improved mobility. However, these approaches operate at relatively lower transmission rates. As yet it is unclear which of these approaches will dominate the market for mobile data services.

6. Tran, C. and Taylor, R., ``IP Convergence in Global Telecommunications - Security Services for IP Networks'' DSTO Technical Report, DSTO-GD-0269 - provides an overview of security mechanisms and associated standards being developed for e-commerce in future business class IP networks. Security services such as IPSec will enable an organisation such as Defence to extend its extranet to other government agencies for secure (up to confidential level) information exchange. Mobile users could gain access to the intranet through Internet Service Providers without interoperability problems associated with security protocols. A number of issues remain to be solved before IP security services can become available, these include frameworks for managing responsibilities and liabilities of users, product development and the administration of Certification Authorities.

While these reports describe large changes to the way telecommunication services are delivered, telecommunication companies (telcos) must still recover their investments in existing technology. As a result, new network architectures will coexist with current networks and migration strategies will be based on the trade-offs between new equipment procurement costs, existing maintenance costs, user demands and new revenue opportunities.

Internet commercialisation, better customer service and business productivity gains achieved through corporate Intranets are the prime drivers behind the increasing demand for data services in wide area networks. Demand for such data services is

growing globally and this demand is further stimulated by the low cost and ubiquity of Internet Protocol (IP) based data networking technology. To satisfy this demand and build new business opportunities, manufacturers of IP switching equipment are developing new products capable of switching high capacity communications over wide area networks. These new IP switches are reaching the capacities of traditional telephone circuit switching equipment, and at relatively lower costs.

Voice communications is of course a very important service to both subscribers and telecommunication carriers. Today's circuit switched networks have been designed for voice communications, whereas IP networks were originally designed for data networks. Carriers are always concerned with the high costs associated with operating multiple networking technologies and as a result endeavour to overlay as many services as possible onto a single network infrastructure. With the volume of data traffic now beginning to dominate global networks, telcos and IP switching vendors are pursuing the development of solutions to provide carrier grade voice services over IP wide area networks. This will make possible the convergence of voice and data services over a single IP network infrastructure, reducing operating costs.

As described previously, BISDN using ATM switching technology was designed to be the next generation networking technology for global telecommunications. Many telcos have already deployed ATM switches in their backbone. This networking technology is more complex than IP but capable of supporting various service types while providing guarantees of service quality. It is essential that service providers have the ability to effectively manage quality of service and ensure that service level agreements are being met. However, with the rapid growth and demand for data services, and the relatively low cost to produce IP switching equipment compared to BISDN, the business case for telecommunication service providers now suggests a move to IP based infrastructure for their next generation networks.

The management and control of large IP networks presents many new challenges because IP networks traditionally provided only best effort service. So in the short term carriers are likely to adopt a hybrid approach, using IP for switched data and voice services over an ATM backbone. Such a strategy enables the use of ATM to manage bandwidth and quality of service that may not be possible with early IP products. Furthermore, ATM allows the service providers to more effectively manage their non-switched data services, such as intranets and leased lines, over their bearer services.

New telecommunication companies, without the concerns regarding legacy equipment, may benefit from the rapid advances in optical fibre transmission system capabilities. The costs associated with rolling out latest generation optical fibre technology are very competitive and offer high capacity bearer services. It then becomes possible to use this available network capacity to over dimension early architectures and overcome some of the deficiencies in managing quality of service.

A trend towards IP convergence for voice and data services is also emerging for personal communication systems. Like fixed network infrastructure, cellular mobile phone networks have also been traditionally designed using circuit switching principles, and like fixed networks users are also demanding Internet type services while roaming. To meet these demands, mobile network developers are looking towards packet switching, and IP in particular, as a basis for next generation mobile networks.

3. Conclusions

The purpose of these reports, in the series just described, is to provide an overview of the global trend towards IP networking as a basis for voice and data convergence in next generation networks. This overview has been based on the analysis and consideration of commercial trends and has not specifically addressed the implications for Defence communications.

There are of course various issues emerging from these trends that will require further consideration regarding the impact for Defence. For example, consider the scenario of commercial telecommunications moving towards IP based networking, and relying on high capacity optical fibre transmission and network over dimensioning to alleviate quality of service problems. Clearly, there will be issues associated with using such commercial switching equipment and protocols in tactical environments where bandwidth is scarce. This is especially the case where tactical trunking is required to efficiently interconnect dispersed groups over a wide area. Also, the role and pervasiveness of ATM (and QoS enabling IP protocols) in these next generation commercial networks will be important in addressing the possibilities for managing service quality and communications availability, as well as the integration of mechanisms to provide the necessary levels of confidentiality and integrity for Defence communications.

These new trends, of service convergence at the IP layer in commercial networks, are also likely to create new opportunities for Defence to improve interoperability between the differing strategic, operational and tactical environments. Furthermore, commercial developments such as wireless local area networks and new packet switching technologies for personal communication systems may provide, in part, solutions to some of the tactical local loop problems (linking end-terminals to the network). So it is likely that these new developments in commercial telecommunications will raise both problems and new opportunities for future Defence communications.

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