



Building integrated services intranets

A White Paper from

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1 EXECUTIVE SUMMARY

Managers responsible for enterprise networks are facing unprecedented changes in the technology which is available to them. These new technologies offer the opportunity to operate enterprise communication at a lower cost with greater efficiency, improved performance and better support of the company's workflow. Internet Protocol (IP) based technologies are making their presence felt in enterprise networks from outside, as service providers adopt these technologies, and from within as communications managers investigate and adopt new IP-based systems.

These new technologies offer many opportunities if chosen wisely, but the wide range of choices also gives rise to many more opportunities for making the wrong decisions and causing major problems for the enterprise. In these circumstances, it is important that the decisions are based on a sound foundation of knowledge about how to move the enterprise network into the future, while maintaining a reliable service during the change. Migration paths and investment protection are key words in defining a viable strategy.

This paper presents some of the opportunities and issues which have to be considered, and suggests how Inalp Networks can help by drawing on our considerable experience in applying IP-based technologies to networking.

It looks in particular at the issues and solutions surrounding:

- Converging PBX networks and WANs, including many of the migration problems related to quality and features
- LAN interconnection
- Making best use of new service provider offerings, such as provider initiated VPNs
- Application Service Provisioning

In each section, it considers how the use of IP-based products and technology can be advantageous in these situations. It also discusses the general issues associated with the convergence of different types of networks.

The paper is based around Inalp Networks' view that IP-based networks hold the key to meeting many of the challenges facing enterprise networks. Inalp Networks has the experience and the products needed to migrate existing enterprise networks to an all IP future, while protecting investment in legacy and future systems and providing a reliable service throughout the migration. This paper gives an insight into our view of the solutions but we have studied many of the issues in great depth. As your partner for the future evolution of integrated services intranets, we would be happy to discuss any of these solutions in more detail. The Inalp Networks web site (<http://www.inalp.com>) contains more detail on Inalp Networks' technology and products and describes a number of practical examples of their application.

2 INTRODUCTION

Unprecedented changes in the technology which is available to them are facing IT and communications managers responsible for enterprise networks. Over the past few decades, these changes have led from LANs to intranets, from token ring over (for example) ATM to Ethernet, and from analogue to digital PBXs to CTI. These new technologies offer the opportunity to operate enterprise communication at a lower cost with greater efficiency, improved performance and better support of the company's workflow.

Today, IP-based technologies are making their presence felt in enterprise networks from outside, as service providers adopt these technologies, and from within. Internet, intranet, extranet, ASP, Voice over IP, LAN based PBX etc are all becoming commonly accepted elements of the enterprise network manager's toolkit. As a consequence of these changes, the physical infrastructure, cabling and layer 2 protocols are becoming consolidated and the focus is moving towards applications and workflow.

These new technologies offer many opportunities if chosen wisely, but the wide range of choices also gives rise to many more opportunities for making the wrong decisions and causing major problems for the enterprise. The manager responsible for IT and communications strategy has to make choices based on requirements, cost and the opportunities provided by adopting a particular technology. They also have to take into account the maintenance and future growth of the system as well as the initial set-up.

In these circumstances, educated choices about how to move the enterprise network into the future, while maintaining a reliable service during the change, are crucial. Migration paths and investment protection are key words in defining a viable strategy.

Inalp Networks can help by drawing on our considerable experience in applying IP-based technologies to networking. This paper presents some of the opportunities and issues which have to be considered, and suggests the Inalp Networks solution to them

3 THE COST OF OWNING A DEDICATED NETWORK

The IT and communications infrastructure of any enterprise is a major investment, and is crucial to its effective day-to-day operation. The costs associated with running a dedicated network are high, in terms of:

- the capital or leasing costs of the equipment (eg PBXs, routers etc),
- the leasing costs of the interconnections (eg leased lines),
- call charges over public networks, and
- the pay of the people needed to keep the network running.

In the traditional approach to providing intranets which can cope with all of the communications services that any enterprise needs, several separate networks need to be set up and run. The opportunities for saving costs in this environment are limited. Inalp Networks' studies have shown us that the adoption of a strategy using IP-based integrated services creates opportunities for radical reductions in the costs of enterprise communications. This paper describes some of the options that are available which will lead to these cost savings.

Since the actual savings will vary from case to case and from enterprise to enterprise, cost figures have not been quoted in the examples given below. However, we would be happy to discuss the likely savings with you based on your particular circumstances.

4 THE ISSUES AND THE SOLUTIONS

The preceding sections have looked in very broad terms at the issues facing enterprise networks. This section looks at some of the issues in more detail. However, there are a host of issues which can affect an enterprise network operator, whatever solution they adopt, and it is only possible to give an outline of how Inalp Networks believe each of these issues should be addressed.

Inalp Networks have looked at most of the issues which could affect integrated services intranets and have developed products which solve many of these issues. As your partner for the future evolution of intranets, we would be happy to discuss any of these solutions in more detail. The Inalp Networks web site (<http://www.inalp.com>) also contains more detail on Inalp Networks' product family and describes a number of practical examples of their application.

4.1 Converging PBX networks and WANs

Decisions on whether or not to install a PBX network have, up to now, largely been based on factors such as the variable costs of calls between sites over the PSTN, the whole-life costs of the network equipment needed and the costs of leased lines. The additional features given by a PBX network have also played a part in these calculations, but the over-riding factor has been the cost of providing basic voice connections.

In recent years the benefits of data networking services (web, e-mail, LAN services) have led to the installation of IP networks which, in many companies, already exceed the PBX infrastructure in performance and capacity. The communications manager can now rethink the PBX network strategy based on this evolution.

While Frame Relay or ATM based multi-service networks have been an option for large corporations for some time, the possibility of integrating voice and data on IP now enables the creation of cost-effective virtual PBX networks in situations where a conventional PBX network would not previously have been viable.

Figure 1 illustrates in a simplified form how this decision-making changes as converged and virtual PBX networks are considered. The amount of traffic (ie call minutes) passing through the PSTN has to be high enough for the (variable) cost of that traffic to be greater than the fixed cost of providing a PBX network, if the provision of that PBX network is to be justified. Since the fixed cost of converged and virtual PBX networks is lower than that of conventional leased line PBX networks, this break even point is significantly lowered.

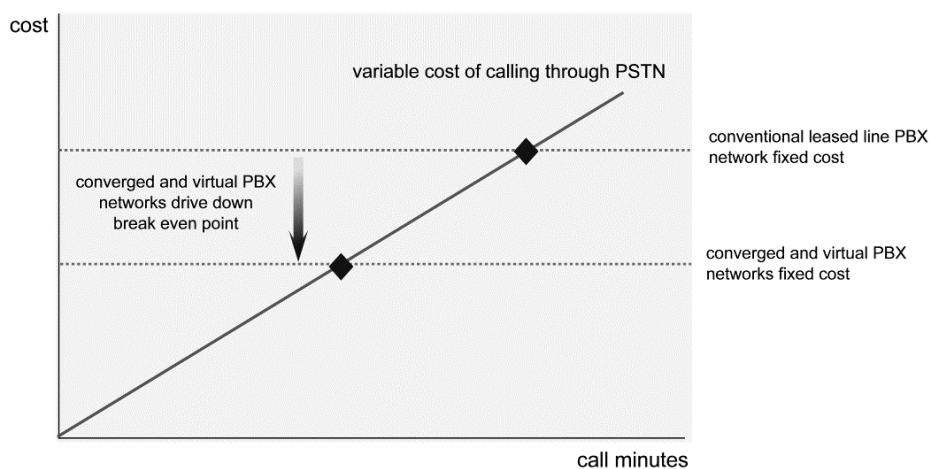


Figure 1 - PBX network costs

4.1.1 Migrating existing PBX networks

Where a conventional PBX network is already in place, the convergence of this network onto the IP infrastructure can cut the costs of using a dedicated leased line and open up opportunities for new IP based messaging and remote access services. The key to making this converged approach a real opportunity is the maintenance of the voice quality and features expected by the users. Since conventional PBX networks rely on dedicated signalling protocols, the support of these protocols is an essential enabling feature in this application.

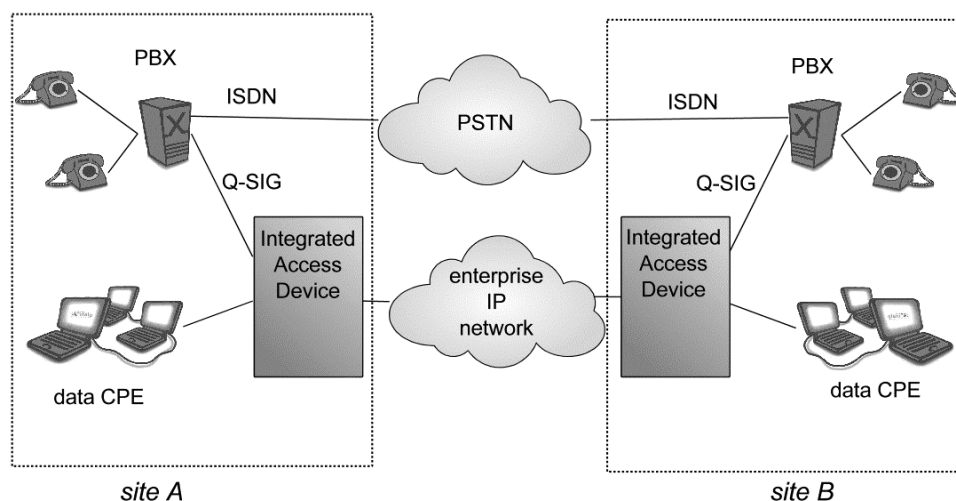


Figure 2 - replacing an existing PBX network

The Inalp Networks SmartNode products provide Q-SIG tunnelling between the PBXs to support private network features such as private numbering or call-back. Superior voice quality is enabled by the real time IP routing core which we provide. By using this approach, features and quality equivalent to the original PBX network can be provided at lower cost. The use of standard H.323 protocols also enables the integration of further value added services on the enterprise network. The interoperability with third party gateways, gatekeepers and related applications such as messaging services that this approach enables opens a whole range of possibilities. Figure 2 illustrates such a network set-up.

4.1.2 New opportunities for SMEs

PBX networks have not generally been an economic proposition for SMEs with a number of sites. The use of intelligent IADs means that it is now possible to construct a viable PBX network for these SMEs. The IAD provides sophisticated call routing functions and a local breakout path to the PSTN and this makes it possible to use it as the basis for a cost-effective PBX network. Dialed numbers belonging to an enterprise site can be intercepted and routed over the enterprise network while incoming calls and external destinations are routed from and to the PSTN. This results in a “virtual PBX network”, without all of the management and equipment overheads of creating a physical PBX network.

The viability of this is further enhanced by the fact that no new interfaces are needed on the customers’ premises equipment and no reconfiguration of the PBX is necessary. Figure 3 shows this scenario. This approach is also particularly useful for small branch sites or networks which do not have networking capable PBXs (for example, no Q-SIG support).

This is an attractive option since it provides a PBX network without the major costs and planning normally needed and allows the network to be reconfigured simply by remotely changing the parameters in the IADs.

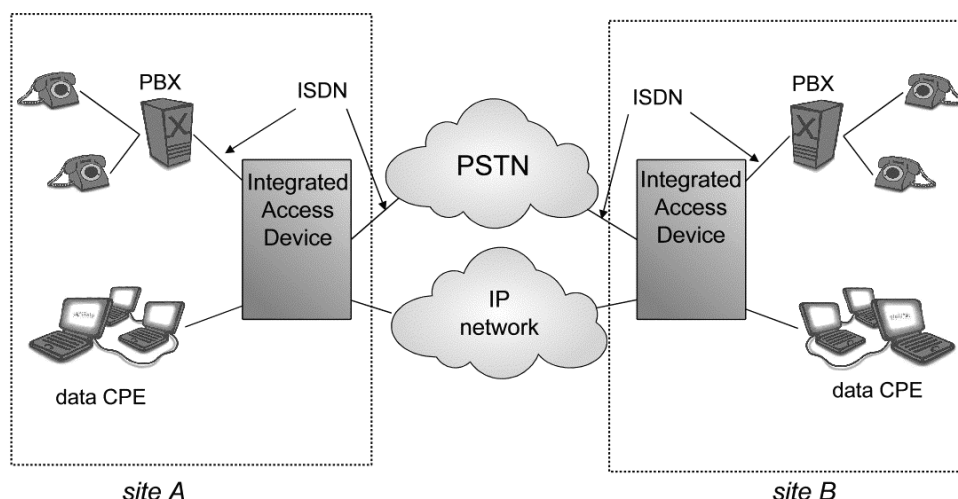


Figure 3 - a PBX network for an SME

4.1.3 The ISDN legacy interface

Throughout most of Europe, ISDN is regarded as the business voice network, as well as being widely used for data transmission. A large installed base of terminal and network equipment is in place and very few new PBXs are installed which do not make use of ISDN access to the PSTN. Any changes in the enterprise network must take this into account.

Inalp Networks have considerable experience in ISDN and have developed a profound understanding of its applications and technology. We have also looked very carefully at what is needed to ensure full interoperability between different types of equipment. The Inalp Networks IADs provide interfaces to ISDN customers' premises equipment which are fully compliant with the standards and can interoperate with a wide range of equipment. On the network side, Inalp Networks have developed the ISDN over IP (ISoIP) protocol, which is described in "Feature expectations" and ensures that ISDN users do not lose any of the features they are used to.

4.1.4 Feature expectations

Employees, as end-users, expect any new service that includes voice to provide them with all of the features of ISDN which they have become accustomed to, in a way which they have become accustomed to. Any enterprise network has therefore to support the full range of ISDN features, such as supplementary services for voice and for data.

Inalp Networks has introduced a voice over IP signalling protocol (ISoIP – ISDN over IP) which is based on the industry standard H.323, but outperforms H.323 in speed and features. ISoIP is able to provide the complete range of ISDN supplementary services over an IP-based network - such as calling line ID, conferencing etc We are also developing signalling solutions that comply with the next generation of fully IP-based carrier call control architectures and support the ISDN features.

4.1.5 Quality expectations

Although all businesses are very cost conscious, they are prepared to pay for quality since the enterprise network and its services have become more and more business critical. The internet is widely perceived in business as a useful tool but is not considered mature enough for major companies to readily sign up to a voice service over the internet.

"Voice over IP" (VoIP) is a service that has been much discussed, and much criticised. However, many people talk about VoIP when they are really talking about voice over the internet. VoIP over a well dimensioned and managed IP network is not the same as voice over the internet. While early applications of VoIP were tempting home users to call their Australian uncle over the internet, and put

up with the limitations, suppliers today recognise the need to provide good quality voice to business customers within intranets.

Merely offering a router which can handle simple voice over IP is not enough to meet their needs, since integrated services which include voice must be based on state of the art real-time networks rather than “best-effort” connections. The access point and gateway to the network is a crucial element in this scenario.

Inalp Networks use an integrated service node (the IAD) which offers a real-time core at the crucial access point and gateway nodes in the network. This is possible because we have developed the real-time capabilities of our routing core so that, for example, the node latency for a voice packet is well below 1 ms (as compared to the 5 ms which other routers may have for any packet). Such real-time response is not easy to achieve and it is an area of expertise that Inalp Networks has invested heavily in.

4.2 LAN interconnection

This is still the most important service in enterprise networking. The ability to access LAN resources (such as servers, hosts and back-up systems) regardless of which site they are physically located on is crucial to the operation of many companies. In recent years, the technological possibilities for achieving this interconnection have become much more diverse. For example, some currently available methods are:

- Leased lines between sites, using IP over PPP. This is discussed below in “Connectivity by leased lines”.
- A Frame Relay network, using IP over PVCs. This is discussed in the section on “Making best use of new service provider offerings”.
- Virtual Private Networks (VPNs) – which can be customer or provider initiated, and use IP over IP tunnels through provider backbones or through the internet. This approach is also discussed in the section on “Making best use of new service provider offerings”.

4.2.1 Connectivity by leased lines

Broadband access providers around Europe are investing heavily in networks based on DSL, cable TV and Wireless Local Loop, and rolling out services to take advantage of these technologies. However, the main transmission technology for enterprise networks in Europe is still by far leased lines. This situation is likely to remain true for some years, especially in those regions where broadband access coverage is a low priority or where the limitations of the technology make it difficult to provide general broadband access.

Inalp Networks support the widespread use of leased lines by producing Integrated Access Devices which support a serial leased line interface. To ensure efficient bandwidth usage, compliance with standards and the possibility to multiplex several PVCs on one line and to access Frame Relay networks, Inalp Networks supports Frame Relay as the data link layer protocol.

4.3 Making best use of new service provider offerings

Taking advantage of the new technologies and regulatory environments which are now emerging, network service providers are offering a set of new services which can be integrated within enterprise communications to reduce costs or to improve service. Some examples of these are discussed below.

4.3.1 Provider initiated VPN

As an alternative to offering pure internet access, service providers are starting to offer provider initiated VPN services.

The most obvious approach to creating a VPN is for the customer to initiate the VPN by creating VPN tunnels through the IP-based provider network between the customer’s sites. This approach is shown in

Figure 4. Connection between the customer's sites is achieved by using this VPN, via the provider's network, and connection to the internet is also through the provider's network, with a firewall being maintained at each site which has internet access.

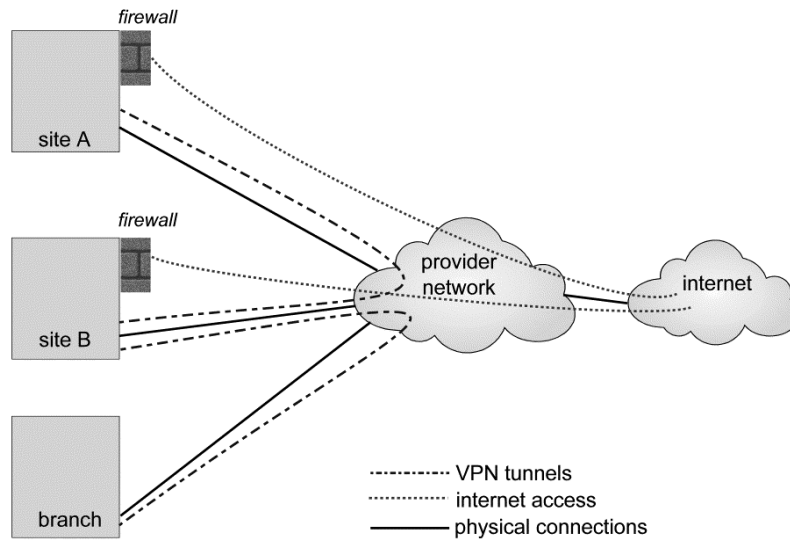


Figure 4 - customer initiated VPN

A more effective approach is for the service provider to initiate a VPN tunnel at his access concentration point (Point of Presence) rather than on the customer's premises equipment, and to support multiple permanent virtual circuits for the customer. This approach frees resources on the access router at the customers premises and makes the VPN more flexible, since new sites can be added by the service provider without reconfiguration of the PBXs at each of the existing sites. This approach is shown in Figure 5.

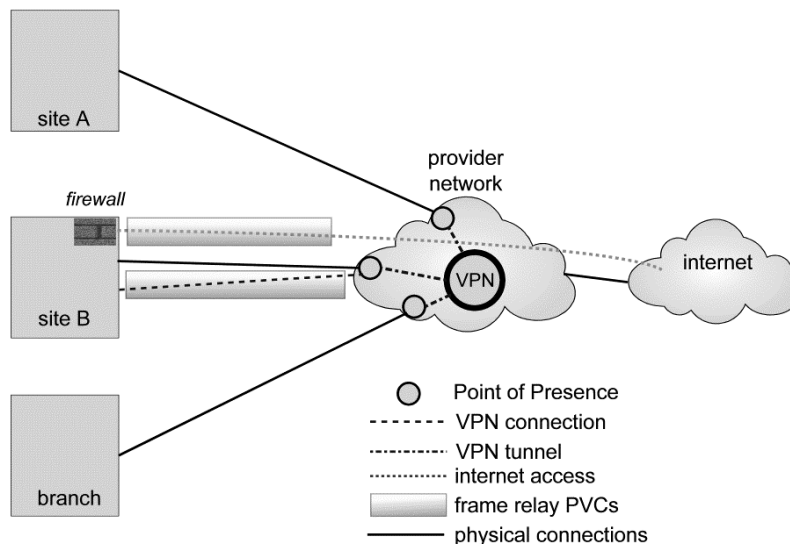


Figure 5 - provider initiated VPN

In the provider initiated VPN, the use of frame relay allows the combination of VPN traffic and internet traffic on the access link. This means that the access router must separate the traffic onto two different PVCs which are then routed accordingly. This solution has the additional benefit of freeing bandwidth on the access link which would otherwise be used by the overhead of maintaining a VPN tunnel from each site. Figure 6 illustrates the effects of saving this tunnelling overhead. It must be noted that both the IP overhead and the VPN tunnelling overhead will vary, depending on the mix of traffic.

The Inalp Networks IAD makes this approach possible by supporting classification of the traffic intended for the VPN (eg to distinguish between voice and data) and the corresponding prioritisation in the way that the traffic is handled.

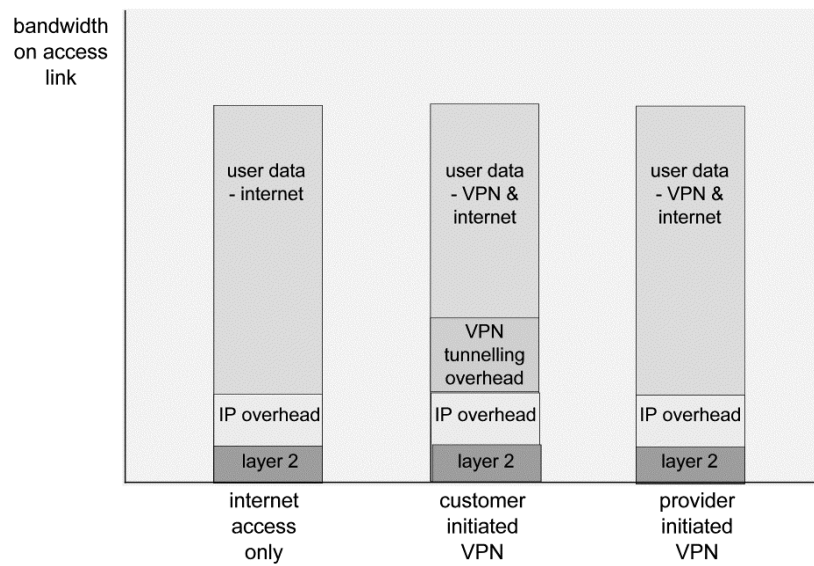


Figure 6 - user data bandwidth

4.3.2 Hosted firewall services

Security is a great concern for businesses, especially for SMEs who lack the in-house resources to continuously track potential threats and to update their security measures. Service providers can fill this gap by providing managed or hosted firewall services between a VPN and the internet (see Figure 7). This considerably reduces the maintenance effort needed for updating security measures. It also ensures that there is only a single point of entry and removes consistency and synchronisation problems. It is obviously only possible to take this approach if a provider initiated VPN is used, but it is a major potential benefit of adopting provider initiated VPNs. The way that Inalp Networks IADs support provider initiated VPNs is described on page 8.

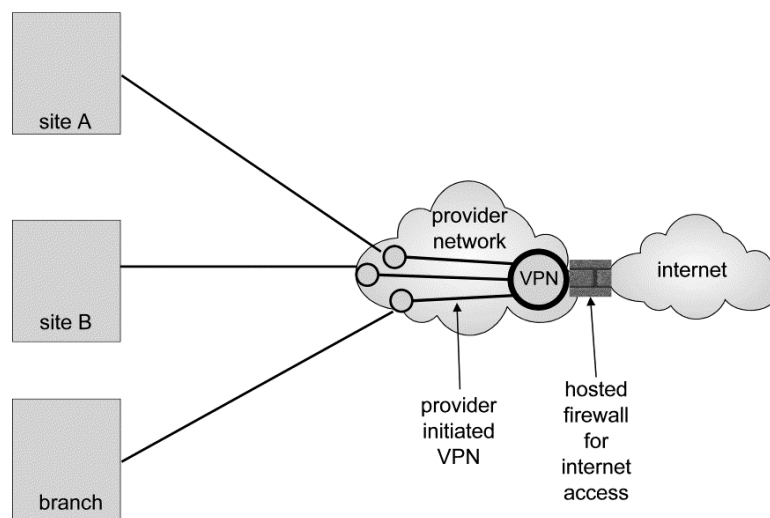


Figure 7 - hosted firewall

4.3.3 IP telephony services

Public IP telephony service providers are now starting to appear in the market place. Once an intranet is in place that can provide Voice over IP¹, this can be used to route selected calls to an IP telephony provider by routing to his gateway on the provider backbone or on the internet. It must be understood that there is a considerable difference between the VoIP service that can be provided over a well defined, dimensioned and monitored IP network (such as a provider backbone or an enterprise network) and that which many residential users will experience over the internet.

Inalp Networks' intelligent Integrated Access Devices make this possible by incorporating sophisticated session and call routing control within the IADs that can be programmed to route calls to the IP telephony provider based on, for example, the destination and/or time of day. This makes it possible for the manager of the enterprise communications to choose the routing that is best suited to each call, in terms of quality and cost.

4.4 Application Service Provisioning

Application Service Provisioning (ASP) is an important new service. For a number of years, companies have had the problem of supporting a growing number of large, increasingly complex software applications which are essential to their business. With the improvements in communications, it is now possible for Application Service Providers to host these applications, giving the end-user the access they need in real-time but taking the maintenance responsibilities away from the customer.

Obviously, one of the prime requirements of such a service is the reaction time, since the service should behave as if it was locally based. This, in turn, places strict requirements on the behaviour of an integrated network (both public and intranet) which supports ASPs. The ability of Inalp Networks IADs to classify and prioritise different service classes makes them well suited for use in this application, since the ASP traffic can be granted the priority which it needs to guarantee the reaction times.

4.5 Converging networks

4.5.1 Throughput expectations and traffic management

With the convergence of different types of services onto integrated networks the need to classify the different types of traffic (eg voice and data) and provide the corresponding prioritisation in the way they are handled has become paramount. By this means, the bandwidth can be intelligently shared so that some services can take a higher priority. Figure 8 illustrates how voice traffic can temporarily be given more of the available bandwidth at the expense of lower priority traffic which can tolerate some delay.

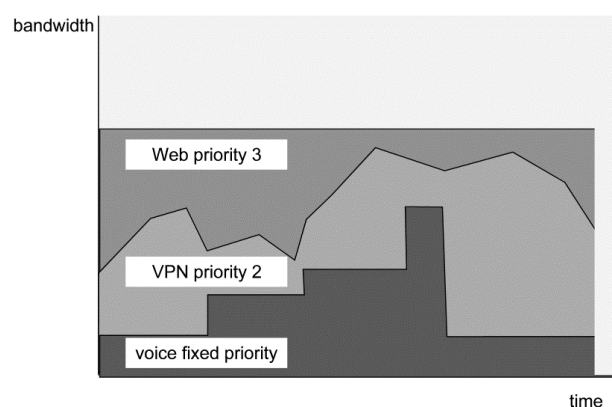


Figure 8 - intelligent use of the available bandwidth

¹ for example, see the virtual PBX network described in "New opportunities for SMEs" above

Inalp Networks believe that the best solution is to use the sophisticated traffic classification and scheduling provided by the IADs to ensure that the traffic is given the right priority throughout the enterprise network. The classification can be based on the source of the traffic, the destination address or the port. This classification and scheduling is extended to other networks by providing network policy compliant labelling of packets (eg TOS, DiffServ).

Figure 9 shows a simplified view of the scheduling process. The system contains two types of queue - the Fixed Priority (FP) queue and Weighted Fair Queue (WFQ). The fixed priority queue serves voice (and other time-critical) services and the weighted fair queue serves the LAN and any other services which are less sensitive to delay. The FP scheduler ensures that the FP queue is served until it is empty. It then allows the WFQ scheduler to serve its queues until another packet is detected in the FP queue. This is an extremely effective way of supporting the jitter and latency requirements of interactive voice traffic.

However effective this process may be, it is not sufficient just to ensure compliance in that part of the network alone. The IADs also help to ensure that traffic is given the right priority elsewhere in the intranet (and in external networks) by providing network policy compliant labelling of packets (eg TOS, DiffServ) to complement the priority they have been accorded within the IAD.

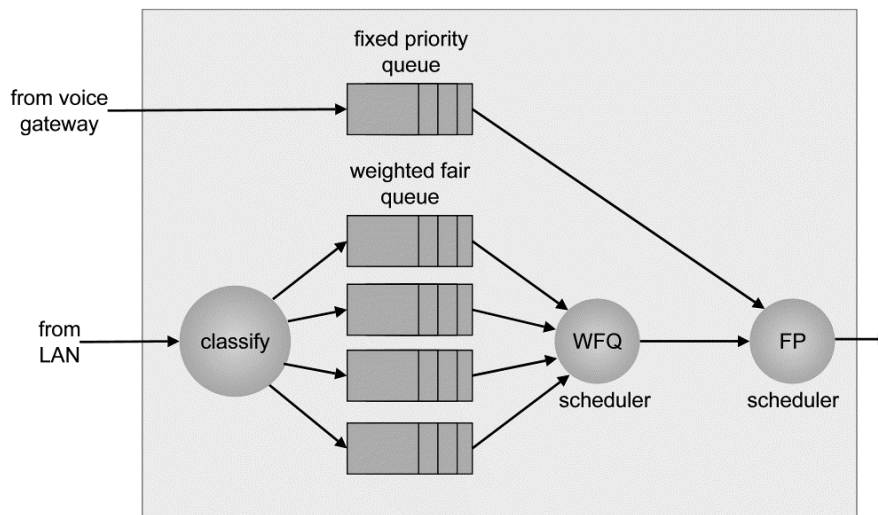


Figure 9 - classification and scheduling

5 CONCLUSION

The provision and ongoing management of enterprise networks is a complicated task. This paper has demonstrated the reasoning behind Inalp Networks' view that IP-based networks hold the key to meeting many of the challenges facing enterprise networks. Inalp Networks has the experience and the products needed to migrate existing enterprise networks to an all IP future, while protecting investment in legacy and future systems and providing a reliable service throughout the migration. This paper gives an insight into our view of the solutions but we have studied many of the issues in great depth. As your partner for the future evolution of integrated services intranets, we would be happy to discuss any of these solutions in more detail. The Inalp Networks web site (<http://www.inalp.com>) contains more detail on Inalp Networks' technology and products and describes a number of practical examples of their application.

6 GLOSSARY

ASP	Application Service Provider – a provider of software services which can be accessed in real-time by a customer.
ATM	Asynchronous Transfer Mode.
CTI	Computer Telephony Integration - a set of technologies that integrate computer and telephony applications - for instance integrated voice, fax and e-mail messaging.
DiffServ	A means of prioritising different types of traffic in an IP network. The DiffServ concept is to aggregate multiple flows requiring a similar behaviour and thereafter deal only with these aggregate flows.
DSL	Digital Subscriber Line - a means of providing broadband services over the standard telephony copper access network. The most common implementation gives up to about 2 Mb/s downstream and about 512 kb/s upstream.
Extranet	An intranet that is partially available to authorised users outside the enterprise that owns the intranet.
Frame Relay	A packet-switching protocol for connecting devices on a Wide Area Network (WAN).
H.323	An umbrella recommendation from the International Telecommunications Union that sets standards for multimedia communications.
IAD	Integrated Access Device – used to provide an interface between equipment on the customers premises and an integrated (typically IP-based) access network.
Intranet	An internet which is exclusively for the use of one enterprise and is protected from access by users outside the enterprise.
IP	Internet Protocol – a universally used protocol for communication over the internet.
ISDN	Integrated Services Digital Network – the most widely used business telecommunications service across Europe.
ISoIP	ISDN over IP – the Inalp Networks solution to providing all of the major features of ISDN over an IP-based access network.
LAN	Local Area Network – normally used for carrying data around a site.
NAT	Network Address Translator - a device used to extend the internet addresses already in use. It allows duplicate IP addresses to be used within a corporation and unique addresses outside.
PBX	Private Branch Exchange – used for switching voice calls within a company’s private network.
POTS	Plain Ordinary Telephone Service – the public voice service which we all use on a daily basis.
PPP	Point to Point Protocol - the internet standard for transmitting network layer datagrams (e.g. IP packets) over serial point-to-point links.
PSTN	Public Switched Telephony Network.
PVC	Permanent Virtual Circuit.
Q-SIG	A signalling system designed for controlling private networks which carry an integrated set of services. It is compatible with ISDN.
SME	Small to Medium Enterprise – typically a company of anything up to about 100 employees.
TOS	Type Of Service information carried in an IP header.
VoIP	Voice over IP – telephony over IP, not necessarily over the internet.

- VPN** Virtual Private Network - a network that is constructed by using public networks to connect nodes in the private network - for example, using the internet as the medium for transporting data. These systems use encryption and other security mechanisms to ensure that only authorised users can access the network and that the data cannot be intercepted.
- WAN** Wide Area Network – interconnecting LANs over a wide geographical area, primarily for carrying data.
- WLL** Wireless Local Loop – which can replace the fixed (copper) access network and provide broadband access.