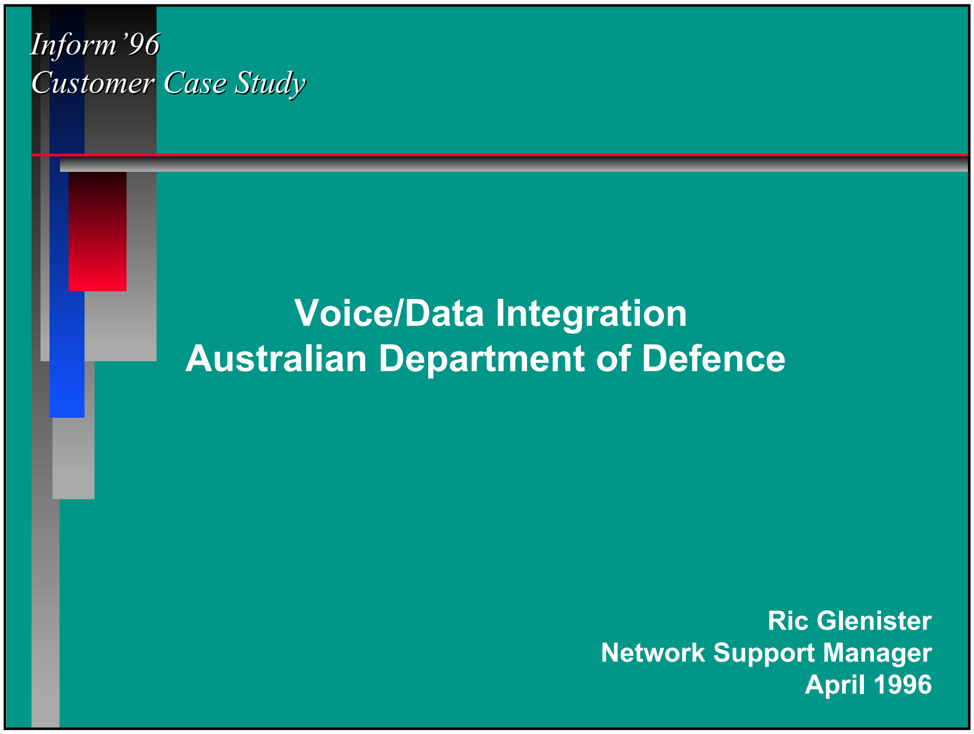
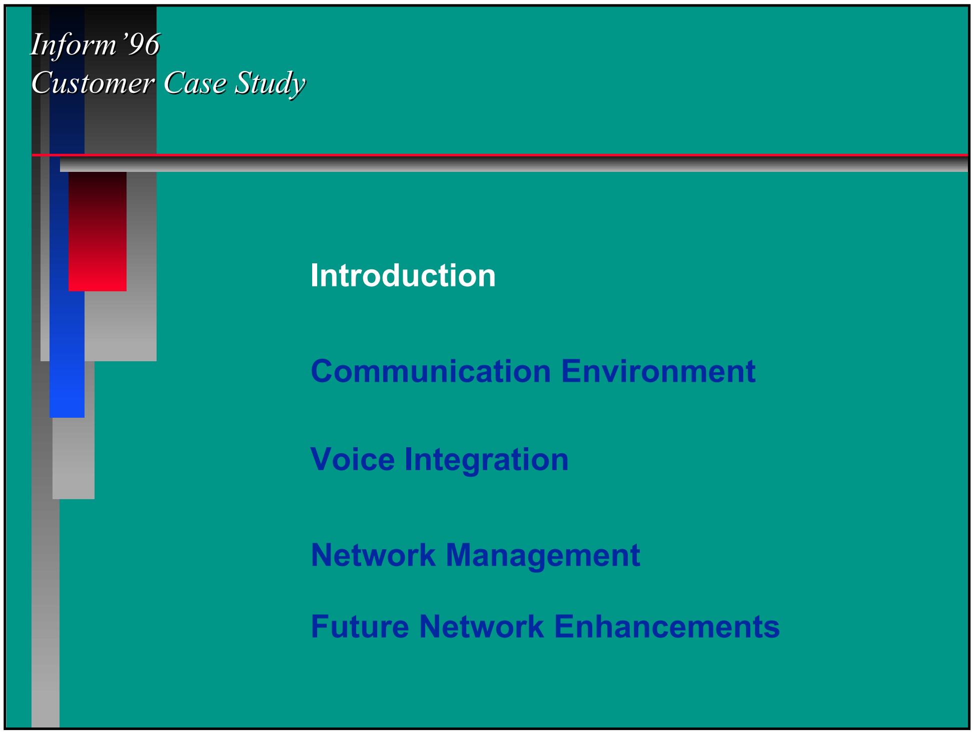


This presentation provides a snapshot of our department's implementation of voice data integration on Passport.

After a brief introduction I will describe the Networks of interest that currently run in the Defence environment. With this background we can examine the voice and data integration that has been completed, how it was planned and implemented and what remains to be done. From there I will comment briefly on Network Management and then raise some issues for future enhancements.



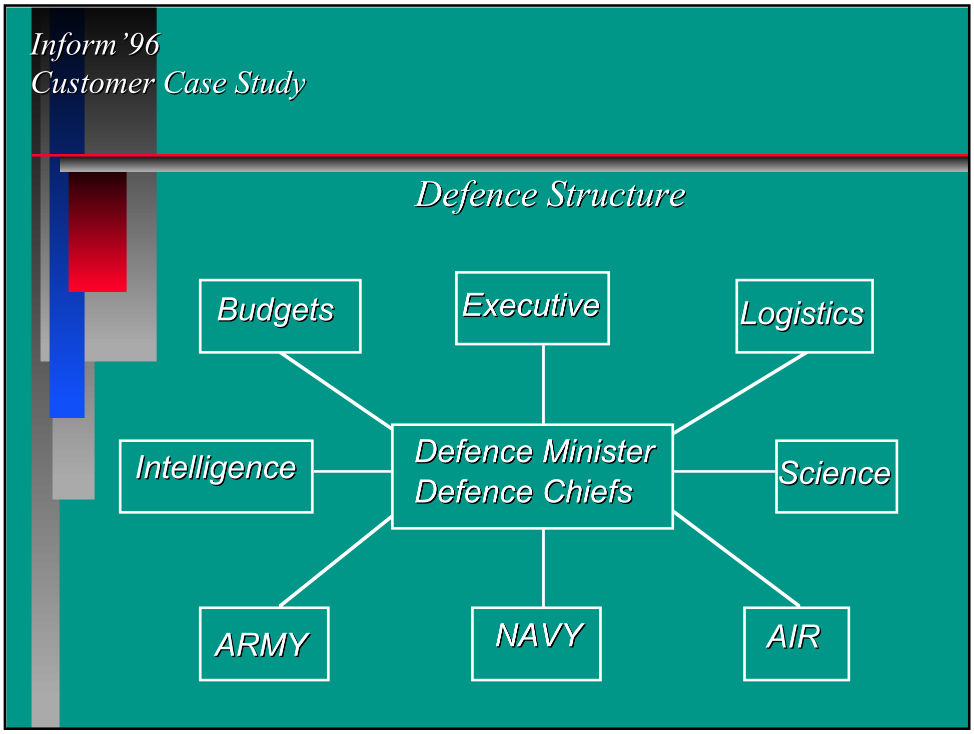
THE PEOPLE

There are several groups of dedicated people working together, building the integrated voice and data network in the Australian Defence environment. A number of them are at Inform '96 and can provide further information if that is desired:

Mr. Sam McManus and Mr. Craig Ross are from the Telstra Applied Technologies staff. Telstra is the main Telecommunications carrier in Australia. Craig and Sam represent the hard working group who implement the the Design ideas and turn the user requirements into working hardware and software.

Mr Brad Flux, from the Defence Material Division, manages the major network development implementations. Also from the Defence staff is Mr Graeme Pigram who works in the planning area. It the planners that we can thank for where we are today.

CAPT Mike Webster is also here. Mike joined our Defence Communications Group in January 1996 and is in charge of the operation of the Networks described in this presentation.



The Defence environment is built up around the requirements of these eight groups.

Army, Navy and Air Force are the three largest of the eight groups or programs. They can be characterised as being more security conscious and are pushing for closed networking.

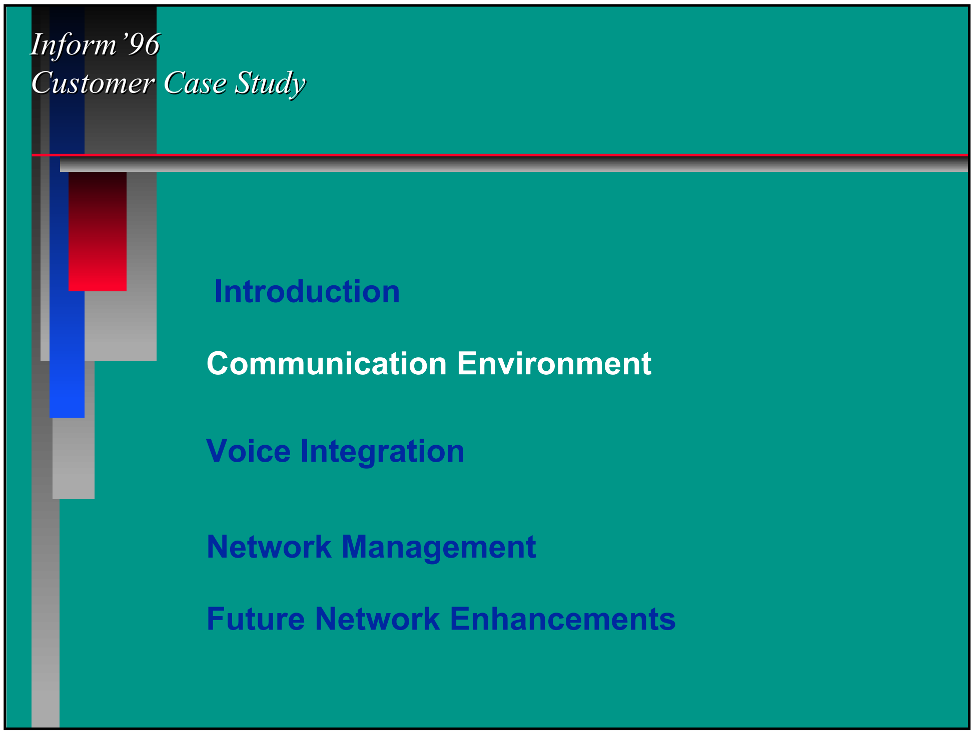
Science and Technology is a small group but tend to be the leaders in application of communications technology and want large bandwidth for multimedia applications. Access to the Internet is also important to the scientists.

The Acquisition and Logistics program is forcing the trend to open networking to allow electronic purchasing and billing.

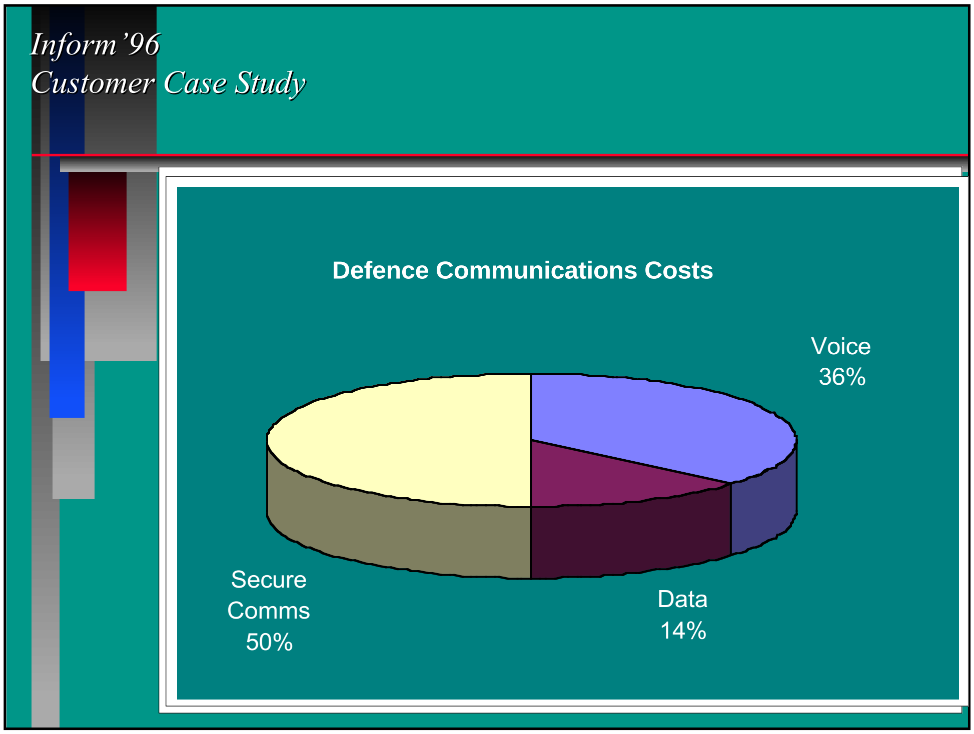
The Budgets and Management Program have been in the IT world for a long time and own most of our legacy networks. They run several large IBM mainframes and run hundreds of remote terminals across Australia. They are our prime SNA customer and they have contributed substantially to the early development of the data network.

The Intelligence community and the Forces Executive Programs have a keen interest in developing and maintaining secure communications.

Of course nearly all these customers require voice communications all day every day. Most own their voice switching equipment but only the Air Force use wide area networking of their Voice Network.

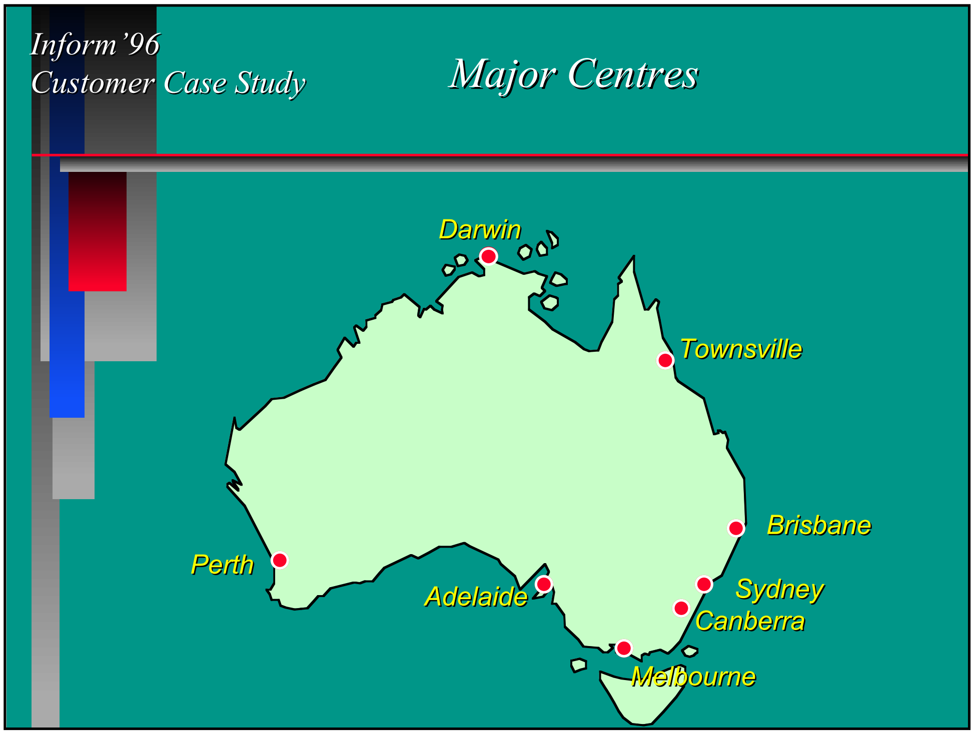


Having described the customers and characterised their requirements, let me briefly describe the Networks that are of interest to us today when considering voice and data integration.



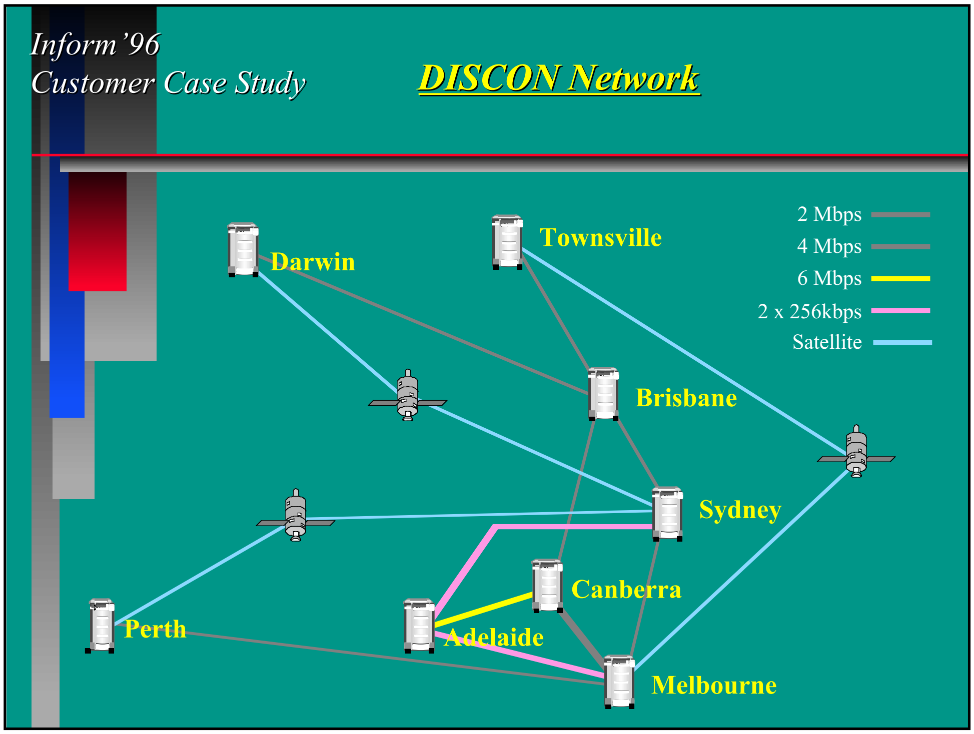
The total cost of the current networks is around $11m pa with an approximate breakdown:

Voice	$4.0m	(36%)
Data	$1.5m	(14%)
Secure Transmission	$5.5m	(50%)



Some words about distances that result in high line hire costs:

Perth to Sydney	3500 Km	2 Mbps	$270k pa
Adelaide to Darwin	2400 Km	2 Mbps	$250K pa
Sydney to Brisbane	900 Km	2 Mbps	$150K pa
Melbourne to Sydney	980 Km	2 Mbps	$150K pa
Brisbane to Townsville	1600 Km	2 Mbps	$180K pa



The Defence Integrated Secure COmmunications Network (DISCON) was conceived in the early 1970's planned and implemented during the 1980's and commissioned in the early 1990's.

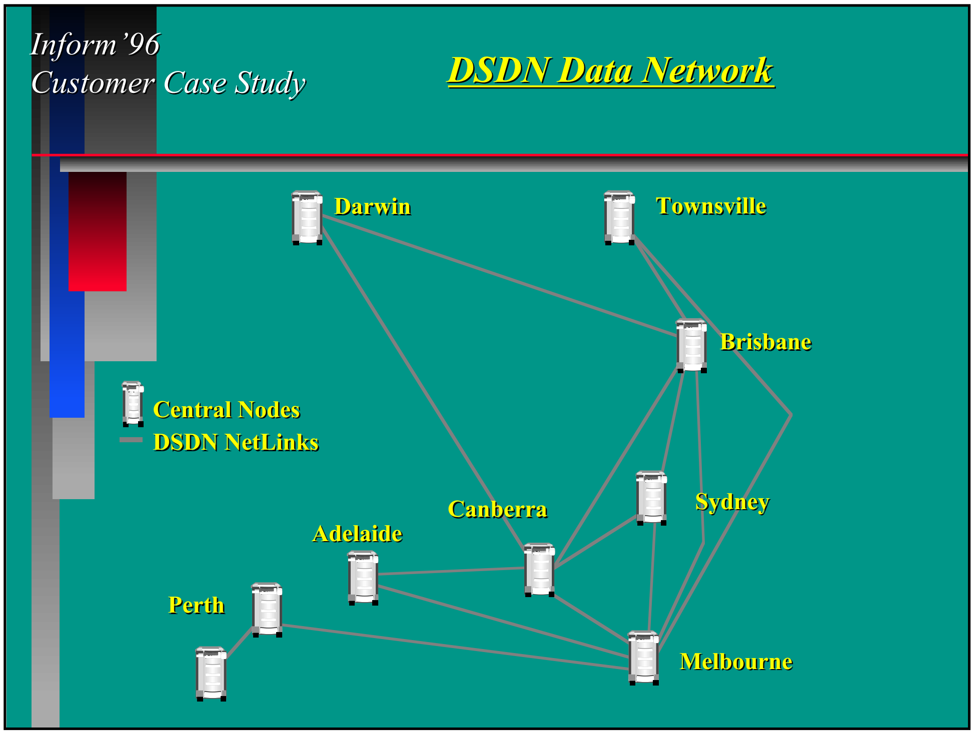
The Security in DISCON is obtained from high grade (Type 1) bit synchronous encrypters on every link.

The transmission is based on Time Division Multiplexers (Data Products 2048T E1 multiplexers) interconnected by 2 Mbps links. This slide depicts the core of the Network, there are many local TDM pairs connected to each major node shown on the slide. The architecture is thus a several stars connected together by this core network.

The data carried on this network serves about 350 secure voice (32K) customers almost as many Secure Facsimile customers and around 100 Secure Messaging (ACP127/128) Communications Centres. The Voice and Fax data is circuit switched at each major node. The Secure Messaging is store and forward switched at each major node.

There are also around 150 customers who use non-switched or nailed up point-to-point services through DISCON TDM services.

The physical layer for the DISCON network includes satellite which is proving to be an expensive backup network as more and more customers demand small delay WAN services. The primary bearers are provided by carriers.



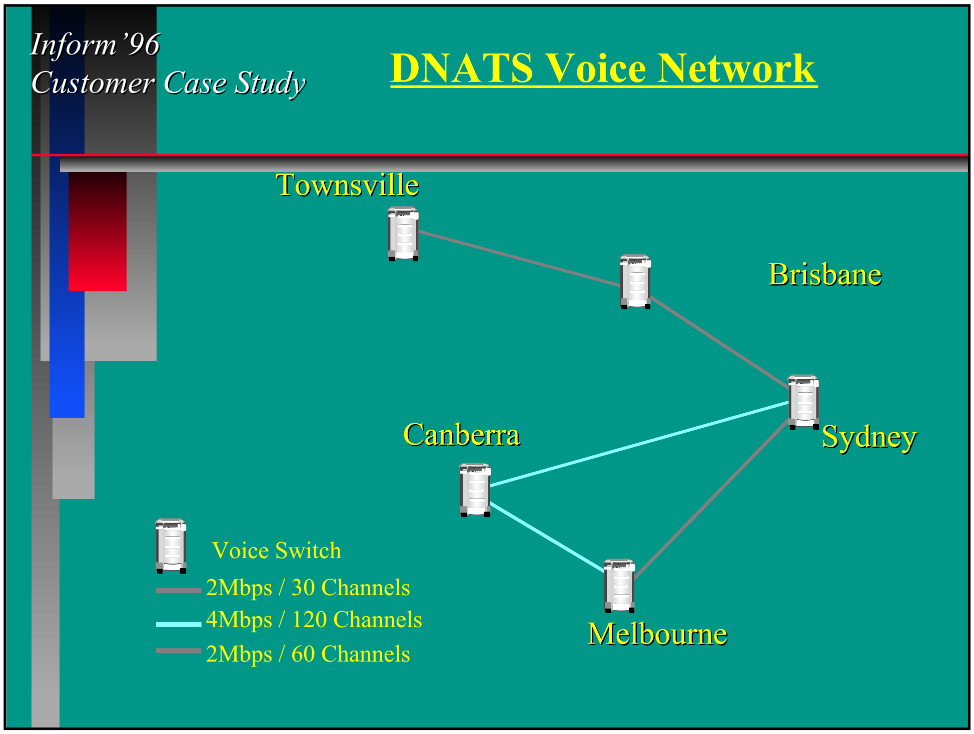
The Defence Switched Data Network was conceived by the dreamers in Defence as a platform to build a Defence-wide messaging network that would support X.400 and its military derivative ACP 123. With this WAN capability and messaging to the desktop we could move towards the planners dreams of a single terminal per desk in an "electronic office environment". Does this sound familiar?

We still don't have the electronic messaging in place and but have largely satisfied the Terminal-to-host customers (SNA and X.25) and are now rolling out IP and IPX routing services and can't keep up with this demand.

The resulting network is depicted in this slide. It is no accident that this core network mirrors the Network on the previous slide. DISCON provides the majority of the Wide area transmission for DSDN and major DSDN switch sites are collocated with the DISCON switches. As a result the true cost of the DSDN trunks is masked by DISCON.

DSDN uses the Nortel DPN-100 family of switches. As a user of the DISCON network, DSDN Bandwidth utilisation is far more efficient than the traditional TDM customer.

DSDN consists of two physically separate networks, one for lower security data and one for higher classification data. There are 4 RMs, 33 AMs, 20+ MAS's, and 100+ DPN-100/1s in the Lower classification NW. The Secure NW contains 3 RMs 2 100/3's and around 50 DPN-100/1s. DSDN is centrally managed by DCG at the Network Operations Centre in Canberra.

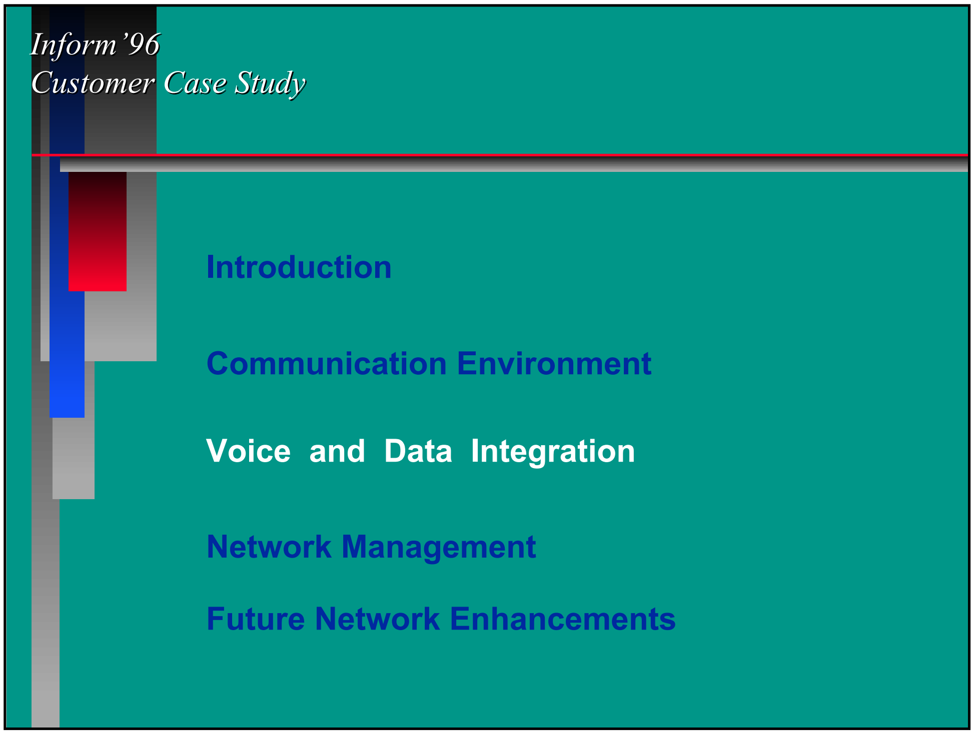


Just when the Defence Data people thought they were beginning to catch up Nortel released the Magellan Passport which opened up the possibility of integrating voice and data into the one network.

Defence Communications Group was formed to manage DISCON primarily and then DSDN and most recently voice. The Defence National Telephone System or DNATS was built up by another group in Defence using Scitec Maxima multiplexers. This slide depicts the core of the DNATS network and shows the bandwidth allocation.

The Voice switching is carried out by Fujitsu transit switches at the major nodes. There are problems with this arrangement as call setup is delayed as each transit switch reads in the full number of the called party.

There is some bandwidth efficiency with this network as the Scitec muxes use ADPCM and compress 60 channels onto one 2 Mbps link.



You can see from these networks that there is considerable scope for rationalisation of the voice and Data networks. Taking the sum of the DISCON and DNATS networks there is a substantial number of parallel megalinks that are not fully utilised. Rationalising these links alone has potential to save considerable bandwidth and money. But there is more; by utilising the Passport voice capability we can achieve greater savings by applying ADPCM (2:1 reduction same as the Scitec) and Speech Activity Detection (a further 2:1 reduction)

The potential to integrate voice and data was seen by the network planners and the first steps were taken in late 1994. The three major DNATS nodes in Melbourne Sydney and Brisbane were chosen as the initial sites for the Integrated Services Pilot Network (ISPN).

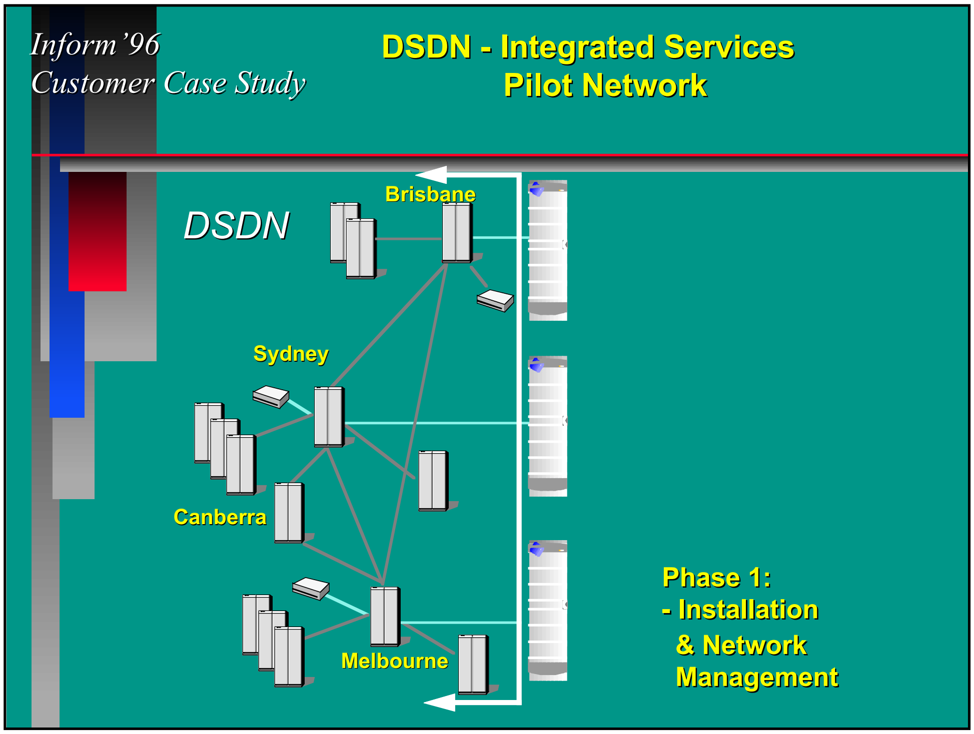
Passports were chosen because of their integration into the Nortel range of products already deployed in DSDN. Their management would be integrated into the NOC without too great an impact on training or manning.

As bandwidth managers, the Passports would allow the old DNATS trunks to be utilised for voice and data, thus releasing the data megalinks which can be cancelled to produce savings or used for expansion of the network with minimum additional cost..

To minimise the risk to voice customers, the Sydney to Melbourne and Sydney to Brisbane links were chosen as there were alternate paths through Canberra in the DNATS network and it was possible to divert traffic via Canberra while the cutover of trunks was carried out. Excess traffic could also hop off and use the Public Network.

Introducing Passport proved to be politically sensitive as several vendors believed they could perform better than Passport.

The implementation of the ISPN was in three Phases, this next slide shows phase 1.

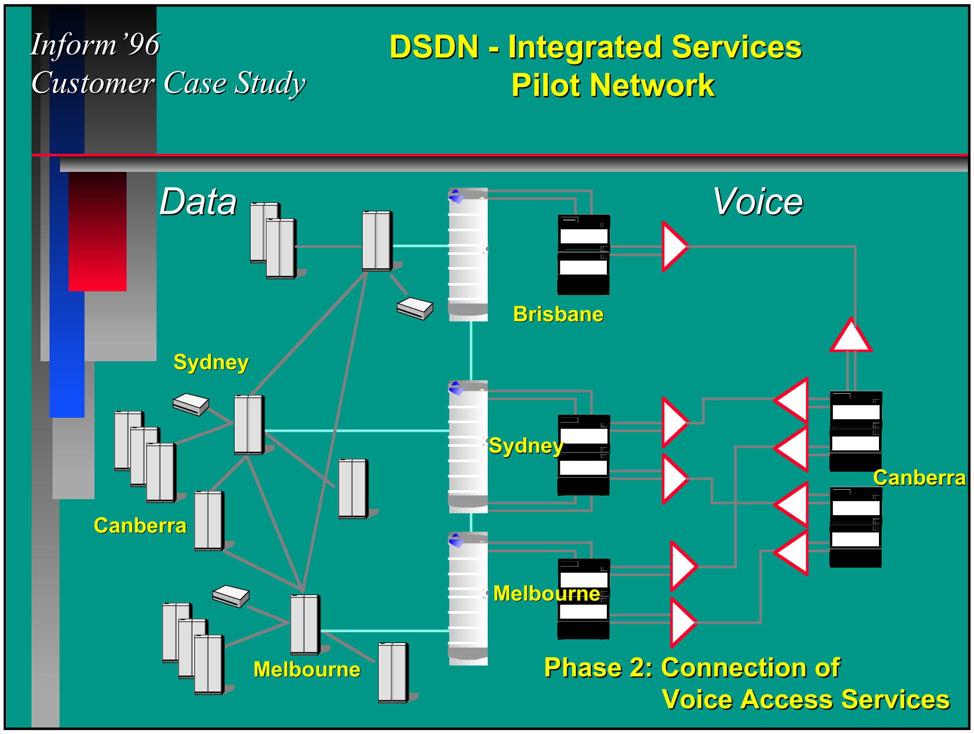


Everything to the left of the arrows is existing DSDN infrastructure. Phase 1 was to install three Passport model 160 switches in Sydney, Brisbane and Melbourne. These switches were to be connected to the DSDN and managed by the Network Operations Centre.

Preparation for this phase included an early upgrade to G.34 on the DPN-100 equipment and training of the Network Operations Centre personnel on Passport.

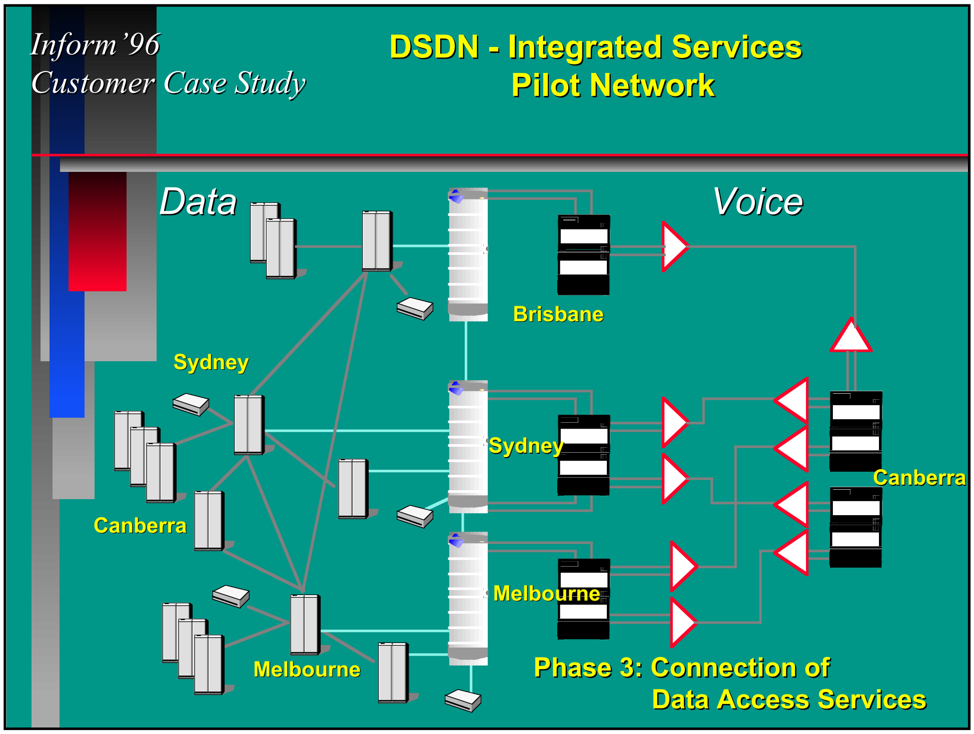
Call Setup Resource Module (CSRM) arrangements for the DPN-100 data through the Passports had to be considered. The Passports were collocated with the voice switches not the DPN-100 RMs, so there were considerations of bandwidth costs.

Clocking for the Voice also proved to be an important consideration.



Phase 2 was the cutover of voice services onto the Passports. This slide shows the small section of DNATS affected by the ISPN and the interconnectivity between the two networks. DSDN Data Network is to the left and the DNATS voice network is to the right.

During this second phase the DSDN Network Operations Centre (NOC) staff were able to gain some experience with the Passport voice management. A period of approximately one month was allowed for monitoring performance before and after the introduction of the Melbourne to Sydney link. The NOC staff were able to monitor the trunk utilisation and provide statistics for the period. Voice quality was also monitored somewhat subjectively (a point of frustration for those used to being able to measure performance with test instruments). Calls placed by a small group of customers were judged by those customers to be satisfactory and whether any change in quality was noticed. In addition a specific but limited test after the introduction of the Passports was arranged between two users to determine the intelligibility of carefully selected isolated words. This test emphasised the difference between 32K ADPCM and 64K PCM rather than finding anything startlingly wrong with the Passports. It should be noted the voice circuit carrying the calls was also fully loaded with frame relay data. The tests concluded the voice was acceptable over a single hop and the next phase of the project commenced.

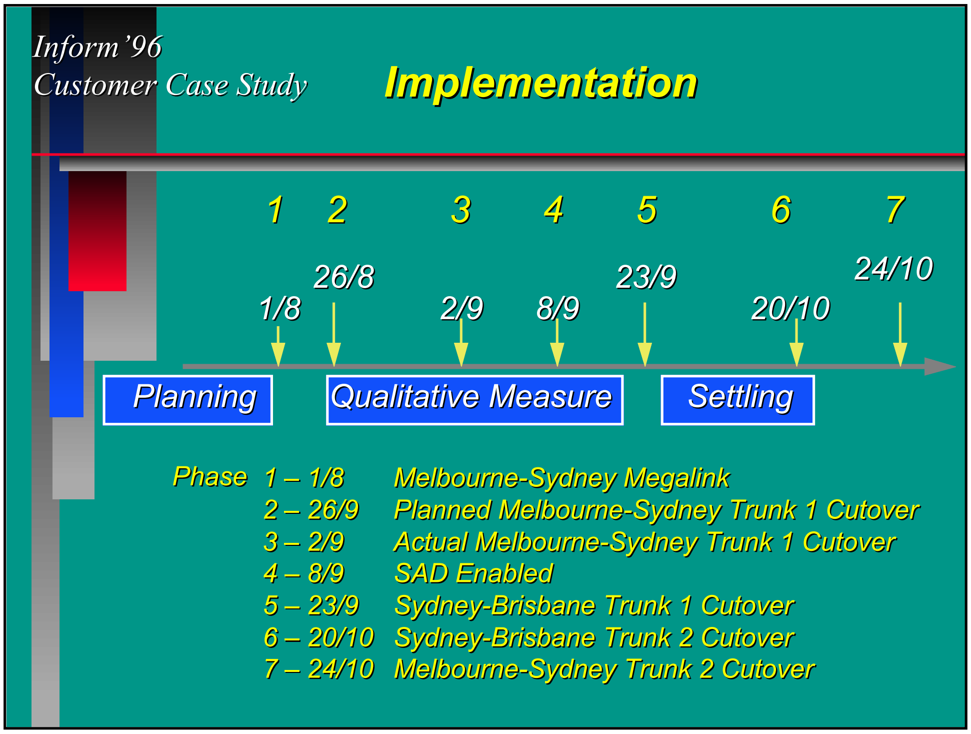


Having satisfied the voice customers that their service was unchanged, data was added to the the network along with the voice. Additional connections were made for DPN-100 and router traffic.

As shown here, Sydney and Melbourne DPN-100 switches and routers were the first data service connections. As mentioned earlier the DNATS voice links between capital cities is using at least 12 megalinks. DSDN is allocated 8x256K links over the DISCON network in the same regions as DNATS.

Transmission savings are being used to grow the backbone and netlink capacities to cater to continual expansions and to prepare for the rapid increases in our customer base.

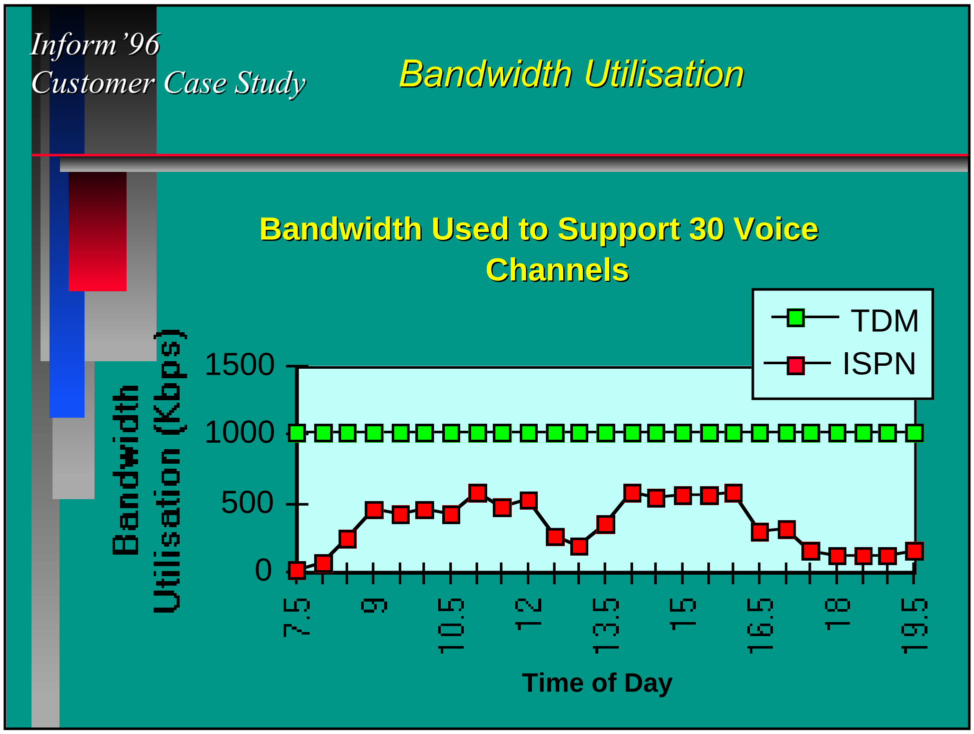
Some brief words about the project schedule may be of interest.



Obviously there was a substantial amount of planning carried out before any work was approved. This project, like any other, required co-operation between all the parties involved in order to make progress on the very flexible schedule. Like most other implementations there were slippages, although some of these could not possibly have been anticipated.

The three switches were installed before July 95. The megalink, between Melbourne and Sydney was scheduled for completion in mid July, however was delayed until mid August at the Melbourne end, due to all the construction activity. The first trunk cutover (completed out of hours) was planned for the 26/8, however, the Thursday before the cutover, the basement where the Melbourne Passport was located, had flooded and the cutover was delayed. Successful cutover of the first trunk was achieved the following Saturday 2/9. The Passports use ADPCM for voice compression and this was enabled at 32K. A week later Speech Activity Detection was enabled, providing **ON AVERAGE** a further 50% of bandwidth saving.

While this work was being carried out, the sample of users I mentioned earlier, were making calls and completing a qualitative analysis of the performance of the service being offered. This was done without the users being made aware of the changes being made. The results indicated there was no noticeable reduction in the quality of services being offered at any stage of the implementation. Following acceptance of the Melbourne to Sydney cutover, the first of the Sydney to Brisbane trunks was cutover on the 23/9. A settling period was agreed with DCG and the second Sydney to Brisbane trunk was cutover on the 20/10 and the second Melbourne to Sydney trunk the 24/10.



A brief look at some figures on bandwidth utilization.

The red graph (labelled ISPN) is a fairly standard voice traffic profile. Overnight utilisation low, peaks during mid morning, the reduction in activity over lunch, peaks again over the afternoon and some final activity just before the end of the working day. This graph is the actual traffic profile for the 11th September 1995.

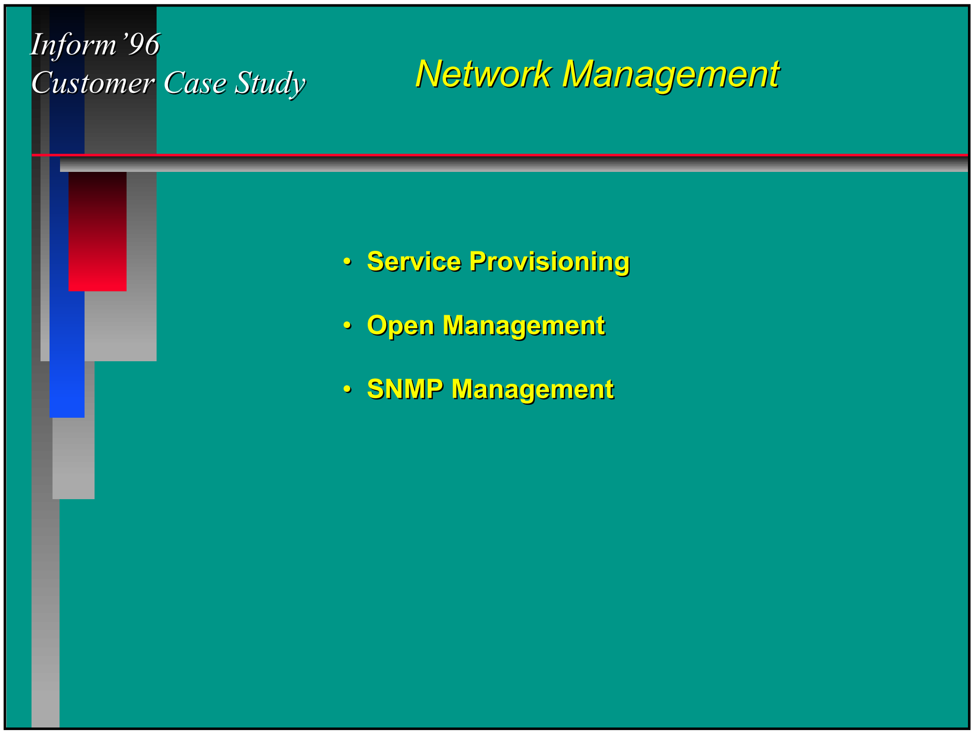
In the TDM environment (with compression at 32k) the same requirement would utilise one meg of bandwidth. With this implementation and Speech Activity Detection enabled, bandwidth is now available for other services.

Some brief words about Network Management before I finish up with a wish list for the future.

The Network Operations Centre (NOC) provides support for Customer Fault reporting, Network monitoring and Statistics for Service Level Agreements, some Security Management (key management of DES encrypters), Address Management for IP and IPX customers, Management of Names servers for IP (DNS) and some limited testing with customers using NexusTrace.

The NOC people are Army, Navy and Air Force technical personnel many of whom have never been involved in data communications. The NOC presents them with a substantial technology shock and subjects them to a very steep learning curve. Training is a constant requirement to bring these individuals to a reasonable level of effectiveness. Being military personnel they have limited tenure so we lose them after two to three years. The NOC does not have long stay experts and the highly technical nature of the data communications and the sophistication of the tools available creates a demanding environment.

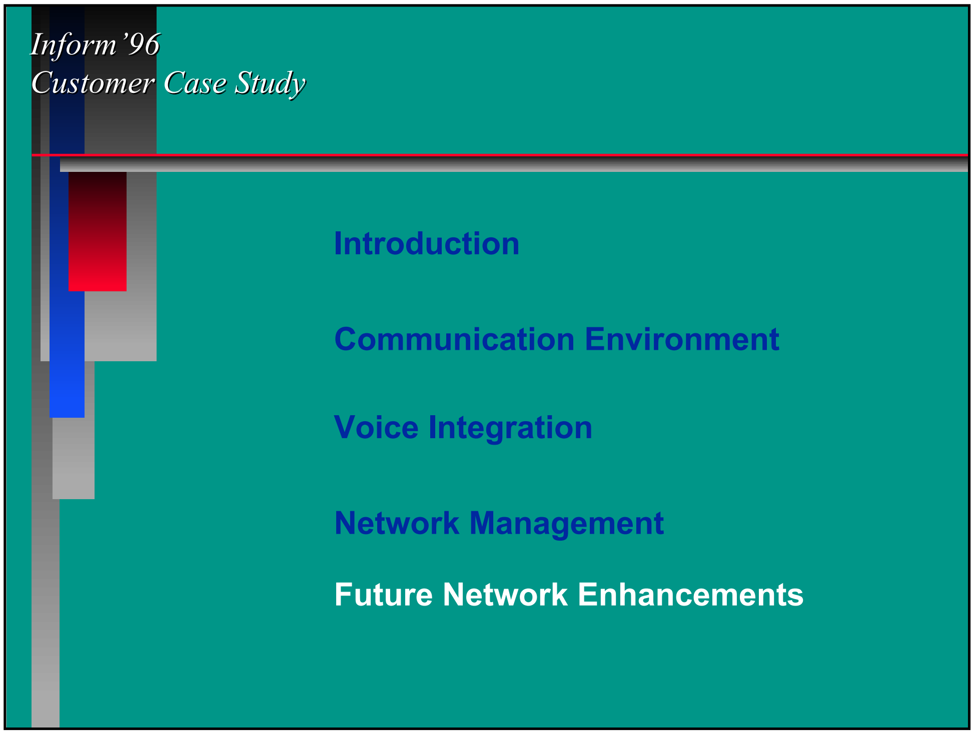
With the introduction of voice into this environment there is another suite of skills required by the NOC and support personnel. The integration of Passport into the NMS is useful but there are some problems with knowledge of how to use the facilities. Training has been completed but skill levels are still low. We are still struggling with the statistics needed for voice and how to present them.



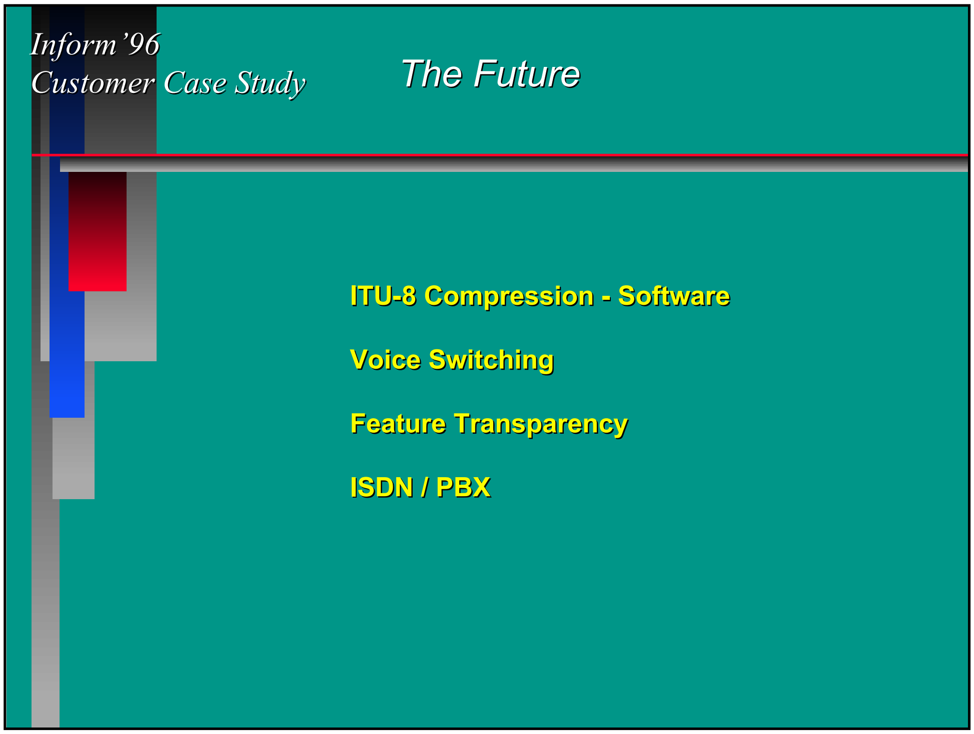
What is needed is a software manager of the network managers. This leads to open management platforms and the promise of SNMP. Currently, the NOC runs Cabletron SPECTRUM to manage the router network (60+ Cisco routers), skill with this sophisticated platform is a limiting factor and only a fraction of its performance capability is utilised. A combination of the Nortel NMS and SPECTRUM capabilities are used. Currently, only NMS is available to manage the Passports and nothing is available behind that to manage the Voice switches when that becomes an issue.

The ability to monitor and report on the voice network centrally is a huge advance for us, and the promise of new features holds tremendous promise for the very near future of integrated voice and data.

The voice switches vary in their capability to be networked and the possibility for remote management. There is a mixture of PBX manufacturers and signalling standards to contend with not to mention the voice community who see their domain being invaded.



Voice and data integration has enabled the Australian Department of Defence to keep pace with a very rapid growth rate without change to the cost of running the networks. This presentation has described a small portion of the network required to absorb all our voice and data. As recognition grows of the advantages of a centrally coordinated approach to a multimedia network, demand will outstrip the current bandwidth and further techniques for bandwidth savings will be needed.

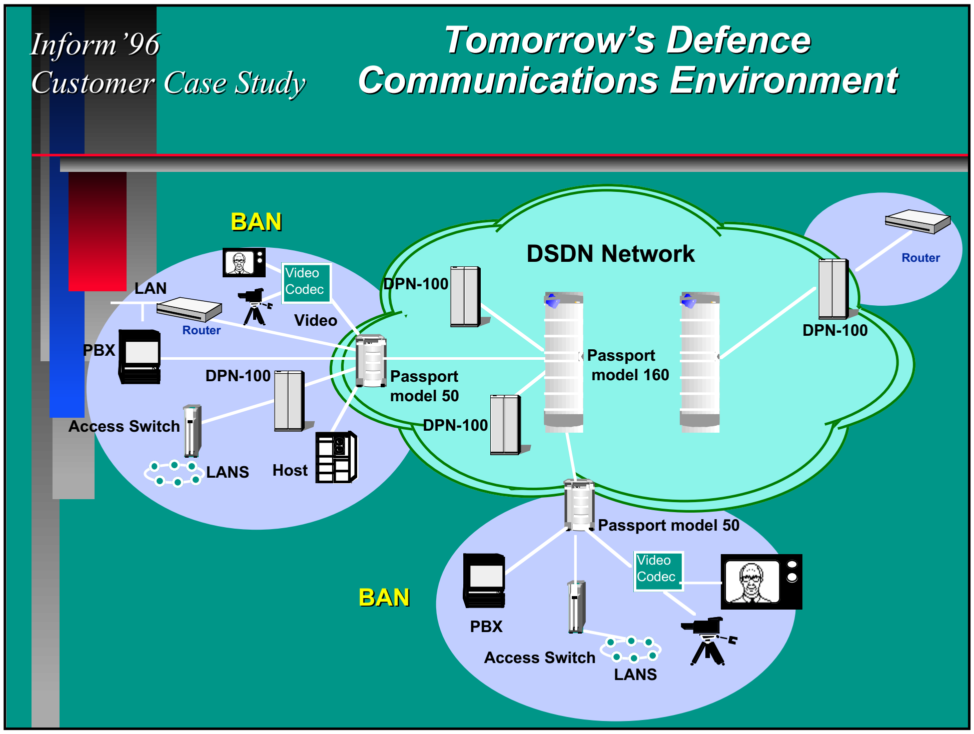


ITU-8 compression holds promise of another 4:1 reduction in bandwidth over 32K ADPCM, we applaud this and will be keen to introduce it when available.

We currently have problems with the Passport acting as a point to point conduit for voice. While there is the possibility of logically connecting Voice switches via the Passport cloud (have more than two Passports between PBX switches), it is not yet possible to switch the voice within the Passport cloud. Introduction of this capability is crucial to our ability to service our potential customer base. We are keen to trial this capability as soon as it becomes available.

Coupled with this is the need for feature transparency to enable the sophisticated services offered on one Defence Base to be passed through the Passport network to a distant Base. Feature transparency is important to us as it will enable a voice cloud to exist across the Passport network and will help break down resistance from those who control the current voice feifdoms.

Many of our PBXs have ISDN capability and the ability to connect these switches through the Passports via their ISDN ports would also be valuable.



Where to from here?

We have X.25, SNA, IP, IPX, Frame Relay, Packet encryption and now voice across the DSDN.

Voice has some growing to do as just discussed and will initially be the major bandwidth user. However, the trend with voice encoding is for voice bandwidth to reduce as the network is grown, so the overall effect is probably for voice bandwidth to remain static.

On the other hand, our Defence customers are just now introducing Base Area Networks with 100 Mbps+ Fibre Backbones. Their connection requirements into the DSDN WAN are modest at the moment (2 x 256K). As they get used to Email and discover video, we expect substantial growth in the demand for data bandwidth.

We are preparing for the immediate growth by combining the voice and data networks using our existing 2 Mbps trunks. This process will be enhanced substantially if we can migrate our bit synchronous encrypters onto the Passports. By reducing the secure bandwidth requirements to a minimum and feeding them through the Passports we can use the existing DISCON 2 Mbps links to expand the Passport network.

We do not charge our customers for bandwidth so there is no constraint to unlimited growth. I don't see free bandwidth being a long term policy, it has been needed to attract customers.

The Passports can support the next two speed increases 34Mbps and 155mbps. Beyond that, it is difficult to tell.

Inform'96
Customer Case Study

Questions