THE AUSSIE EXCHANGE STORY

Telephone exchange (Switch or "Central Office" in USA Speak) technology in Australia can be classified in six distinct historical categories;

1.) Manual – Stretching from the first magneto exchange opened in Melbourne on 12th May 1880, through to the installation of the first automatic exchange in Geelong (Vic) in 1912.
2.) Strowger Step by Step Automatic – Stretching from 1912 to the installation of the first 2000 type automatic exchange in North Sydney (NSW) in 1938.
3.) 2000 and SE50 Step by Step Automatic – Stretching from 1938 to the installation of the first LME Crossbar exchange in Toowoomba (Vic) in 1961.
4.) The Crossbar Era – Stretching from 1961 to 1982 with the installation of the first LME AXE Digital Exchange.
5.) The CCS7 Digital Era – From 1982 to about 2010.
6.) The NBN (National broadband Network) – from 2010 to today.

Analog Telephone Switching Worldwide

You may have often heard it said that World War 2 was a catalyst to advance technology. With radio and television – perhaps. In the world of telephone switching?– nothing could be further from the truth! When World War 2 broke out in 1939, many technologies that form the backbone of our electronics today were in their experimental infancy. The most significant was undoubtedly the FET transistor - the forerunner to MOS technology, which is at the core of every electronic gadget we have available today.

The FET transistor was first demonstrated in the laboratory in 1928. When World War 2 came along, the war effort on all sides demanded instant results. There was no time to experiment with laboratory theories! Engineers therefore worked with what was available at the time. This was electro mechanical technology. The emerging sciences then sat ignored until the 1950s.

During and after World War 2, engineers pushed the old analog technology to it's absolute limits. Beyond anything it should ever have been expected to do. It took 20 years for science to catch up again. The result was a litany of enormous, mind boggling analog telephone switching networks that grew throughout the '50s, 60s and in to the '70s. Many of these remained in service until the late '90s. The Australian Ste by Step (SxS) and Crossbar experience is a classic example.

Australian Telephone Networks

Australian telephone networks differ greatly from others around the world. This was due to the way our networks grew in the very early manual days. Back then, development funds were extremely limited and distances were vast. The very young age of our cities and rapid growth in relation to other major capitals around the world also had a major impact.

Transferred to the Automatic era, this resulted in Australia's metropolitan networks having a far larger number of smaller exchange areas than was common overseas. Typical auto exchanges in the US and UK consisted of large machines serving 30 to 40 thousand lines per exchange. In Australia it was common for the same size area to be served by a network of seven or eight exchanges each with around four to five thousand lines each. This kept line costs down. However it dramatically increased complexity of our networks (particularly junctions between exchanges). As a result, a lot of local technical innovation and engineering took place to get overseas designed equipment to work properly in our Australian networks.

"Electromechanical" telephone switching predates the development and use of the transistor semiconductor in the 1960s. Logic functions were carried out by use of large numbers of magnetic relays, mechanical interlocks and time delays. The technology was made to do things that were extremely difficult or often thought impossible to do at the time. This is one of the most outstanding aspects of electromechanical telephone switching. Because of it's ubiquity both in Australia and around the world it remained in service for up to 20 years - well after more advanced and efficient technologies became available. In the '90s, replacing and getting rid of it became almost as big a challenge as putting it there in the first place.

Two complete generations of electronic engineers – some of our most brilliant minds and hands in Engineering in the modern era – cut their teeth working with this electromechanical technology. Automatic telephony took several forms in the late 19th Century. The American system originally invented by Allan B. Strowger had taken hold by the early 20th Century as the preferred system worldwide. The "Step by Step" system had as it's central component a dial operated bi motional mechanical switch controlled by two electromagnets which stepped and rotated a series of wipers across a bank of contacts. This allowed subscribers to select a telephone line directly instead of requiring the assistance of a human operator.

The first such system in Australia was produced by AEC in Chicago and installed in Geelong Victoria in 1912. By 1920 this technology had been refined in to a system generally referred to as "Strowger" - although this term is incorrect since suppliers were numerous and had little to do with the original inventor. In Australia "Strowger" became known as "Pre 2000 Step".

There are no examples remaining in existence except for small demonstration exchanges (consisting of single, small racks) in private collections. These are considered valuable items amongst telephone collectors. The last Pre 2000 exchange in Australia was replaced in 1978. Tragically, a Pre 2000 step exchange initially "preserved" in Drummoyne (Sydney) in the '80s was later destroyed because the heritage order neglected to include the building contents!

At North Sydney in 1938 the APO trialled a new redesign of the Strowger system developed in the UK. This used construction methods and designs refined over the war years to produce a reliable, smaller and standardised exchange system which became known as the "2000" type. This new Step equipment was initially all supplied from overseas.

After the war, it became important to ensure that equipment could be made locally so as to guarantee supply. A redesign ensued to create the first completely Australian telephone exchange switch – the SE50. Throughout the 1950s this exchange type was then manufactured locally by Plessey (Sydney) and TEI (Melbourne). Interestingly enough the author has also uncovered evidence which suggests the Aussie SE50 selector was actually also exported back to the UK – with the design even being manufactured by UK makers and then sold back in to Australia by GEC.

The Step networks along with Australia's cities and towns quadrupled in size over this time – All the new 2000 and SE50 equipment only met new growth. Older equipment still remained in service. The SE50 was compatible with the 2000 switch in such a way that a mix of both present in the same exchange posed few engineering problems.

The 2000 / SE50 era resulted in a huge amount of local initiative and engineering input in order to get Step technology to work in our Australian networks. Because of the topology legacy left from our manual era, it was common in our cities for even local calls to traverse up to five exchanges before finally reaching their destination. Overseas, less than three would be used over the same distance – with the vast majority being handled within a single machine. A great deal of engineering effort was put into making dial pulse repeaters and complex tandem networks work reliably - especially in Sydney.

Unlike our other cities, Brisbane adopted a different Step system - the Siemens S16. This was electrically incompatible with both the earlier Strowger and later 2000 types. As a result several exchanges in the Brisbane network were allowed to grow in S16 until 1960. Brisbane is unique in this regard. Albion exchange (in Brisbane) retains a working model example of S16 Step equipment.

Port Kembla (old) exchange in NSW (which contains both 2000 and SE50 equipment) is the only known remaining example of a complete Step exchange left in Australia. Even this is a hybrid. It was modified in the '60s with a Crossbar 1st selector stage. It's future is currently uncertain. An interim heritage order was raised in 2008 by NSW Heritage (for the contents this time!). The exchange has also been earmarked by the Telstra Museum for possible preservation however it is unlikely that it will be happen at it's current location.

In 1959 the Australian Government commissioned the ANSO report(Automatic Network and Switching Objectives) which resulted in the Community Telephone Plan for Australia in 1960. By this time, outer areas of our cities (which had previously been classified as trunk calls) were becoming suburbs. Until this time, calls between these areas were still time charged. This was placing an enormous burden on the trunk telephone network. Keeping track of millions of short distance timed calls was a pain in a pre computer world of hand written dockets and punched cards!

The ANSO plan involved converting many large outer lying suburbs of the cities to "unit call fee" (i.e. local call) status. This in turn was seen as a way of dramatically improving service in these areas and at the same time reducing stress on the existing trunk exchanges. Part of this plan also included introduction of seven digit numbering

to most of the Capital cities. The complexities of this would be well beyond the ability of the existing Step technology in place at the time.

As a result a new standard exchange system was adopted – the Ericsson Crossbar system. This differed from Step in that calls were set up using registers instead of directly by the caller's dial. The registers and markers were essentially computers built using electromechanical technology. This separated the numbering scheme from the tandem and junction networks. It meant that the route used through the network could be changed depending on traffic in the network – without changing the actual telephone number dialed by the customer.

A great deal of local and overseas engineering work took place in the 1960s to enable Step and Crossbar systems to work alongside each other. Programs were implemented to convert existing step exchanges to Crossbar register control (known as "SR/B" switching). Design of Crossbar GV (Tandem) stages which had enough availability to switch the enormous amount of junction traffic in our city networks was another headache. Again this was necessary because of the larger number of smaller exchanges in our cities compared with overseas.

The network grew in Crossbar to over one million ends during the 1970s. By this time the pre 2000 "Strowger" equipment still in service was at the end of it's working life. It was eventually replaced however the 2000 and SE50 exchanges remained. In the late 1970s most of metropolitan Crossbar exchanges were upgraded as part of the REMO (REgister MOdernisation) program. This involved replacing some of the most complex (and most troublesome) electromechanical computing equipment with electronic computer based technology.

The result was the "ARE" exchange. This bastardized beast (amongst other things) allowed such features as Calling Line Identification. In turn this opened the way to full STD and ISD (National and International) direct dialing. Now customers could be billed for each timed call separately without intervention of an operator and there would be no more mysteriously huge phone bills with no description as to what calls went where.

In 1982, the first fully electronic exchanges (AXE) were deployed into the network. These were soon meeting all new growth by the '90s. The point of difference with this technology was that the setting of the voice path through the network was now completely separate to the voice path itself. The new control network known as CCS7 (Common Signalling Scheme No. 7) meant that the intelligence in the network no longer had to be co located with the switches doing the actual work. This essentially meant that in our Australian networks, even though we have lots of small exchanges, these could now essentially be treated as just a few large ones (just like overseas) with smaller bits (called an RSS or "Remote Subscriber Stage) placed in all the local exchanges themselves. The curse of the complicated Aussie phone network had finally been broken.

The new electronic equipment used much less building space and was far more efficient than the electromechanical designs. By the late '80s, the digital AXE network had virtually replaced the analog Crossbar and SxS inter exchange junction networks. This left the older local analog machines completely isolated from the

others, in effect acting as “line concentrators”. All the inter exchange “heavy lifting” was now done by the more modern CCS7 systems.

In the early 1990s the remaining and now life expired 2000 and SE50 Step equipment was finally cutover to AXE. Shortly afterwards a massive program (known as FMO or “Future Mode of Operation) commenced to replace the huge stock of groaning and ageing Crossbar equipment with a newer system from Siemens called the S12. This allowed work methods (and employees) associated with maintaining the electromechanical gear to be retired without adversely affecting network reliability.

In the 1990s, Mobile networks also began to take a foothold. Today, more than 60% of total voice telephone traffic in Australia is switched either into or out of the three mobile networks currently owned by Telstra, Optus and Vodaphone. An early digital service (known as ISDN) has been superseded by ADSL technology, which uses existing telephone infrastructure to provide near Broadband data speeds on existing telephone lines. Much of the ADSL equipment occupies space in exchange buildings previously made vacant by removing earlier Step or Crossbar. A growing proportion of this equipment is owned by private companies who lease the space from Telstra.

With the NBN (National Broadband Network) announced in 2010, the existing AXE and S12 networks (now approaching 20 years old) will now be replaced by new Broadband Fibre networks. These VOIP (Voice over Internet Protocol) networks will extend the digital junction network first to pillars and cabinets on street corners, then all the way to customers. The traditional copper telephone line will finally vanish. Replacement of a network which began with the first manual exchanges in the 19th century will finally be complete.

This new network will render most metropolitan exchange buildings redundant altogether. It will greatly increase the data rates available to customers and allow “micro cells” to serve very high capacity mobile services. By 2015 it is expected that over 90% of voice telephone traffic will be switched within mobile or VOIP Internet networks.

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2014.