ROHILL

Whitepaper

**Softswitch technology**

TetraNode

Abstract

Softswitch technology has shown rapid growth during the last years. Softswitch based PABXs have been introduced by all major telecommunication equipment manufacturers, and are steadily replacing the traditional, hierarchical type of PABXs. The integration with Computer Telephony and Voice-over-IP functionality are just a few of the new possibilities, which are difficult to achieve without the concept of softswitching. Growth of softswitch applications has been accelerated further by the availability of Commercial Off The Shelve (COTS) hardware and software platforms.

Softswitch technology can also be applied to TETRA infrastructure solutions. This article describes the benefits of TETRA solutions on basis of softswitching. Because of the TETRA specific signalling requirements, the use of softswitching creates even more advantages compared to PABX applications in which softswitching is now commonly used.

History of switching

Telephony is now in existence for more than 100 year. The first 30 years switchboards (patch panels) were used to manually interconnect subscribers. During the 1920s, the stepping relay was invented, which made it possible to interconnect subscribers automatically. From the 1970s, computer controlled switches were introduced, first using In band Signalling (MFC, SS6), later replaced by Out of band Signalling (SS7). SS7 systems are currently the backbone of international telephony, which provides a highly reliable and scalable solution for speech communication, although the equipment and operating costs are very high.
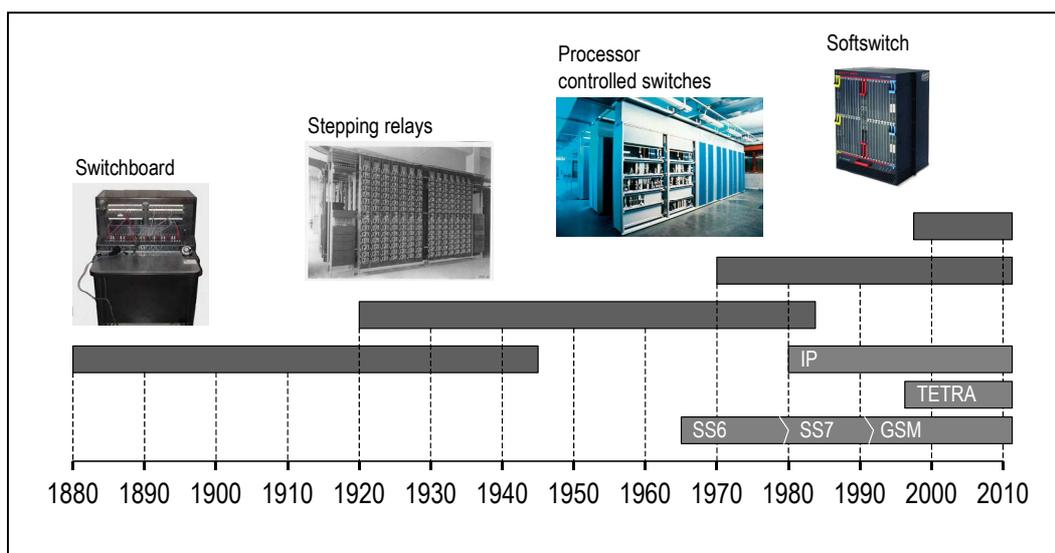
Timeline of switching technologies

During the late 90s, the performance of a single CPU became sufficient to run a large number of different tasks for a large number of subscribers at the same time. The concept of using a large number of processor boards to build a strict hierarchical system was not necessary anymore. Also the fast growth of the use of IP networks to carry voice has spurred the development of software based switches.

Because the first generation of TETRA systems just appeared before the introduction of softswitch technology, all of the early TETRA infrastructure solutions are using circuit-switch based technology, and cannot benefit from the advantages of softswitching. These systems are also based on proprietary hardware and software solutions, which increases the dependency on the supplier for future maintenance and system migration.

COTS hardware platforms

The use of Commercial Off The Shelve (COTS) components is probably the most important driver for the success of softswitch technology. The benefits of COTS were first recognized by the military, which were accustomed to high cost proprietary solutions. COTS platforms are now also in use for commercial and industrial applications.

COTS products are components or modules that are not developed according the requirements of a single customer. The same COTS platform can thus be used for a variety of applications. COTS products are mostly based on industry standards, such as the PC platform and CompactPCI. Such COTS systems can be used for a variety of applications, including IT servers, PABX, Voice-over-IP and 3G telephony switches.

The benefits of using COTS hardware platforms include:

- Similar hardware is available from multiple vendors, reducing the risk for component obsolescence
- Reduced cost due to the economy of scale of production
- Suppliers of COTS hardware provide better support including the implementation of drivers for popular operating systems, documentation and evaluation kits
- No need to invest in hardware development
- Longer lifetime of the investment due to the ongoing migration of COTS processor boards to higher processor speeds and increased functionality

COTS software platforms

The same trend of following industry standards is seen in the software industry. Proprietary operating systems are rapidly replaced by COTS operating systems such as Windows NT and Linux.

Today, Linux offers excellent real-time capabilities, making it the best choice for obtaining softswitch solutions. Although Windows is more widespread and engineers are easier to find to produce softswitch applications, Linux is more suitable for the task. Also Linux is a real open operating system and it is IP-centric and thus most suitable to obtain IP solutions.

Linux also received a large number of strategic design wins within telecom manufacturers including Nokia, Alcatel and Siemens, and it is preferred by many governments including Germany, France, Russia, China and South Korea.

Pure softswitch technology

Most traditional switches are based on circuit switch technology and use a hierarchical topology to improve scalability. Many different CPU boards are needed to fulfil the requirements for reliability through resilience and redundancy. Every CPU has its own task within the hierarchy. Especially the centralized switches require a high switching capacity, which makes load-sharing between different CPU boards necessary. Because of this, traditional switches often consist of more than 10 processor boards in their smallest configuration.

Starting from the mid 90s, softswitching began to appear with COTS platforms based on telephony buses such as MVIP and H.100. Basically, the architecture is similar to traditional switches; only the proprietary hardware is replaced by standards-based boards such as ISA, PCI and CompactPCI boards. Specialized companies started to develop boards to interface with ATM and IP networks. This allowed migration from circuit switch technology to packet switch technology. Redundancy and resilience is provided for by adding redundant nodes and using distributed databases, while scalability is achieved by networking nodes using a flat networking topology.

Because of the Gigahertz speeds of today's CPUs, it is now possible to build a pure softswitch solution. Instead of using telephony buses and PCM highways to perform the packet and circuit switching in hardware, all switching and routing is performed in software. Because of using less hardware, system complexity is further reduced, the reliability is improved and the flexibility is increased. However, to keep the speech delay to acceptable levels, it is essential to use real-time operating systems such Linux with its real-time extensions.

Seamless integration with IP networks is one of the key advantages of pure softswitching. Because the speech stream is already processed by software, it is relatively easy to route the speech stream to the IP stack, which is available in all modern COTS operating systems.

Importance of pure softswitch technology to the TETRA marketplace

Pure softswitch technology is an excellent basis for building TETRA systems. All of the signalling and speech data need to be pre-processed before switching due to design of the TETRA protocol stack. Examples of processing requirements include air interface encryption, traffic channel stealing and support of end-to-end encryption. Because of this, TETRA can benefit even more from pure softswitch architectures than PABX solutions.

Some key advantages that we experienced include:

- Simple hardware architecture: the minimal use of hardware improves the system reliability and makes it easier to install, configure and maintain the system

- All functionality is provided for in software. This makes pure softswitching a very flexible solution, not limiting implementation of new functionalities and thus eliminating any hardware migration needs.

- All protocol stack layers run on a single processor environment. This has simplified the implementation of advanced TETRA functionality, such as packet data and Class 3 (DCK) encryption considerably.

- Fast call setup. The absence of inter-processor links speeds up the processing of calls because all bottlenecks are removed.

- More than adequate capacity. One single high-performance CPU can serve over 16 TETRA carriers. Further scalability is achieved by networking nodes together.

- Multi air-interface support, such as simultaneous support of TETRA and legacy MPT standards, is easier to achieve

- Simplified integration of IP. As discussed before, pure softswitching provides integration with IP networks by adding software only.

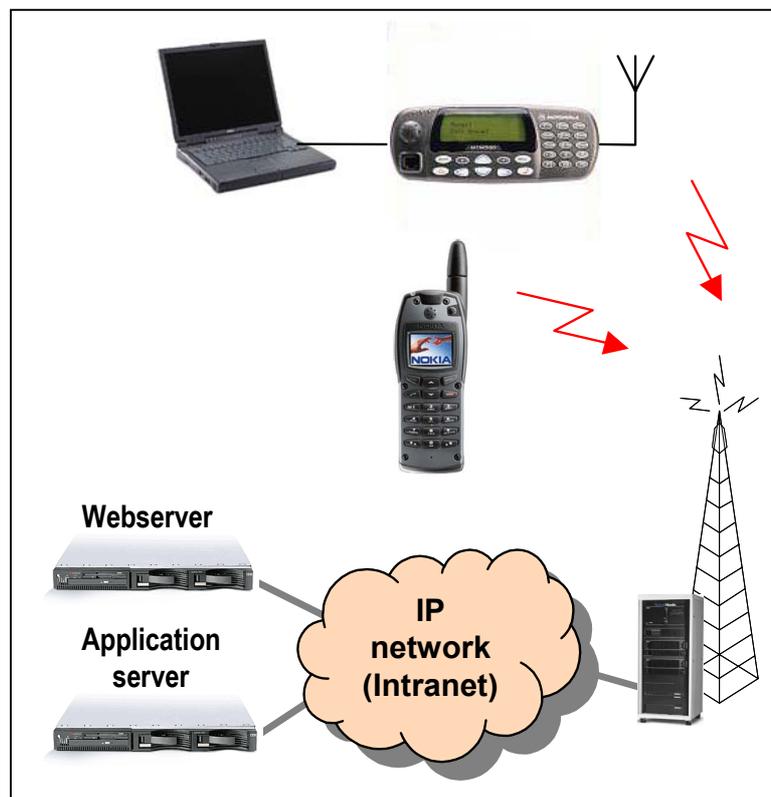### IP-over-TETRA and TETRA-over-IP

Much has been said about the advantages of IP-over-TETRA and TETRA-over-IP. It is not my intention to repeat the pros and cons of each of the solutions, but there is no doubt that IP integration is an essential requirement today and will only grow in importance in the future.

Softswitch technology offers the following benefits if IP connectivity and IP-over-TETRA is considered:

- Softswitch solutions offer fully integrated IP gateway solutions, not requiring external gateways or servers. This allows exchange of SDS and Status messages, or streaming of circuit speech and data connections.

- Real IP-over-TETRA is offered by the Packet Data function. Packet data enables mobile access to the private Intranet and public Internet, either by means of a handheld device, notebook computer or using a WAP-enabled TETRA handset.

- IP is definitely the basis for interconnecting Network Management applications. Except for client/server solutions for interactive system configuration and subscriber management, support of the Simple Network Management Protocol (SNMP) is essential for any serious TETRA application.

To improve security, most COTS operating systems offer integrated security and firewall capabilities. In particular Linux offers IP Security (IPSec), Secure Socket Layer (SSL), Secure Shell (SSH) and also the Point to Point Tunnelling Protocol (PPTP), which makes it even possible to connect the system to the public Internet without compromising security and stability of system operation.
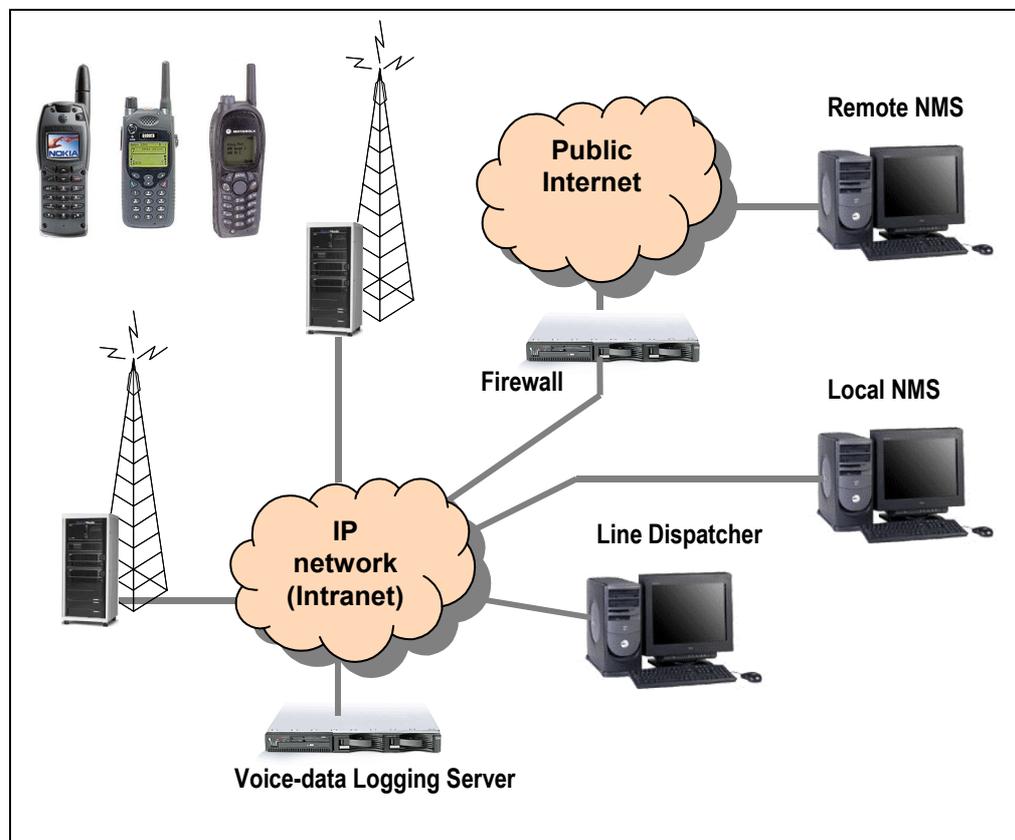

IP-over-TETRA applications

TETRA-over-IP, thus networking TETRA system components by means of an IP network needs careful consideration before it can be applied to a mission-critical TETRA infrastructure solution. However, if the necessary IP capacity is available and Quality-of-Service issues are taken care of, softswitch solutions really make the difference.

These softswitch solutions provide for:

- High performance routing and switching of speech and circuit data is essential to keep the latency to acceptable levels. Due to optimizations of the IP stack within Linux for more than a decade, the Linux operating system is the best choice for this requirement.

- Speech and circuit data traffic should be given priority above signalling and database synchronization. This is obtained by using Quality-of-Service mechanisms such as MLPS.

- A distributed database architecture is essential to ensure resilience of the TETRA infrastructure

- In addition, innovative solutions have been developed to interconnect Line Dispatcher Stations (LDS) via the IP network and to produce a Voice-data Logging Server (VLS) solution that does not require additional interfaces and external tape recorder or hard disk recording solutions.

TETRA-over-IP and other IP applications

Open TETRA

TETRA infrastructure solutions are often considered as being extremely complicated and difficult to manage. This is not necessary anymore when applying softswitch technology.

Of course, the Radio Frequency (RF) part is still a sophisticated and high demanding type of product, and the complexity of the TETRA protocol stack and call services have not to be underestimated, softswitching hides this complexity by integrating all software in one single software application.

Just as for the tendency to use open hardware and open software solutions, the TETRA system does not have to be considered anymore as an inaccessible "black box" solution, which can only be managed by the supplier if a major problem occurs.

A coherent solution is offered by using the IP as a single standard to support all external connectivity.

The following standards can be used to make the TETRA infrastructure solution accessible for any human and external application:

- Extended Mark-up Language (XML) provides a standardized method of exchanging information between the system and an application

- The Hyper Text Transport Protocol (HTTP) is the perfect basis for developing Network Management solutions. It can be used both for a client/server architecture, where a Windows application is used to perform system management tasks and for direct access of the system through a web browser.

- The Simple Network Management Protocol (SNMP) is the industry standard for delivering status and alarming information to third party applications

- The File Transfer Protocol (FTP) is designed to allow uploading or downloading of large files, which is useful e.g. to perform software upgrades

- Use of the Point to Point Tunnelling Protocol (PPTP) with adequate encryption is ideal to perform remote network management through the public Internet. PPTP is trusted by major corporations for Virtual Private Network (VPN) solutions.

- Secure Socket Layer (SSL) and Secure Shell (SSH) allows secure access to the system from within an Intranet

- And finally, the Microsoft's Server Message Block (SMB) concept makes the system just as easy to access as any other Microsoft Windows based server within an office environment.

Conclusion

It is difficult to summarize all benefits of softswitching into a few sentences. Especially for TETRA, softswitch technology creates the basis for well-scalable, flexible, reliable and open solutions. COTS hardware and software platforms play an essential role to enable softswitch solutions.

Many companies and state organizations have recognized the advantages of softswitch technology in the PABX and Voice-over-IP marketplace for more than four years. It is evident that also TETRA has to move forward, and that TETRA infrastructure solutions should be based on softswitch technology.

Pure softswitch technology offers the ultimate in system simplicity. The complexity of TETRA is now entirely hidden in a single software application. This provides the basis for a real open, standards-based TETRA infrastructure solution.