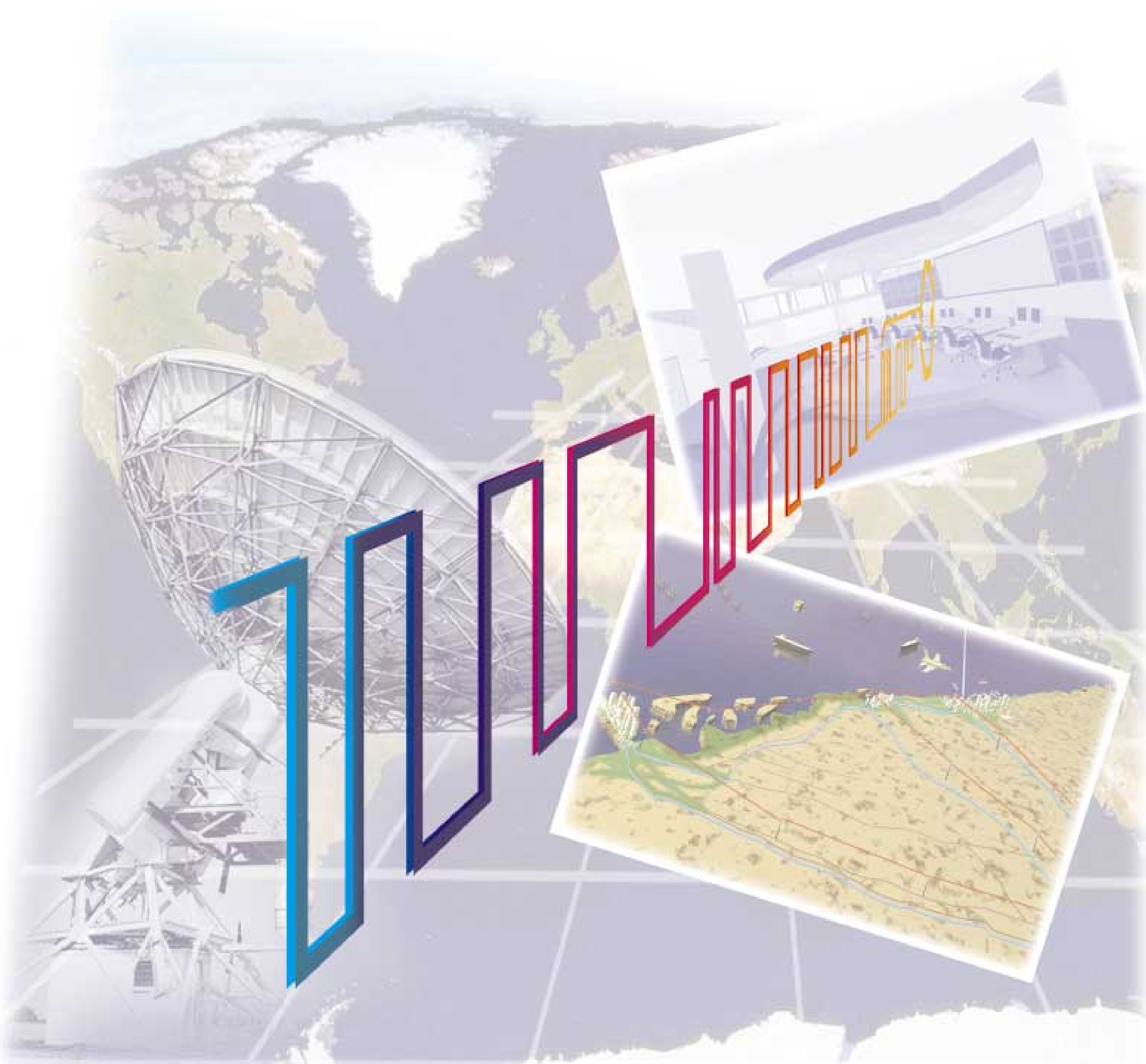
SIEMENS

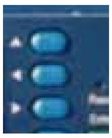
White Paper
Networks
in the Military Sector



for Security Agencies

Information and Communications

1 Contents



2. Generic Networking Trends

Expanding technical developments within the field of network technology can be used to speed up and simplify existing work procedures. They also permit the technical implementation of completely new and more efficient procedures and applications. Information can be made available across large distances and at great speed or in large quantities. Secure encryption technology permits secure connections for the exchange of confidential information. Modern terminals permit service convergence, in other words the processing of a range of different services and associated information within a single device. In connection with the continuous progress being made within the sphere of miniaturization, this means that these services are becoming increasingly easy to use, even in mobile environments.

Information and knowledge can be used and made available far away from the physical location where it originated. Conferences across large distances are possible, as is the provision of documents and information, sound and text. In this context, knowledge management is becoming an increasingly important factor. Furthermore, communications services make possible new applications from the sphere of "monitoring" in connection with the transmission of sensor information (e.g. GPS, video, hospital technology, counters).

The opening up of the telecommunications market has led to the founding of a large number of private service providers, who offer telecommunications services at all levels. These range from the provision of bandwidths (Dark Fiber) via leased-line services (PDH/SDH/SONET) and data and voice services (Frame Relay, ATM, IP) to business value-added services, e.g. internet service and application service providers.

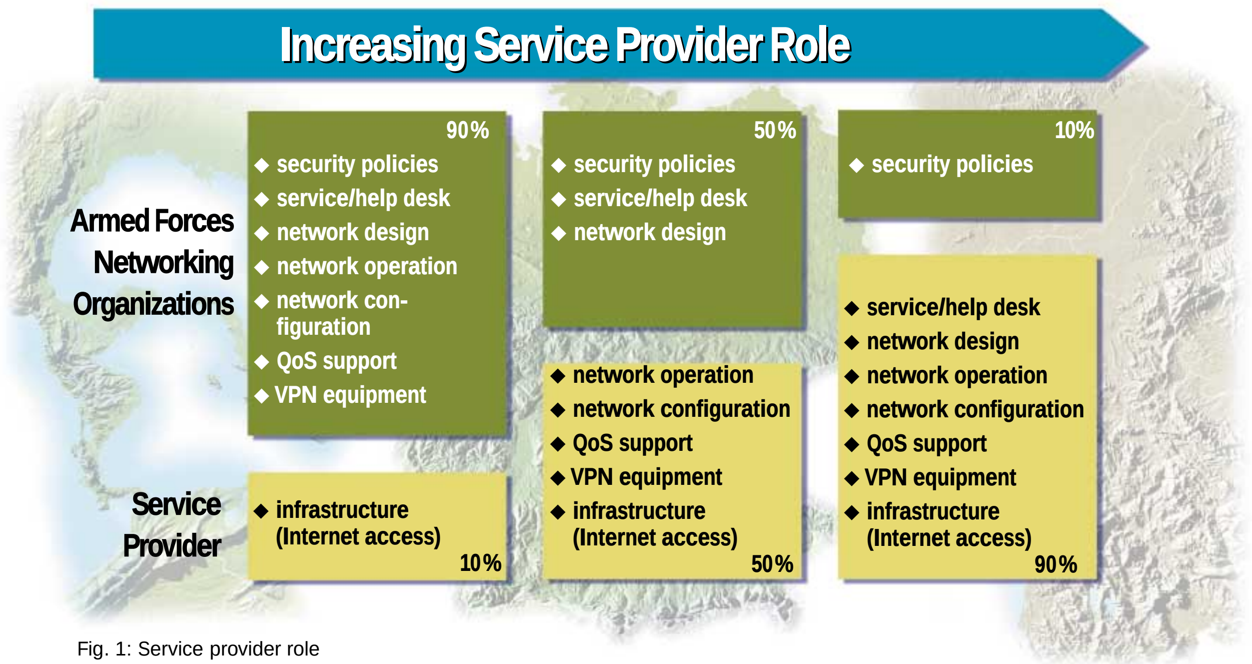


Fig. 1: Service provider role

Generic ...

Many businesses and institutions are therefore currently subjecting their Information and Communication infrastructure to a basic review process, which includes not only far-reaching decisions regarding investment in new communications equipment, but also basic decisions regarding network operation.

In general, three basic possibilities can be distinguished in this respect:

a) Invest and run the network as one's own operator
b) Leasing of services from a public service provider
c) Complete outsourcing.

The following arguments support the establishment of a separate military forces network:

- Control over the entire network including infrastructure
- Availability of the network
- Adaptation of the network to meet specific requirements
- The inclusion of areas with a weak infrastructure (developing countries)

Arguments in favor of outsourcing include:

- Cost savings
- No specialist staff is necessary for the operation and servicing of the transmission network, enabling the military forces to concentrate on their main task
- Flexibility in the selection of an operator and in the employment of new technologies

Despite the fact that the markets have basically been opened up, the regulations in individual countries sometimes vary widely due to the regulatory bodies responsible for this field. This makes it essential for the network concept to be adapted to the local situation.

Basically, however, there is no alternative to network consolidation, in other words the provision of all voice, data and multimedia services via a uniform network infrastructure on the basis of industry standards (Commercial Off-The-Shelf, COTS), including the provision of corresponding gateways and network transitions to partners, allies and mobile task forces. In this solution IP serves as the exchange for the interworking of the applications (Service Convergence) and is the basis for the use of internet and intranet services. In order to guarantee a carrier-grade service quality (Quality of Service, QoS) in multimedia and voice-integrating services, combined IP/ATM Next Generation Networks with an open applications interface for current and future convergent services have proved optimal.

This means that the IP/ATM capability of the corresponding network and application components is an indispensable aspect of any new investment. In order to protect the existing investment as well as guaranteeing a sensible migration path during the introduction of the new technologies it is essential that the incorporation of the existing legacy network via appropriate communication interfaces is guaranteed.

3. Networks in the Military Sector – The Status Quo

Workflow processing based on Information and Communication (I&C) is developing into the most important business trend within the industry. Consequently, the I&C network is emerging as the strategic platform which all companies and institutions require in order to run their business successfully. Furthermore, nowadays IP technology is taking over company networks. Intranets are increasingly becoming the information basis, so that today virtually all large companies within the industry operate an intranet. This trend has led to a rapid and ever-accelerating development in network technology, which as in the IT sphere is producing an ever-faster innovation cycle.

For many years, specific network technology was employed within the military sector. In view of the secrecy and security requirements in particular, this technology was the result of time-consuming developments and tests. In the choice of technology, tactical deployment was usually accorded more importance than the applications necessary for operational use. This meant on the one hand that the communications networks used by military forces could not keep pace with the innovation cycles applying in commercially available technology, and on the other that the specific developments represented an enormous cost factor, since the lack of standard interfaces meant that cost-sharing with other users was not an option.

Armed forces are currently using data and voice services which are mostly based on a variety of legacy networks. These legacy networks demonstrate various characteristics:

- No state-of-the-art technology
- No interconnection between the various legacy networks
- A wide range of networks and a large number of isolated solutions
- Highly sophisticated specialized network management systems requiring highly skilled operators
- Slow delivery of services
- Reduced possibilities of introducing new IP/WEB-based applications
- Unsatisfactory interoperability and thus inadequate communication between the different branches of the armed forces and with other allied forces
- In some cases, excessively long network realization times (up to 20 years). During this period several technological revolutions will have taken place in civil networks.
- In some cases, legacy equipment being used by end-users and within the network (compared with civil networks which have to be migrated to networks based on new technology).
- High operational and maintenance costs
- Deficits in the crucial spheres of new services and applications, network integration, network and service management

...The Status Quo

Therefore there is a strong need for consolidation of the existing military operational communication with respect to the need to introduce a modern, cost-effective and innovative network.

Armed forces today are spread across a variety of geographically distributed locations like staff departments, training centers, airports, operations centers etc. as well as partner institutions such as public departments and local authorities. Typically they consist of a number of (small) locations spread over a metropolitan area as well as worldwide. In addition, it is necessary to maintain communication links with alliance partners (e.g. NATO).

There is also a growing need to provide support for international missions undertaken by the armed forces with particular reference to mobile environments. Military survival requirements may also have to be met.

Fig. 2: Geographical distribution

4. General Network Design Aspects of Military Networks

The physical construction of a modern network for military forces must take into account the geographical, topological and organizational restrictions of the force in question. In general it can be stated that:

- The construction of a network for a property (or a location) on the basis of LAN technologies (Local Area Network):
  The properties can differ widely regarding the number of terminals to be linked up and the area to be covered as well as the services, interfaces and applications to be supported.
- The construction of a network linking a number of properties within the national boundaries of the military force in question:
  The requirements to be met by the network within the national boundaries of the military force in question can also be very different, depending on the situation within the country and the size of the military forces. In fully industrialized countries it is usually no problem to employ transport network techniques based on fiber optics. In developing countries and very large countries the use of radio technology is preferable for transport networks. The choice of technology is also different for the backbone and access spheres.
  Special requirements arise in the access sphere due to the mobility of communications partners (ships, aircraft...).
- The establishment of a network for properties outside the national borders (Out of Area):
  Here, a distinction must be made between fixed bases (long-term installation and use) and crisis operations with high mobility requirements. In any case, large distances will have to be bridged in this situation. It may even prove necessary to make use of satellite communication.

In addition, the following specific marginal requirements are also relevant:

- The linking-up of a large number of properties (>100) with widely differing service requirements
- The bandwidth requirements are based on those of company networks, not those of carrier networks (Backbone <2.5 Gbit/s). The provision of low-bit-rate services will remain indispensable for a long period (legacy)
- Exceptional attention must be paid to radio technology
- Transport of the entire bandwidth of the telecommunications services available today
- Strict requirements regarding network security (security against failure, access protection ...)

Design Aspects ...

A prerequisite for communication between communication endpoints is to have a universally agreed structure of the data and exchange rules, regulated by so called protocols. Beside realizing individual protocol adapters for the different and mostly heterogeneous systems it is state-of-the-art to use standardized communication protocols, which every system has to adapt to. In accordance with the so called OSI reference model, the communication is split into several functions, which are realized by different layers (OSI defines 7 layers). Each layer covers certain services, which are offered to the next layer and are based on services of the preceding layer. Communication between these layers is again defined by standardized protocols via so called service access points, where each layer embeds the primary data in protocol information located in a header and a trailer (protocol overhead), e.g. sender and receiver addresses. Only at the lowest layer does physical transport take place. In addition each layer of an end system communicates with the equivalent layer of the target system (peer-to-peer, horizontal communication).

Each layer has its own role in the standards. In real networks much overlapping and collapsing of the respective layers is possible.

Bearing in mind these aspects and in particular the migration capability of existing networks/ network technologies into modern, convergent Next-Generation Network (NGN-) solutions, modeling of the entire network on the basis of current technology in accordance with the following layer structure has proved to be advantageous:

- Infrastructure & Outside Plant Layer and Transport Layer:
  Infrastructure & Outside Plant Layer represents the physical medium for the transport of information, like copper cable, fiber optic cable, radio relay. The Transport Layer ensures access to the physical medium in a secure and efficient manner.
- Networking (Switching & Routing) Layer:
  The Networking Layer has the task of routing the information through the network and ensuring the consistency of the information.
- Communication Service Layer:
  The Communication Service Layer provides the services needed for the applications mentioned below (e.g. ISDN feature set).

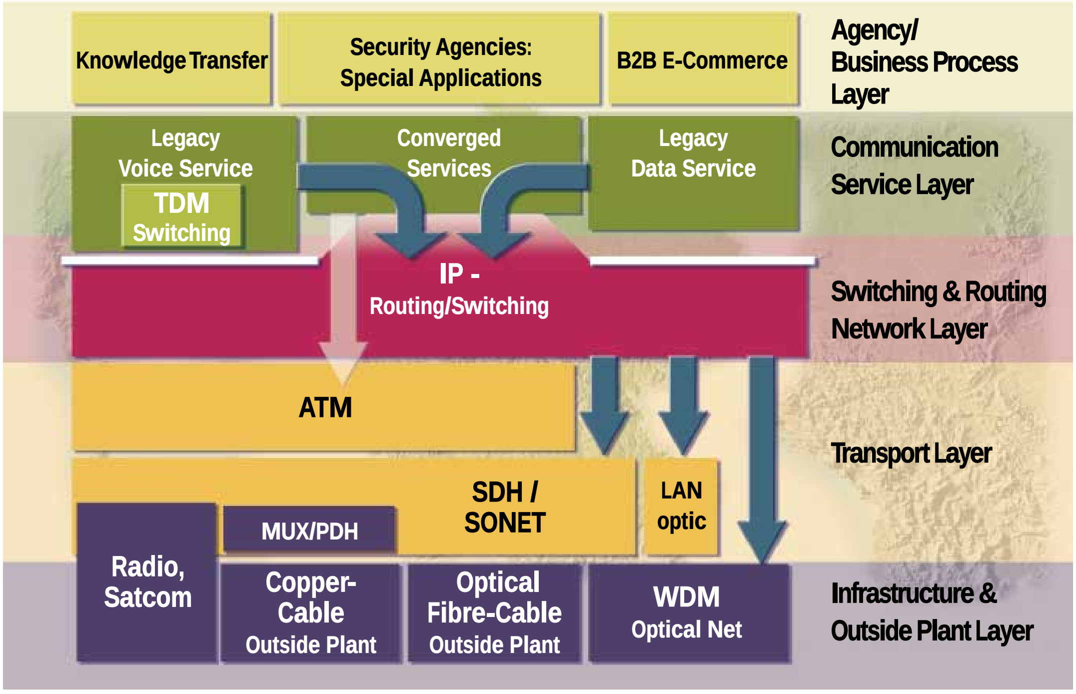


Fig. 3: Network layering

Based on today's technology, the most likely approach to realizing the different layers with technologies and protocols is shown in Fig. 3 and illustrated in the following section.

Today SDH/SONET provides a well-established platform within the transport network, independent of the underlying physical technology, such as fiber, radio or even WDM technology in case of fiber scarcity.

The key feature of the ATM sub-layer is to support the integration of voice, data and multimedia traffic without sacrificing Quality of Service (QoS) guarantees.

There is a clear trend that in future IP will become the Unifying Layer in the network that is common to all services. However native IP does not offer any QoS as it is a connection-free protocol. There are numerous projects under way which aim to extend the protocol (e.g. IPv6, Diff-Serv, MPLS etc.); nevertheless there is still some way to go in terms of modifying the IP protocol so that it is able to provide the necessary QoS so that it can also carry real-time traffic such as voice and video as well as legacy data traffic.

5. Trends and Requirements in the Armed Forces

5.1 General Requirements

The requirements for the establishment of networks linking military properties can be summarized as follows:

- Several hundred thousand participants within the military forces, spread throughout a number of properties
- Communication within the military sector itself, as well as with partner institutions and allies
- Geographical distribution of the properties within the country as well as links with mobile troop units out of area during operations
- Properties which vary considerably in size; the number of properties may vary from few to many, depending on the size of the country
- Some sections of a property which in some cases cannot be connected via LAN technology

Today communication relations consist mainly of PBX interconnection or low speed data links between all locations based on TDM technology.

Apart from the classic voice connections, data and multimedia services are increasingly required. LAN interconnection is an indispensable requirement. The localization of server farms, on which the intranet applications run, must be transparent beyond the boundaries of the property.

The availability and security of the corresponding service is of paramount importance. In particular, this guarantee must be maintained and secured by corresponding mechanisms even in crisis situations:

- Powerful secure global communications connections for Command & Control, logistics and staff data
- Internet and intranet applications as information exchange
- Network services with Multipoint/Broadcast functions
- Equipment integration (e.g. access-control systems)
- Standardized interfaces and protocols for multinational and civil interoperability
- Security of information

5.2 Applications Scenarios

The application scenarios describe the Security Agency Application layer in Fig.3.
The following chapter lists a selection of possible applications:

- LAN Interconnection
- Voice Interconnection
- Distance Learning
- Videoconferencing
- User Mobility
- Tele-Medicine
- Simulation
- Operations Headquarters
- INTRANET/INTERNET access
- Teleworking
- Call Centers
- Transport and/or fleet management
- Administrative services

LAN-Interconnection

For the interlinking of local computer networks (LAN) situated within individual properties, in order to involve the latter in overlapping military procedures (logistics, staff administration, salary accounting etc.). Depending on the application, the capacities here range from single 64Kbps channels to several 2Mbit channels. LAN interconnections must also be available for ships and with a potential military operations area via SatCom.

Voice Interconnection

For the purposes of providing internal connection within the military forces for local voice communication. This can be obtained in the classic manner via network protocols of PBXs such as QSIG, or can be achieved (if sufficient resources are available within the backbone network) by means of new technologies such as Voice-over IP. The performance features of voice transmission systems should be transmitted here as transparently as possible. Voice interconnections must also be possible with ships and with a potential military operations area via SatCom.

Videoconferencing

For oral and visual communication between two or more participants in different properties.

INTRANET/INTERNET access

As an universal point of access to data which is relevant for the user, or for the provision of data for a large group of potentially interested individuals. Examples of this are:

- Current information regarding a unit or an operation
- Geographical data and meteorological information
- Logistics information
- Location information

Trends...

Teleworking

For the representation of the customary work surroundings at a fixed or random location. This permits work to be carried out independently of location on the basis of familiar tools and rights of access. Examples of this are:

- The same communications tools and rights of access in the operations area as in the barracks
- A workplace at home to increase willingness to work outside normal working hours or at the weekend

There are special risks here attached to the areas of security of information and the administration of access rights.

Transport and Fleet Management

For the direction of vehicle fleets country-wide and during operations and associated logistics (cf. also LAN Interconnection)

User Mobility

For communication between participants on foot or in vehicles, regardless of location. Examples include:

- Logistics vehicles
- Guard and other security forces such as bodyguards and military police
- Senior officers
- Users within an operations area without permanent communications infrastructure

Here it is essential to ensure security of information as regards both voice and data communication. It should also be ensured that the communication is at least partly independent of the civil networks, since the latter may be destroyed or overloaded.

Distance Learning

For the training of staff based on a centralized teaching structure, thereby saving travel and accommodation costs.

Tele-Medicine

For the local independent treatment of patients by specialists (e.g. for the treatment of casualties in the operations area by drawing on the assistance of specialists in a military hospital at home).

Simulation

For the cost-effective training of personnel by using simulation instead of actual applications. Examples include, amongst others:

- Simulators for weapons (hand gun, rifle, Hawk, etc.) and weapons systems (tanks)
- Simulator for combat direction
- Simulator for artillery observers

Operations Headquarters

For the direction and monitoring of operations. Here it is possible to make use of a wide variety of communications (permanent network, radio, SatCom etc.) and data networks (logistics, staff, INTERNET, etc.) from a central headquarter, which provides the staff with specially adapted software to support their operations efficiently.

Call Center

For the automatic registration of telephone calls, supported by databases and menu control. Possible applications include:

- Call Center for the registration of calls during recruiting campaigns
- Call Center for the registration of calls from the public in crisis situations or during operations or following image campaigns

Administrative services

For the execution of services related to the administration of properties (accounting procedures for electricity, water, heating, staff etc.

Trends…

In general, a distinction is drawn in the case of network operators between the public internet, intranet and extranet.

The intranet comprises the logical (IP-VPN) or physical IP network of a company or authority (e.g. the German army) and the applications installed within it (e.g. e-mail). Distant locations are linked with each other via a secure-access remote traffic network, e.g. based on ATM. Secure access means here in particular that information within the network is protected from access by non-authorized persons.

The network and the applications which are defined for cooperation with other companies or authorities are described as an extranet. Intranet and extranet can be located on the same physical network; nonetheless a logical separation is required in order to fulfill security requirements. The public internet transports traffic between various sources (e.g. from public internet users) and does not guarantee security of information. In the case of intranet applications, in addition to the security factor, quality with regard to delay and data throughput plays an increasingly important role. A further aspect is intranet access with regard to a gradual extension involving new network users or an increase in traffic.

Therefore, a combined approach, based on flexible, integrated IP/ATM switch or router devices, allows for a smooth and cost-optimized migration towards an IP (via ATM) network, thus ensuring QoS and bandwidth economy, both of them are essential requirements for security agencies networks.

The business process layer provides the applications, embedding the converged services offered by the Communication Service Layer into an efficient business/workflow procedure. This aspect is gaining increasing significance for security agencies as well as for all leading companies today. For example, this may comprise applications to improve knowledge management and transfer, business-to-business e-commerce or special applications tailored to the needs of security agencies, deploying services as referred to in section 6.2.

6. Suggestions for a Solution…

…for the Establishment of a Network for Military Forces

6.1 Network Design of Core Networks for Armed Forces

Based on the considerations relating to generic network design, the network layer structuring and the technology available at the present time, the establishment of a network linking properties should be based on the following suggestions: The use of a transport layer remains necessary. Together with an ATM / IP transport function, this makes available the bearer and infrastructure resources with the required high availability, flexibility and bandwidth economy. On this basis, the required networking and communication services are to be implemented.

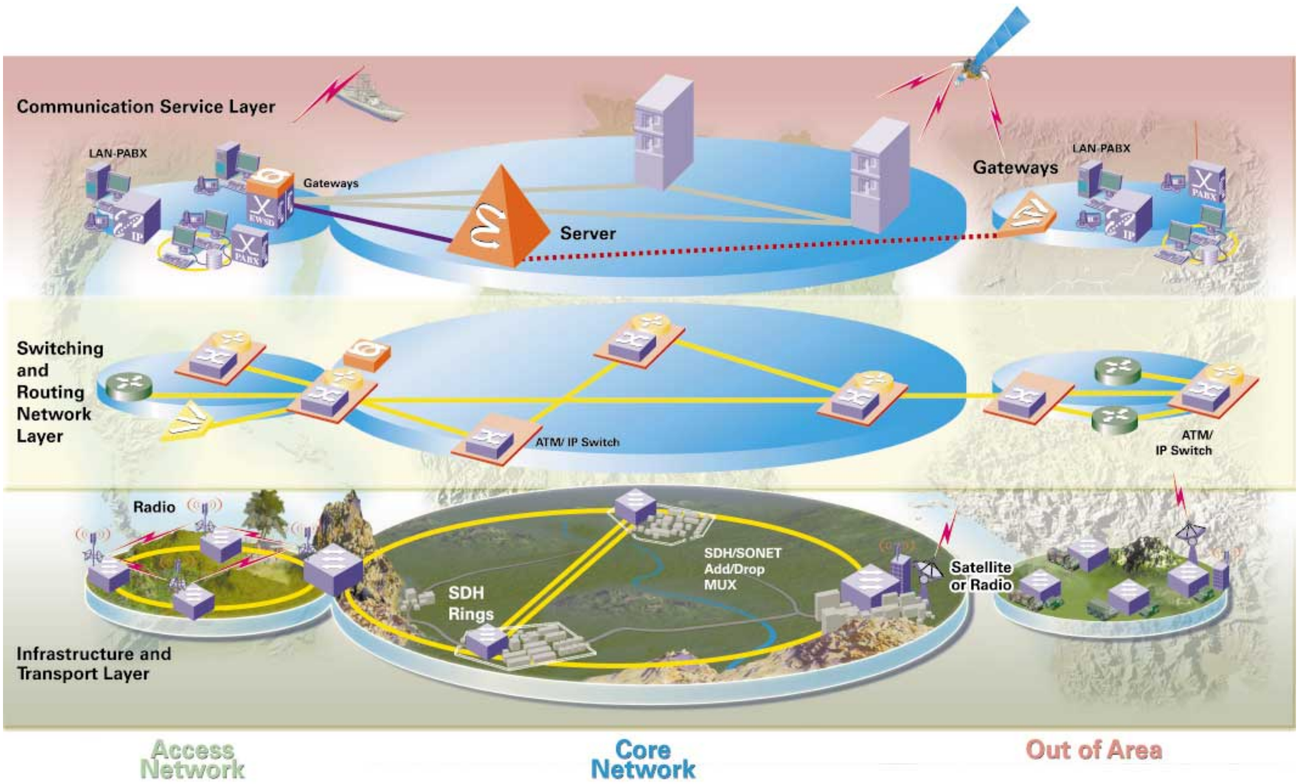


Fig. 4: Network design

Suggestions...

The Transport Layer, consisting of

- SDH transmission network (directional radio and/or cable and active components (multiplexer, cross-connects,...)
- PDH transmission networks in the access sphere (directional radio, point-to-multipoint, cable, multiplex)
- Radio components
- SatCom components

The Networking Layer, consisting of

- ATM multi-service switching and transport components
- ATM multi-service components with integrated IP routers
- Media gateway components
- Explicit IP routers

The Communication Service Layer, consisting of:

- Legacy voice switching
- (PABX, SS7 local exchange or possibly also SS7 transit exchanges)
- PABX services; CENTREX services; IN services;
- Legacy data services
- IP data services

6.1.1 Transport Layer and Infrastructure Layer

The requirements of the transport layer differ considerably in the backbone and access sphere as regards capacity, security requirements, costs, interfaces etc. Correspondingly, very different technologies will have to be employed here.

Depending on the size or the number of network elements in the backbone transport network, it may prove necessary to build up a hierarchy of several sub-networks. In general, this is carried out by linking together several sub-networks. The linking up of the sub-networks is achieved by means of an interlinked cross connect structure, whilst the sub-networks themselves are established by means of a ring structure. Within each layer, network elements with varying performance levels and functions are employed, depending on the priority attached to performance and topology.

As an established manufacturer in the field of transport technology, Siemens can provide the full range of infrastructure equipment required. Based on fiber infrastructure this ranges from SDH Crossconnects, Add Drop Multiplexer, Line Equipment, Optical Service Nodes as well as DWDM equipment.

In order to provide links with properties which are difficult to reach, or in the case of Out-of-Area operations, point-to-point or point-to-multipoint radio connections provide a solution, since no time-consuming and labor-intensive cable-laying is necessary.

Within built-up areas, the increased use of radio can be observed. Mini-directional radio, such as point-to-multipoint directional radio, is widely employed. Point-to-multipoint directional radio is primarily used to provide connections for base stations distributed across a large area within mobile radio systems. However, it can also be employed to connect scattered groups of subscribers. Within the local area, radio links with transmission rates of up to 150 Mbit/s are used to link LANs.

Descriptions of the products available can be found on the internet [1].

Fig. 5: Infrastructure and transport layer

Satellite communication is used when terrestrial cellular networks are not available (infrastructure is non-existent or has been destroyed, desert, etc.). It also serves to bridge large distances.

A GSM base station in a suitable GSM container can also be connected to a MSC via satellite or, if a mini-MSC is built into the container, the mini-MSC can be linked up with another MSC in the home country.

Satellites are also used for communication with ships and aircraft. In combination with GPS, satellite communication is part of vehicle fleet management systems.

Satellite radio is a type of directional radio and therefore belongs to the category of transmission technologies.

Planning, operation and monitoring of satellites today is mostly undertaken by organizations on an international (e.g. INTELSAT and EUTELSAT) level, which in some cases run their own satellite communications networks.

Connection of directivity subscribers to the WAN, e.g. of ships etc.

- Radio
- Maritime VHF (Voice, DSC)
- Terrestrial VHF
- Aeronautical VHF
- HF (Voice, TELEX, DSC)

See also [3].

Suggestions...

6.1.2 Switching & Routing Network Layer

Armed forces are in a very particular situation. On the one hand they need to be able to provide new services very quickly, whilst on the other they are required to preserve legacy systems for long periods in order to protect existing investments. For these reasons, the pure transport layer with its available services is inadequate when it comes to providing an efficient network system. In particular it is not compatible with these goals to run separate voice and data networks; it is too expensive, too inflexible and inadequate for coping with "bursty traffic" applications.

On top of the transport and infrastructure layer at network layer level, a technology will be required which:

- Enables a universal network consolidation
- Supports legacy services and interfaces
- Is scalable and flexible
- Supports standard interfaces and thus guarantees interoperability
- Provides end-to-end network and service management

The entire network is divided into a backbone and an access network. In the case of small networks, the two network levels can also be combined, so that the backbone functionality is covered by the access network elements.

In contrast to, for example, TDM/SDH networks with the point-to-point connections of fixed bandwidths or router networks with connectionless traffic flows without bandwidth and delay guarantees, within an ATM network all types of information can be mapped in the most suitable ATM service class (e.g. CBR, nrtVBR), so that on the one hand the traffic requirements are fulfilled, and on the other the transport and transmission of the traffic can be carried out in the most cost-effective manner.

ATM is therefore particularly suitable for use as a network layer transport technology, since it is the only technology which combines the following characteristics:

- Statistical multiplex despite optimal bandwidth use
- QoS
- All possible classes of traffic
- All possible grades of interface
- Standardization
- PVC/SVC
- Available today
- End-to-end network management

The choice of products is determined on the basis of the planned services and applications as well as the node throughput. The network segmentation further depends on the geographical distribution of the users' locations and the amount of traffic to be transported between these locations.

With the aid of Siemens service elements the user is supplied with the following services:

- Voice and Telephone over ATM (VTOA)
- Circuit Emulation Services (CES)
- Frame relay services
- IP routing and switching
- Native ATM services
- ISDN, CORNET-N, QSIG, X.25, SS7
- SNA environment (Host, 3174, etc.)

Today more and more traffic is IP-based. This is true for all traffic classes. Siemens offers several possibilities for handling IP traffic at the network layer:

- Distributed routing in all access switches
- Central routing

As soon as it is available, all IP traffic will be carried via MPLS. As customer demand for MPLS is increasing, our multiservice ATM product line needs to be upgraded to include MPLS functions. For further information see [4].

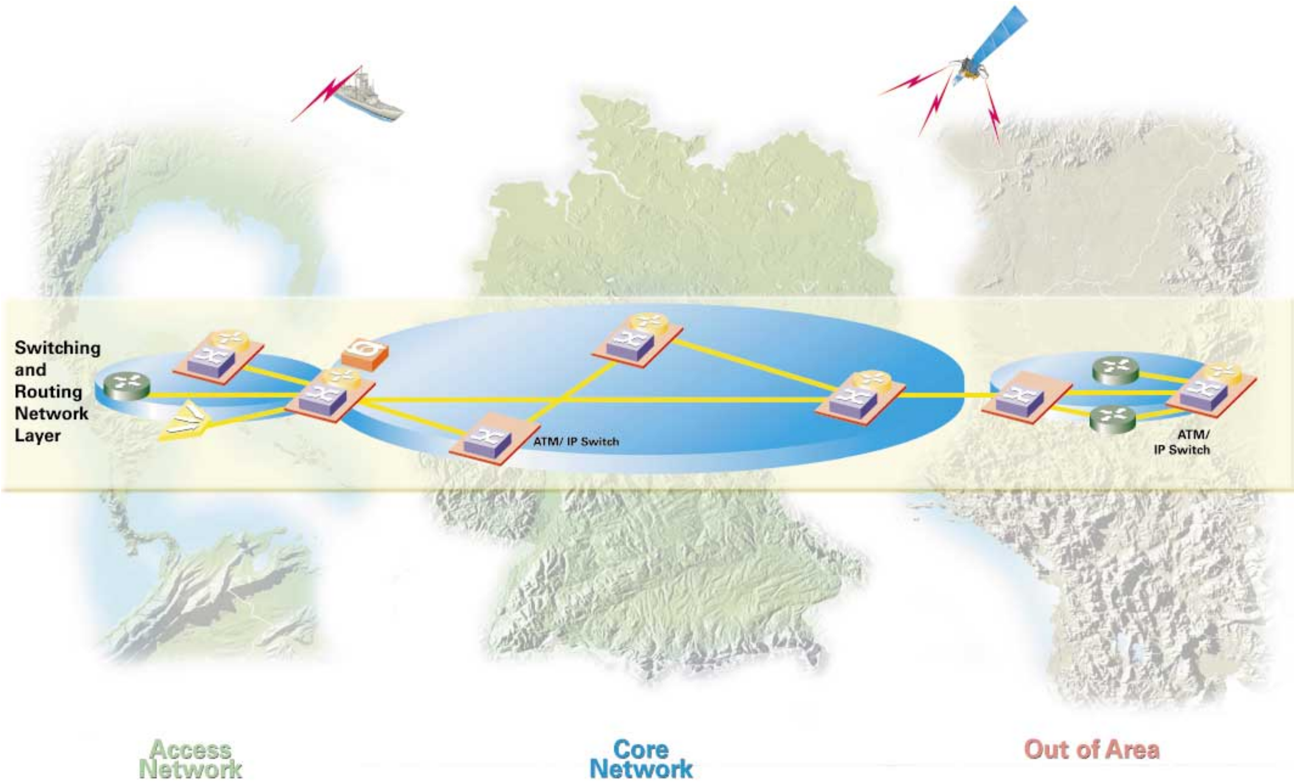


Fig. 6: Switching and routing network layer

The access network can also be two-layer. In this case the network operator places a connection multiplexer at a location with a number of users in order to effect a consolidation of the voice and data services on the basis of ATM or FR. In addition to the consolidation, a concentration of traffic into a single traffic flow is achieved, which then results in a reduction of the connection bandwidth as a result of the statistical multiplex effect at the cell/ package level and also on the connection level (in the case of SVC traffic). For example, instead of using a separate E1 connection for voice and data, there will then be only one common E1 connection for both classes of service.

The second access level then effects a further concentration of the various ATM and FR traffics into a single ATM traffic stream, also permitting direct communication between two locations via the access nodes. In this manner only the traffic which has to cross greater geographical distances will thus be transported to its destination via the backbone network.

For management of the services and applications in the network, it may be necessary in some cases to install additional servers.

In this sphere Siemens provides the range of products by means of which can be effected the supply of almost all known access interfaces with corresponding consolidation and supply to the switching & routing network.

Suggestions...

6.1.3 Communication Service Layer

The Communication Service Layer provides those services to which the business application is really connected. This layer resides in most cases on top of the transport and infrastructure layer as well as on the switching and routing layer.

6.1.3.1 Voice-Services

The classic applications of a Voice Network are divided into various logical or physical instances. These are:

- Local Network Node
- Transit Network Node
- Signaling Transfer Point (STP)
- Network Interworking Node in fixed networks
- Mobile Communications Network Node in mobile networks
- Service Switching Point (SSP) in Intelligent Networks (IN)

Local network nodes are used to switch the incoming and outgoing traffic for the connected users, offering the complete range of subscriber interfaces:

- Analog lines
- ISDN basic accesses
- ISDN primary rate accesses
- V5.1/V5.2 interface
- high bit-rate lines (UDSL/SDSL)
- 2Mbit/s high-speed lines

In the transit or long-distance network nodes, interregional traffic is switched to and from other network nodes. These network elements are needed to build up large networks.
Signaling transfer points transfer the signaling traffic of the SS7-based networks.
Network interworking nodes are used for switching international and intercontinental traffic, a feature which might be necessary for customers operating globally.
All these different nodes might be integrated into one or more physical nodes, depending on the network design.

The term intelligent network (IN) is used throughout the world to represent a network architecture in which services are controlled from a central location. Siemens offers a complete IN solution.

- Network-wide features are provided by a highly sophisticated call procedure:
- Call charge registration
- Traffic routing
- Network management
- Traffic data management
- Signaling
- Voice processing

Today's switching networks are created using the TDM technology (Time Division Multiplexing), or so-called Circuit Switched Networks based on the transport technologies already mentioned above (SDH/PDH/HDSL).
For further information see also [5].
Trunk/Networking of corporate voice networks are based on standard protocols and open interfaces. CORNET-NQ is Siemens' standards-based signaling protocol for private network solutions and provides a huge range of related services.
CORNET- NQ is aligned with the international QSIG private network protocol for all features that are common between the two protocols.
CORNET-NQ transmits Hicom features and central services throughout the entire corporate network as well as transpartently across the public PSTN. These features enhance intra-site communications, improve customer service and allow flexible working practices.
The Hicom network makes it possible to connect systems from other manufacturers via the QSIG protocol, or in selected countries the DPNSS1 protocol, for heterogeneous networking with tunneling of the CORNET-NQ protocol for end-to-end features transparency.
Existing systems can also be connected via analog interfaces. For further information see also [6].

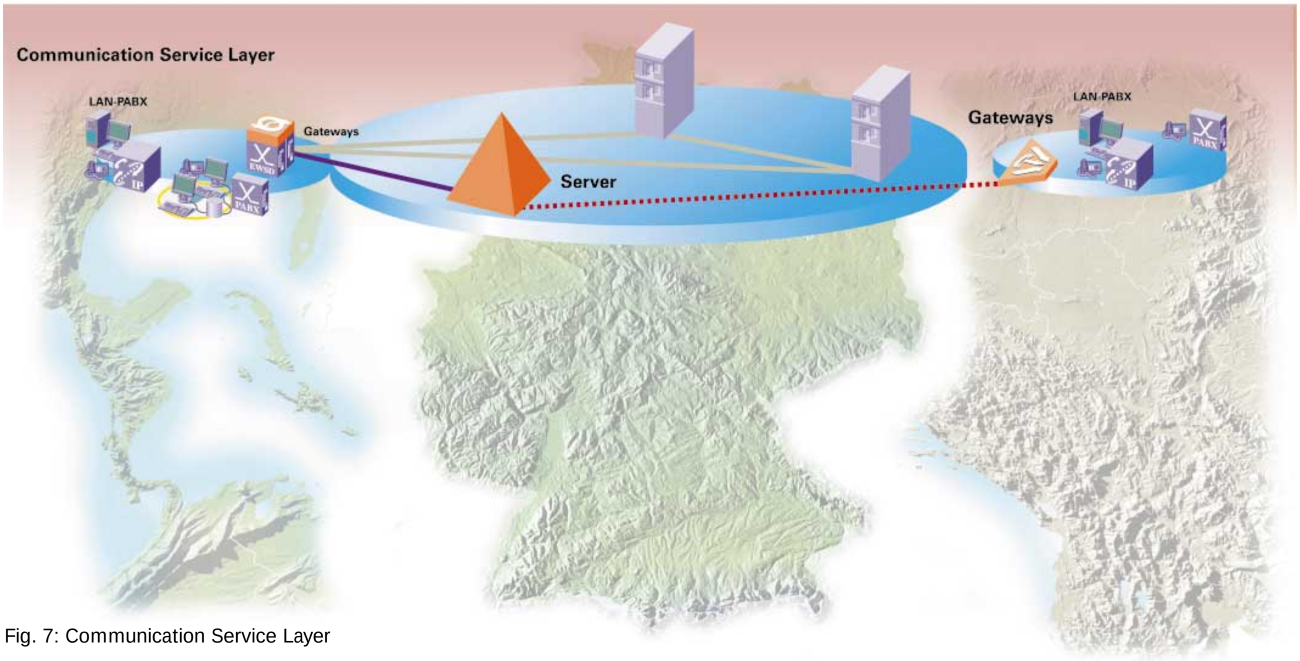


Fig. 7: Communication Service Layer

6.1.3.2 Data Services

The ATM service is provided at an ATM access node. The connecting bandwidths are typically E1, n x E1 (IMA), E3 or STM-1. UNI 3.1 or 4.0 is used as a user signal. Common connections are PVCs, SVCs, SPVCs and PVPs. An ATM connection is either an end-to-end ATM connection (in other words, with ATM users at both ends of the network), or an ATM user is connected to the user of another service, e.g. Frame Relay. In this case a service interworking takes place in the transition from Frame Relay to ATM.

Depending on the applications in use, the ATM traffic classes CBR, rtVBR, nrtVBR, ABR or UBR are used. For example, routers with an ATM interface typically use rtVBR or UBR.

Frame Relay is regarded as an access service to an ATM-based multiservice network, particularly for bandwidths < 2 Mbit/s. The applications in use relate not only to data, but also to voice and video. Connecting appliances are, for example, routers, bridges or Frame Relay Access Devices. TDM-/Leased-Line Services refer to constant traffic flows in the bandwidths n x 64 kbit/s, E1, E3 and STM-1. TDM-/Leased-Line Services based on ATM rely on the Circuit Emulation Service (CES) with the ATM traffic class CBR. The bandwidths n x 64 kbit/s and E1 are those most commonly observed. Higher bandwidths are usually inexpensively transported via a PDH/SDH network. A typical application for this service is the PBX network link-up via ATM.

Video services refer to the applications of video-conferencing, professional video transmission (e.g. between TV studios) and video monitoring. For broadband video, the standards are MJPEG and MPEG2. With regard to the MPEG2 card, NTSC, PAL and D1 Digital (270 Mbit/s) are supported. For the transport of the encoded broadband video signals, e.g. to a monitor, typically ATM traffic class rtVBR is used.

Narrowband video systems can either be connected directly to the ATM/FR-connection multiplexer, e.g. via V.35 (Leased Line) or BRI/PRI, or the video signals are converted via video termination to the required interfaces. For further information see also [7].

Suggestions...

6.1.3.3 Converged Voice and Data Networking

The answer for convergence of voice (circuit-switched) and data (packet-switched) is HiPath and SURPASS, which are network solutions that combine the advantages of circuit-based and packet-based networks.
SURPASS is the Siemens answer for those customers who have an EWSD network as installed base or who have carrier class feature and reliability requirements (e.g. SS7, 99.9999% availability,...).

HiPath is the Siemens answer for these customers, who have an installed base of a HICOM or PABX network and/or who want to build up a next generation network to run converged applications that integrate voice and data.

6.1.3.3.1 SURPASS

SURPASS introduces a new architecture for merging the advantages of a packet-oriented, multimedia-capable network with the complete intelligence of traditional real-time TDM networks.

Instead of creating trunks in circuit-switched networks, the traffic is forwarded through so-called virtual trunks routed through a packet-switched network. The concept recommends a call-control architecture where the call control "intelligence" is outside the gateways and handled by external call control elements.

At the core of SURPASS is the SURPASS hiQ server, a centralized server for voice call and call-feature control, combined with powerful signaling mediation capabilities for interconnection to various networks; thus leaving the operator the choice of the underlying switching/routing "transport" technology (either ATM or IP or still TDM). SURPASS hiQ also incorporates an open service platform for fast and efficient deployment of innovative and differentiating converged voice-data service applications.

SURPASS hiQ controls media gateway products at the edge of the underlying data network, based on open protocols (i.e. the Media Gateway Control Protocol MGCP for conversion of the PSTN/ISDN network intelligence into a new form of data stream control). Siemens is the leader in standardization activities related to MGCP. The controlled media gateway products of the SURPASS hiG family efficiently perform the bridging between TDM voice-based and packet-based data networks.

The following figure illustrates the integration of SURPASS components hiQ, hiG and hiA into a consolidated TDM and IP/ATM network structure in order to migrate smoothly towards an all-packet networking infrastructure: The TDM transit exchange traffic (SS7) may be supplemented by virtual trunking, i.e. joint usage of the IP/ATM data network for VoIP trunking, legacy data and transport of new-type converged multimedia services, which are processed at centralized, decoupled application servers on top of an open service platform.

The next Figures show migration steps from a traditional Switching Network to a Converged Network Architecture with emphasis on protection of existing investment.

Most legacy networks architectures are constructed as pointed out in Fig 8, voice and data services are provided on different network infrastructures.

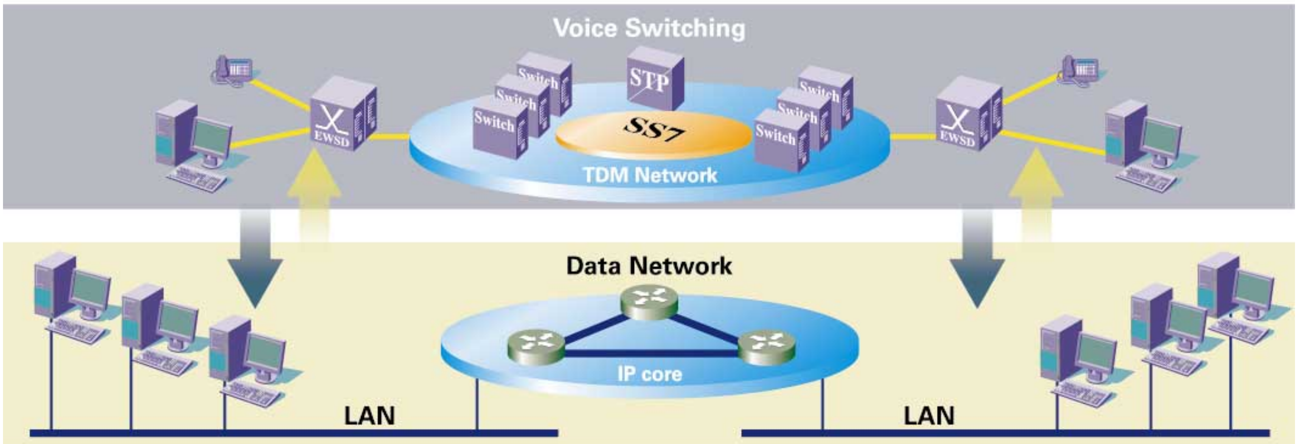


Fig. 8

The next step might be to keep the voice service on the TDM network, but to use the IP network as a backup facility for voice.

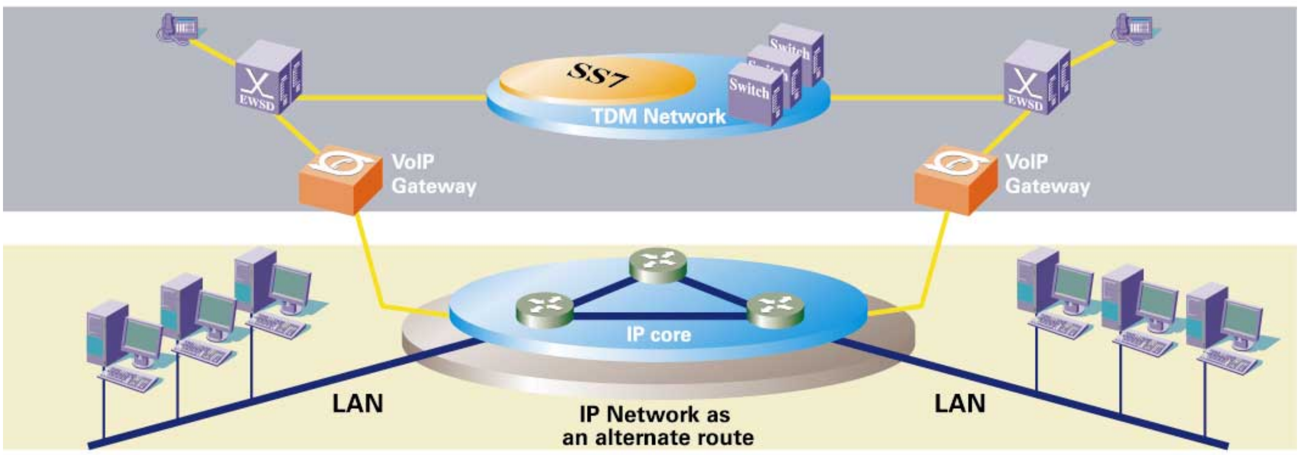


Fig. 9

Suggestions...

The Voice over IP (VoIP) Gateways take voice traffic, compress and packetize it and forward it as IP packets to an IP network, and vice versa. In a second step the signaling and call routing intelligence will be extracted from the network equipment itself and provided on server machines, which will offer the same services on the IP network as on the TDM network. The next step might be to keep the voice service on the TDM network, but to use the IP network as a backup facility for voice.

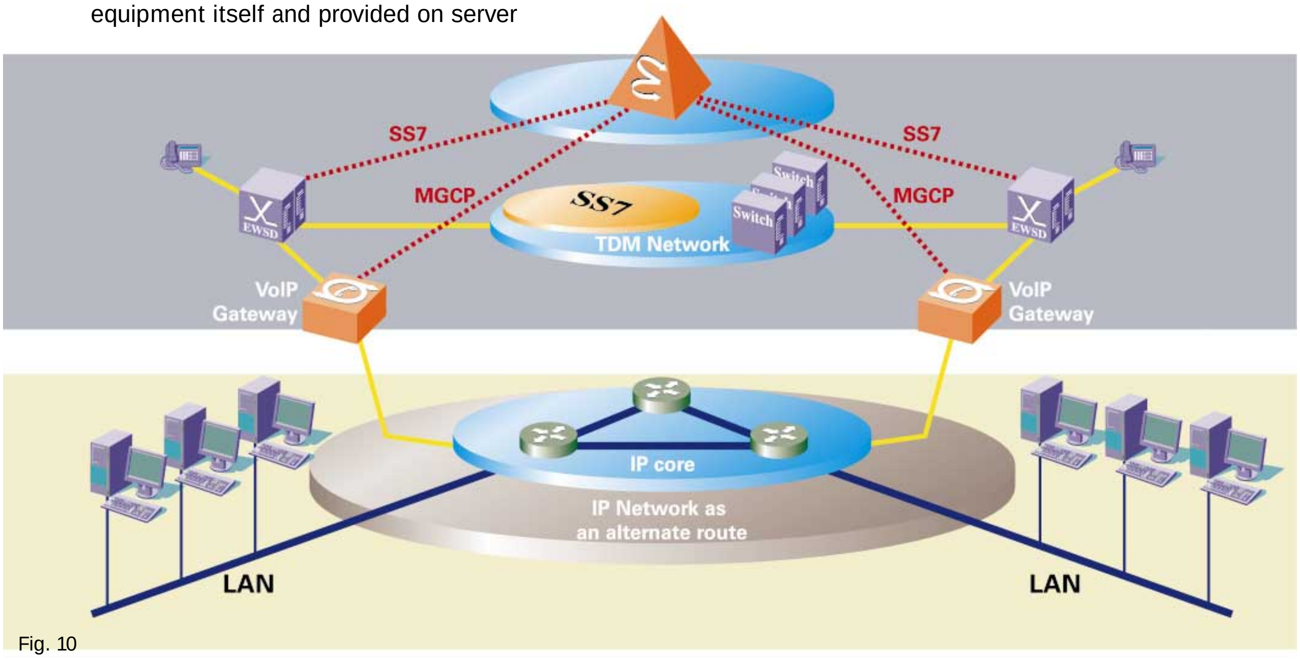


Fig. 10

The next step in the migration path is to switch the voice traffic over to the data network and use the TDM network as backup only at a subsequent stage.

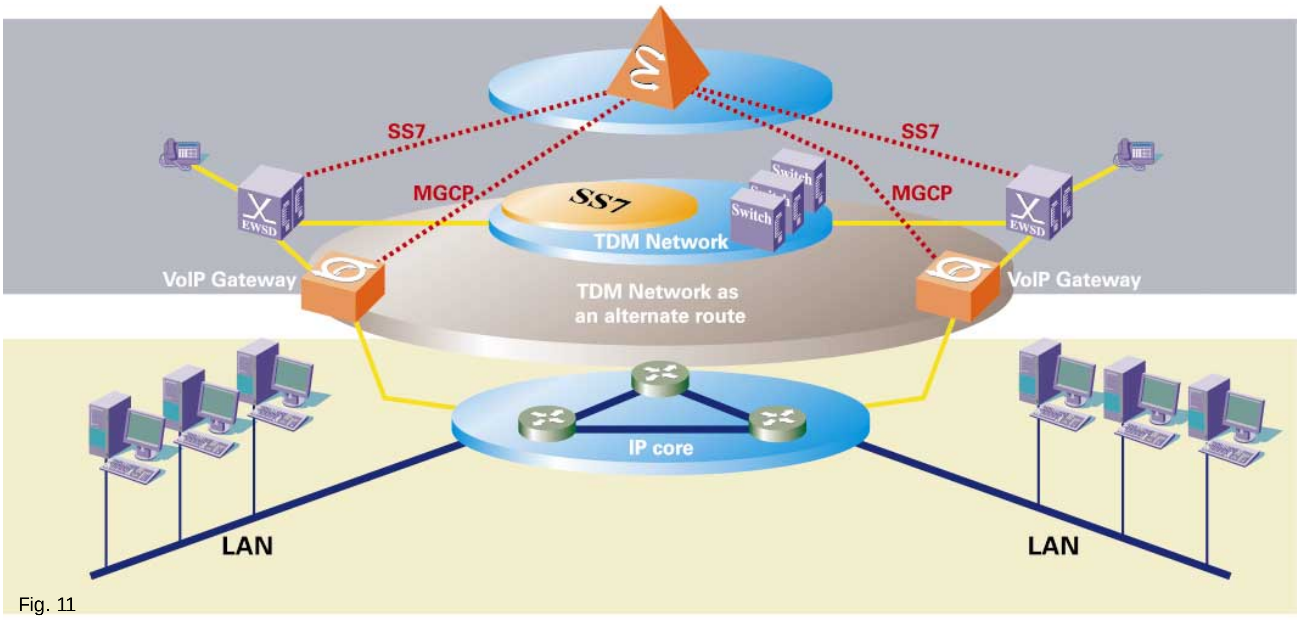


Fig. 11

The final step is to have one single network handling all the traffic. The final building block for this functionality is the introduction of intelligent broadband access devices, controlled by Surpass hiQ via MGCP.

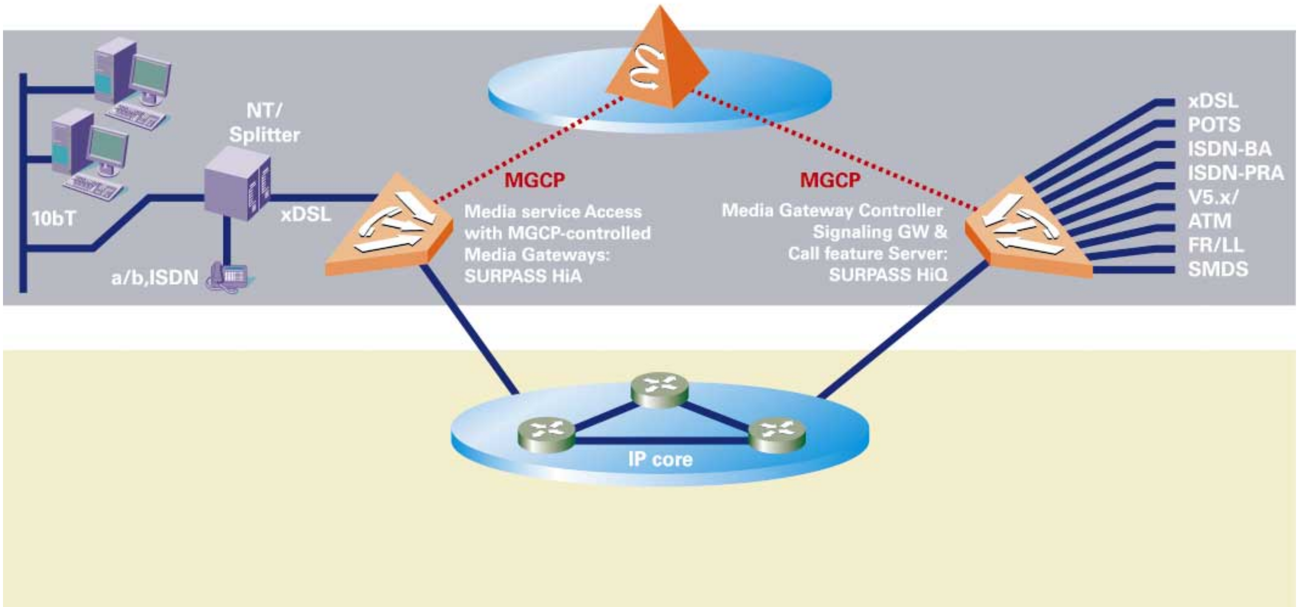


Fig. 12

For further information see also [8].

Suggestions...

6.1.3.3.2. HiPath

HiPath supports new, innovative technologies, applications and services. It offers open application programming interfaces and a distributed architecture, which is represented by the following components:

- The information and communication infrastructure
- The communication platform
- Applications

The information and communication infrastructure components can be built with a variety of technologies and topologies and are not restricted to TDM networks any longer, but backbone networks running widely used standard protocols such as ATM or especially IP. The crucial application is to run VoIP for real time voice traffic, which requires guaranteed QoS via multiple mechanisms, like traffic prioritization (e.g. DiffServ), explicit reservation (e.g.RSVP), voice compression as well as policy based management.

The core of the HiPath architecture is the communication platform, which includes control functions (setting up and handling calls), switching (physical connection between endpoints) and interfaces to the clients (access points).

The communication platform provides

- Access to IP networks
- Access to standard H.323/H.450 based terminals
- Switching of call connections in the IP network (no switching matrix needed any longer, routing and physical location is determined by the underlying IP infrastructure)
- Support of IP QoS

Therefore HiPath makes is possible to have a fully distributed architecture of all components within the Local Area Network as well as across the Wide Area Network based on an ATM or IP infrastructure.

HiPath: Siemens Enterprise Convergence Architecture

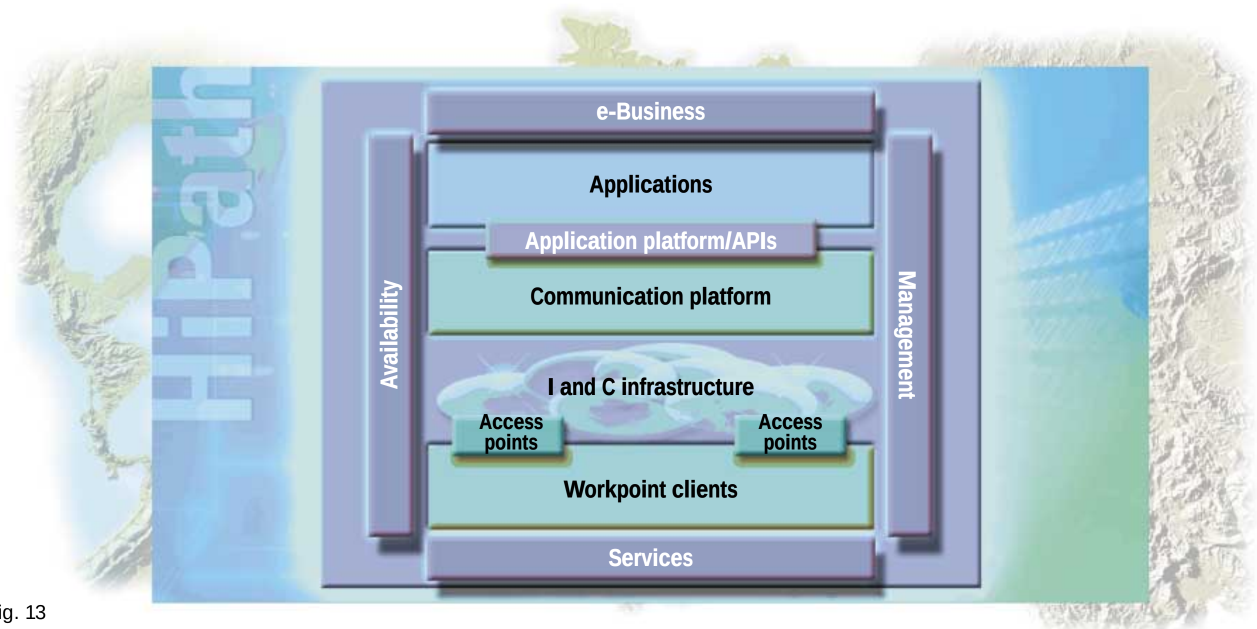


Fig. 13

For further information see also [9].

6.1.3.4 Mobility Services

Fully mobile communication clients enable limited to full-feature access from any location via wireless networks already in place. These client devices will range from industry standard cellular telephones to Siemens wireless clients.

For mobility, the following options are available or will be available soon:

- Hicom cordless E
  (based on DECT/GAP-standard)
- Corporate GSM
  (mobile solution based on GSM) provides Enterprise communication features and billing via GSM wireless handsets. A customer will be able to use his/her Corporate GSM telephone in the office as a system telephone, then when he/she leaves the office it automatically becomes a cellular telephone. The customer still has access to the office and receives calls as if he/she were in the office.
- WirelessLAN
  Provides IP voice and data access via VLAN technology
- Teleworking ClientWorkpoint device can be any of the above. Teleworking clients have the ability to "log on" to the communications platform from any remote location via the information and communication infrastructure (public or private) in place. Provides full feature access and applications to the user as well as those wishing to communicate with that individual. Teleworkers can have the same optiset guide via audio with their teleworking cellular telephone. (see [3])

Suggestions...

6.2 Network Design of Core Networks for Armed Forces

6.2.1 Access Networks in Sparsely Populated Areas

The character of the applications as well as the number of subscribers in sparsely populated areas do not demand high bandwidth as voice and low bandwidth data services only are requested here. Nevertheless there is the need to provide full end-to-end interworking through a core network.

Due to economical and geographical reasons this enforces a special architecture in terms of the topology and technology of these kind of access networks.

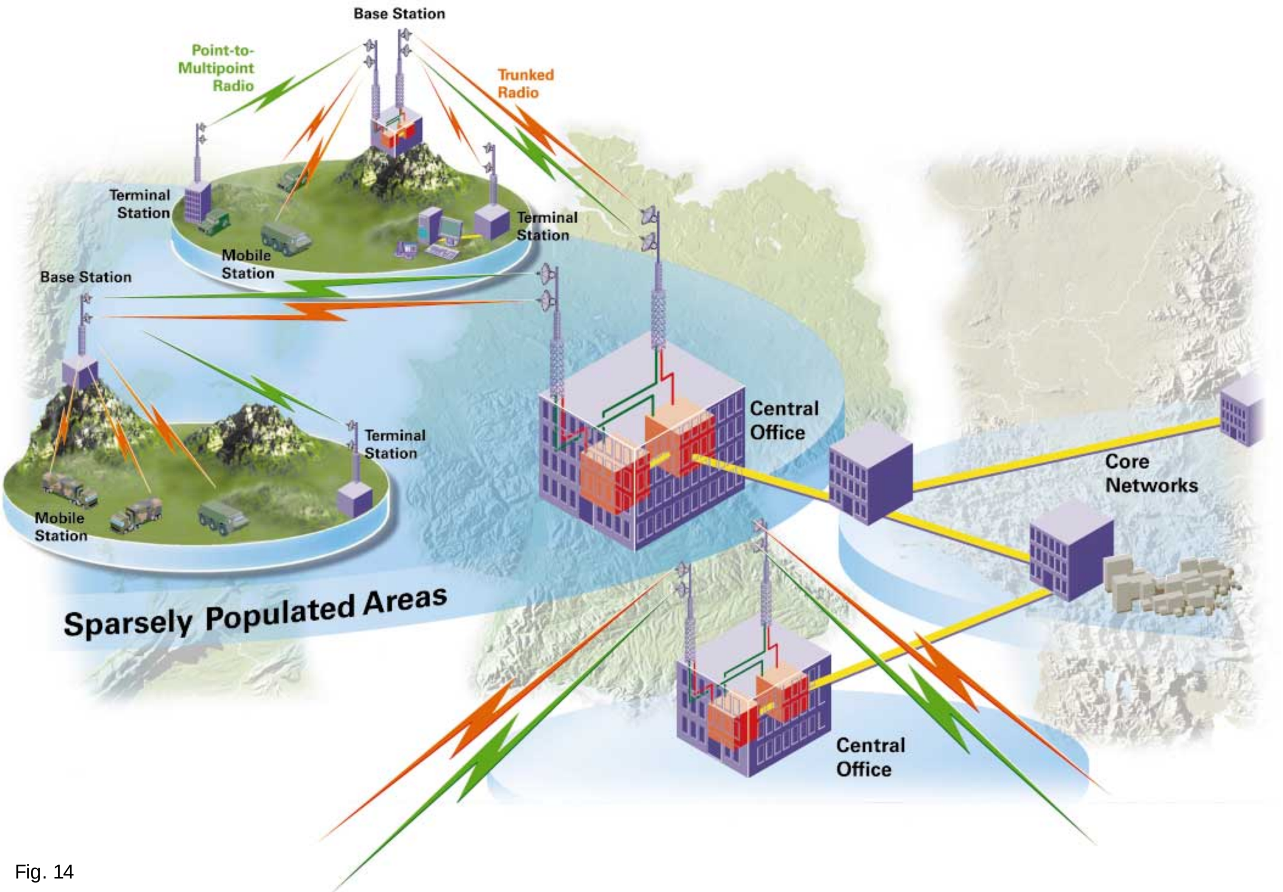


Fig. 14

Sparsely populated areas show up the problem that there is almost no cabling available or even possible, due to economic as well as geographical reasons.

Based on the network design discussed in chapter 4 this should have an impact on the infrastructure and transport layer only. A possible solution is based on radio technology mixed on point-to-point or point-to-multipoint.

Bandwidth and reach are the areas for network capacity and topology and must undergo in-depth network planning. The SDH backbone will be implemented as a dual-ring structure, supporting the necessary availability features such as Path Protection.

PDH or SDH radio equipment will transport traffic from Central Offices in remote locations to the SDH backbone. The traffic within the sparsely populated areas will be collected by point-to-multipoint radio equipment which has to be selected on criteria like reach, geographical topology and costs.

Communication Service equipment will be connected via this transport and infrastructure transparently. The voice services in particular can run directly connected to the PDH/SDH network or on top of a switching and routing network equipment e.g. ATM switched.

Requirements for providing mobile services for the subscribers can be realized by trunked radio equipment (analog or digital). Access calls for a separate infrastructure (base station to mobile terminal). Consolidation of this traffic can be realized in the first central office within the transport network.

Suggestions...

6.2.2 Network Solution for Out-of-Area Intervention

Today's armed forces have to build up fast intervention troops in case of crises. There is a great need to link these troops in the remote location spanning several sites as well as to the base in the home country. Due to the fact that there may be no complete terrestrial infrastructure available in the intervention area, the solution has to cope with:

- Communication to the home country base via communication satellite systems
- Several sites linked via communications satellite systems due to the fact that no terrestrial network is available in time
- Several sites linked via microwave line systems
- Several sites linked via terrestrial links

On top of this transport and infrastructure layer at the communication services layer, requirements may occur for multiple virtual networks with different requirements in terms of service, connectivity and security aspects (common user data networks, secure networks, closed networks,...).

The PABXs will predominantly be connected to the transmission and networked via various satellite links. The camps at A and B will be connected via cables (fiber or copper) or radio (microwave). Some camps may have a connection to the local public network.

Fig. 15

The requirements for the data networks may be split up into so-called classified and unclassified local area networks (LANs), wide area networks (WANs), remote terminal access services (RTAs) and servers/hosts. Typical bandwidth available on satellite links are E1/T1.

- An unclassified common data network that is connected to the worldwide information system of the armed forces organization, to support daily operations
- A secure data network that is connected to a confidential data network for highly confidential information transfer and
- A closed network to support data communications between allied forces in the remote location

These networks have to provide quality of service (QoS) that ensures applications receive the bandwidth and priority they require utilizing IEEE 802.3 standard high speed switching flow control for individual user, servers, and ports, which will be provided by technologies and equipment related to the switching & routing network layer (6.1.2).

The satellite segment consists of commercial-off-the-shelf (COTS) satellite terminals.

The satellite ground station is built in mobile containers to provide the required mobility of the troops for fast movement in the area.

The connection from the satellite ground station to the command and control center is based on radio technology, where all services are transparently transported on top of the transport and infrastructure technology.

Connection to the home base might be organized in star topology via a satellite link.

Suggestions...

6.2.3 Network Solutions for Coastguard Services

Coastguard services represent special task of the armed forces, specifically the navy. The objective of a coast control system is to provide maritime traffic control as well as other coordination and control functions for rescue, port activity, combating smuggling or pollution.

These tasks need to be supported by coastguard systems that include many hardware and software components like

- Detection equipment (radar, direction finder, meteorological stations, tide sensors)
- Communication equipment, including radio equipment with different bands, radio links, switching systems and recorders
- Additional equipment for power supply, security, protection equipment and remote monitoring etc.
- Data processing, including the computers and software

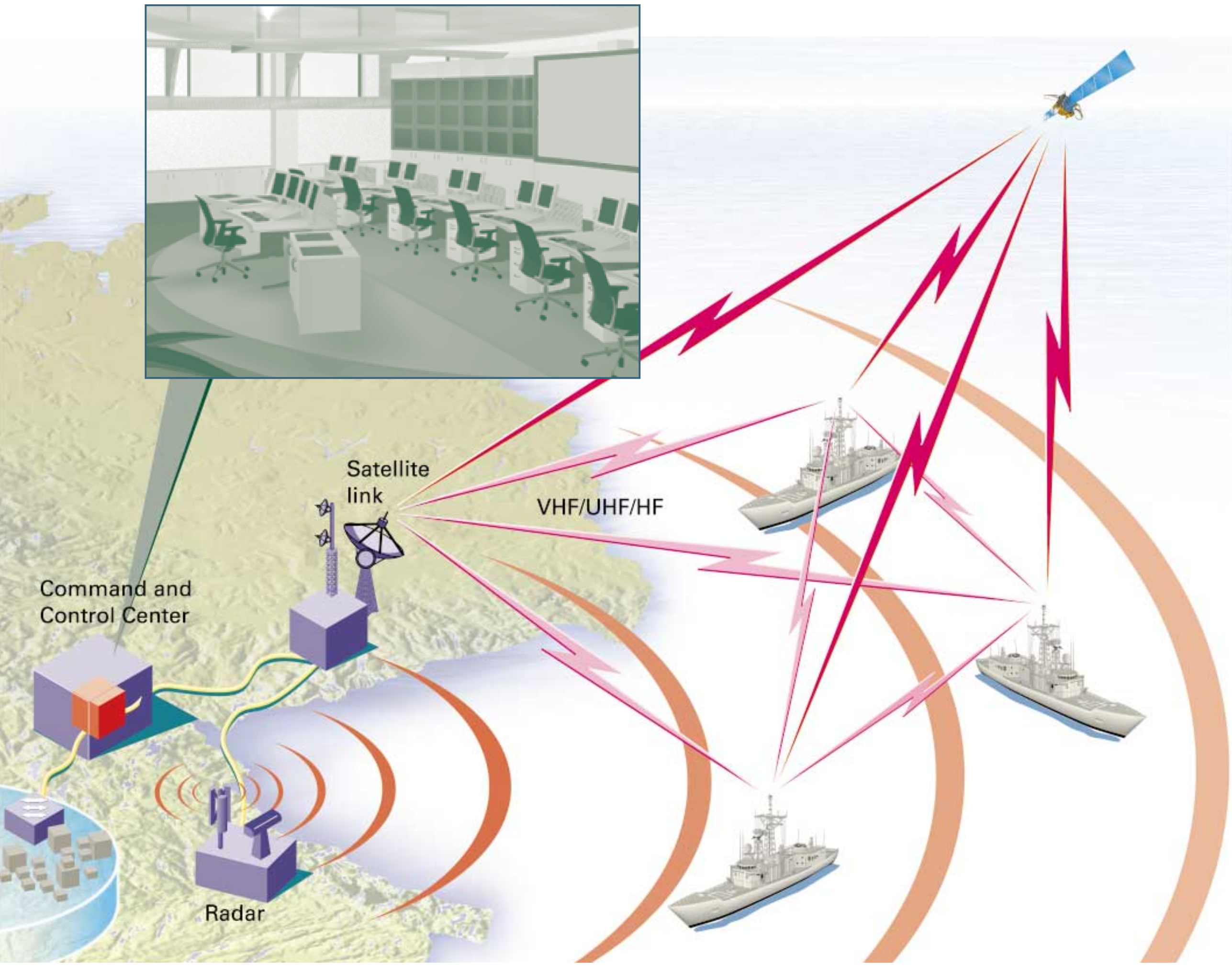


Fig. 16: Coast Guard network solution

The underlying communication network requires a communication infrastructure with special characteristics, as ships are mobile entities which cannot be connected to land based control centers via cabling. It will be realized by special radio equipment such as

- Maritime VHF band, optionally with Digital Select Calling (DSC) modules for communication with ships
- Land VHF band for communication with mobile land forces
- Aeronautical VHF/UHF band for communication with helicopters and aircraft
- Maritime MF/HF band, optionally with DSC modules and radiotelex for communication with ships over long distances
- Links to the fixed network via microwave or leased lines

Maritime communications are regulated by the International Maritime Organization.
IMO regulation includes the Global Maritime Distress and Safety System.
The Global Maritime Distress and Safety System (GMDSS) is a new international system using improved terrestrial and satellite technology and shipboard radio systems. It ensures rapid alerting of shore-based rescue and communications authorities in the event of an emergency.

Although ship-to-ship alerting is still an important function in GMDSS, the emphasis is on two-way communications between ships and shore facilities.

There are four "Sea Areas" defined internationally in the GMDSS:

- Sea Area A1 Within range of shore-based VHF DSC coast station (40 nautical miles)
- Sea Area A2 Within range of shore-based MF DSC coast station (excluding sea areas A1) (150 nautical miles)
- Sea Area A3 Within the coverage of an Inmarsat geostationary satellite (approximately 70°N to 70°S) (excluding sea areas A1 & A2)
- Sea Area A4 The remaining areas outside sea areas A1, A2 & A3 (polar regions)

Taking into account the above, Vessel Traffic Centers must have the ability to communicate with ships via the radio remote sites and have additional radio equipment such as:
VHF equipment

- One local TxRx for Channel 16 (distress).
- Several TxRx for the working channels assigned to the VTS Center.
- Optional equipment can be aeronautical VHF for communication with aircraft and helicopters, and terrestrial VHF for communication with land resources.

On top of this special infrastructure and transport layer, interfaces are today available to

- Wired transport layer equipment (PDS/SDH multiplexer)
- Equipment of the switching & routing Network Layer, like multiservice nodes and routers
- Communication Service Layer equipment like PABXes, where, for example, analog or ISDN service will be available between the control center and the ships

Suggestions...

6.3 Security

Security matters are of ever-increasing importance to our clients. Therefore carefully thought-out security measures are an important component of our solutions:

- Comprehensive security advice,
- Security components for integration in existing I+C environments,
- Provision of complete solutions for secure I+C networks.

The potential risks can vary considerably, depending on the business involved. They require a security solution adapted to suit the environment in each case. Since networks are becoming increasingly accessible from the outside, Siemens also provides concepts for the reliable authentication of persons as well as for encryption.

A detailed description of this integration of security concepts and solutions for the link-up of networks in properties will be found in the White Paper "Security" [10].

6.4 Network and Service Management

Network management includes the central monitoring, regulation and control of all network components. This must be guaranteed even in critical situations. In order to provide security against failure, the connections between the network elements and the network management system can be secured redundantly via separate line routing. For external situations secure provision can be made for the individual network elements to be administered via Local Craft Terminals.

As pointed out in the previous sections, today's networks consist of many different technologies and services in order to fulfill the requirements of armed forces users.

A wide variety of network elements by different providers and using different technologies make these services available. Hence the following typical management questions arise:

- How can I integrate these different network elements and their related services into my IT infrastructure and my business processes?
- How can I complete this integration work within a short period of time and with a high degree of cost-efficiency?
- How can I maintain stable management integration considering the number of new network element releases in the future and the introduction of further network elements and new services inline?
- How can I build up an open management system that will easily integrate new technologies, new networks and new services in future as well?

The answer to all these questions is the Siemens Service & Network Management Solution (S&NMS), which is primarily optimized for Siemens network elements but which also permits the integration of non-Siemens equipment and services.

An efficient network and service management system links the communications network with a modern IT infrastructure and supports business processes.

The S&NMS solutions are geared towards a clear management architecture with:

- Dedicated data & file servers and connection servers to network element data
- Specialized application servers
- Thin clients with (WWW-capable) graphical user interface.

S&NMS is built on best-in-class element management applications. These include features for configuration management, test management, performance management and fault management with electronic manual support for fast and efficient fault clearance.

The building blocks include applications for

- Domain Element Management
- Domain Network Management
- Cross-Domain Network Management
- Domain Service Management
- Cross-Domain Service Management
- Customer Care and Billing
- Trouble Ticketing
- Inventory Management
- Etc.

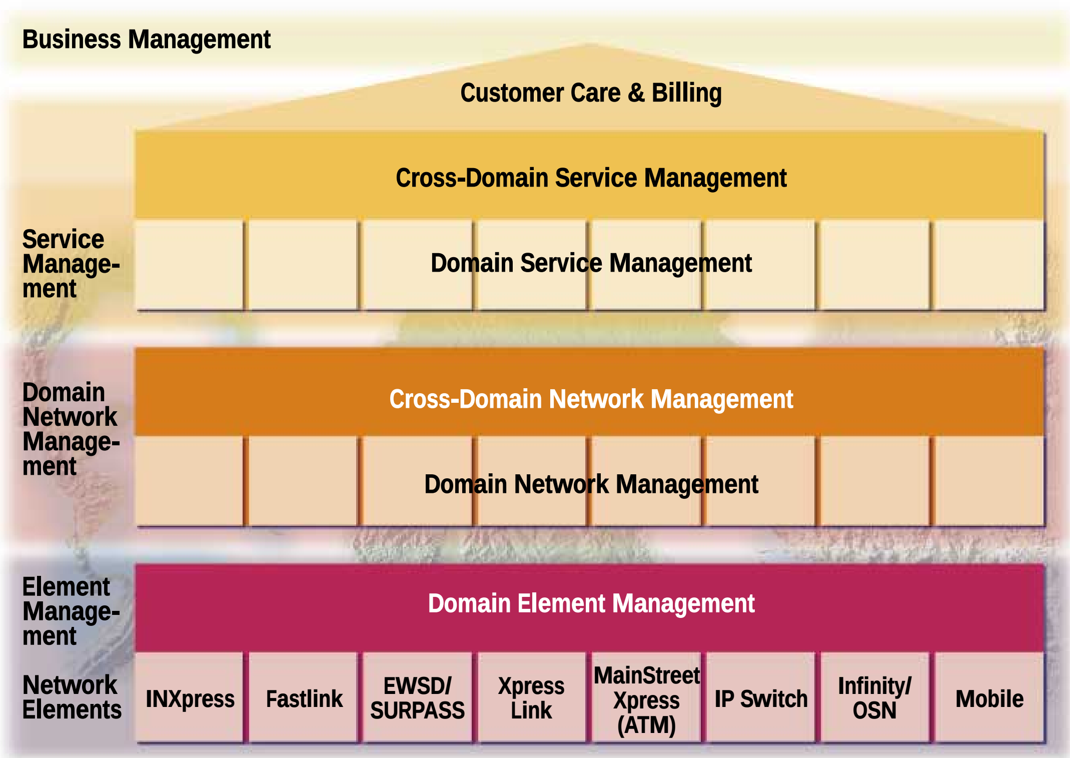


Fig. 17

A detailed description of all components of our S&NMS solutions can be found in our brochure "Multi-Service Network Management at your Fingertips."

7. Conclusion ...

Infrastructures are long-term investments due to their very nature. In spite of the high speed with which innovation continues to progress, this observation also applies within the telecommunications sphere to networks, especially of course those in the backbone sphere. Any re-design of networks which may already exist, including the technical execution, must constantly bear in mind the economic aspects, a factor which in general only permits an evolutionary approach. An evolutionary approach means that existing network projects, including those currently under construction or in planning, must be taken into account. Another important point is the qualification of the staff necessary for the operation of the network. In most cases it will therefore be necessary to carry out the redesign of the network in a number of stages. The planning must ensure that it is possible to fall back at any time upon a functioning network. Therefore, any concrete proposal for a solution must start with an analysis of the existing network infrastructure.

Common for all these projects is, that they are normally on a nationwide scale, but may extend to a regional or world-wide scale. Although the use of commercial off the shelf products is highly recommended, a significant degree of customization and integration has to be carried out.

Siemens is the competent partner for the realisation for networks in the military sector due to

- Worldwide support presence and capabilities
- Technological credibility & expertise (espec.IP)
- Understanding of customer’s business
- Pre-sales competence & profess. services
- Ability to build leading edge I&C solutions
- System integration capabilities
- Ability to deliver the solution
- Partnership expertise
- Single point of contact (SPOC)
- Broad product portfolio
- Brand/market leadership
- Network manageability
- Distribution/channel development expertise

8. Links ...

1	http://www.siemens.com/transport-networks
2	Link to VIS-Homepage: http://www.siemens.com/vis Link to VIS-Products: http://www.ic.siemens.com/networks/gg/vis/ourpro.htm
3	Whitepaper “Mobility“ : Order Number: A50001-N1-W132-7600 Link to VIS-Homepage: http://www.siemens.com/vis Link to VIS-Products: http://www.ic.siemens.com/networks/gg/vis/ourpro.htm
4	http://www.siemens.com/ipsolutions http://www.ic.siemens.com/networks/gg/ib/ps.htm
5	http://www.siemens.com/ewsd
6	http://www.siemens.com/hicom
7	http://www.siemens.com/ipsolutions
8	http://www.siemens.com/surpass
9	http://www.siemens.com/hipath
10	Whitepaper "Security" Order Number: A50001-N1-W108-7600 Link to VIS-Homepage: http://www.siemens.com/vis Link to VIS-Products: http://www.ic.siemens.com/networks/gg/vis/ourpro.htm
11	Broschüre “Multi-Service Network Management at your Fingertips“: Order Number: A50001-N2-W15-1-7600 Link to WN-Homepage: http://www.siemens.com/wireline

Glossary . . .

ATM	Asynchronous Transfer Mode Very high speed transmission technology. ATM is a high bandwidth, low-delay, connection-oriented, packet-like switching and multiplexing technique.
B2B	Business to Business
BRI	Basic Rate Interface One of two subscriber 'interfaces' in ISDN. The other one is PRI (Primary Rate Interface).
CENTREX	A business telephone service offered by a local telephone company from a local central office. It is basically a single line telephone service delivered to individual desks, with some features added. These features include intercom, call forwarding, call transfer, toll restrict, least cost routing and call hold.
CES	Circuit Emulation Service An ATM term. The ATM Forum circuit emulation service interoperability specification specifies interoperability agreements for supporting Constant Bit Rate (CBR) traffic over ATM networks that comply with the other ATM Forum interoperability agreements. Specifically, this specification supports emulation of existing TDM circuits over ATM networks.
CORNET	A Siemens protocol for PBX-to-PBX signaling over a Primary Rate connection.
COTS	Commercial Off The Shelf
DECT	Digital European Cordless Telecommunication The pan-European standard based on time division multiple access used for limited-range wireless services. Based on advanced TDMA technology, and used primarily for wireless PBX systems, telepoint and residential cordless telephony today, potential uses for DECT include paging and cordless LAN.
DPNSS	Digital Private Network Signaling System A standard in Britain which enables PBXs from different manufacturers to be tied together with E-1 lines and pass calls transparently between each – as easily as if the phones were extensions off the same PBX and were simply making intercom calls.
DSC	Digital Selecting Calling A synchronous system developed by the International Radio Consultative Committee (CCIR), used to establish contact with a station or group of stations automatically by radio.
DSLAM	Digital Subscriber Line Access Multiplexer A new technology being developed to concentrate traffic in ADSL implementations through a process of TDM at the central office or remote line shelf.
DWDM	Dense Wavelength Division Multiplexing A SONET term. High-speed versions of WDM, which is a means of increasing the capacity of SONET fiber-optic transmission systems through the multiplexing of multiple wavelengths of light.
EUTELSAT	EUropean TELecommunications SATellite organization Inter-governmental organisation that aims to provide and operate a communications satellite for public intra-European international telecommunications services.
EWSD	Name of digital central office switches from Siemens Stromberg-Carlson
FR	Frame Relay An access standard defined by the ITU-T in the I.122 recommendation, 'Framework for Providing Additional Packet Mode Bearer Services'. Frame relay services, as delivered by the telecommunications carriers, employ a form of packet switching analogous to streamlined version of X.25 networks.
GAP	Generic Access Profile A wireless term.
GPS	Global Positioning System A satellite system to allow us all to figure out precisely where we are anywhere on earth.
GSM	Groupe Speciale Mobile, now known as Global System for Mobile Communications. It is the standard digital cellular phone service in Europe, Japan, Australia etc. GSM actually is a set of ETSI (European Telecommunications Standards Institute) standards specifying the infrastructure for a digital cellular service.
H.323 / H.450	This ITU-T standard defines a set of call control, channel setup and codec specifications for transmitting real-time voice and video over networks that don't offer guaranteed service or quality of service – such as packet networks, and in particular Internet, LANs, WANs and Intranets. This ITU-T standard defines the the negotiation and adaptation layer for video and audio over packet switched networks.
HDSL	High-bit-rate Digital Subscriber Line The most mature of the xDSL technologies, HDSL allows the provisioning of T-1/E-1 local loop circuits much more quickly and at much lower costs than through conventional means.

Glossary . . .

HF	High Frequency, see also VHF
Hicom	Name of a Private Branch exchange switch from Siemens
IN	Intelligent Network
INTELSAT	INternational TELecommunications SATellite organization. A worldwide consortium of national satellite communications organizations.
IP	Internet Protocol The most important of the protocols on which the Internet is based. It's a standard describing software that keeps track of the Internetwork addresses for different nodes, routes outgoing messages, and recognises incoming messages.
IPovATM	IP over ATM
IPv6	Internet Protocol Version 6 The new proposed Internet Protocol designed to replace and enhance the present protocol which is called TCP/IP, or officially IPv4.
ISDN	Integrated Services Digital Network
IT	Information Technology Frequently used term for data processing
ITU	International Telecommunications Union
LAN	Local Area Network A short distance data communications network (typically within a building or campus) used to link together computers and peripheral devices (such as printers) under some form of standard control.
MGCP	Media Gateway Control Protocol
MPEG	A series of hardware and software standards designed to reduce the storage requirements of digital video, developed by the Moving Pictures Expert Group, an International Standard Organization (ISO) group responsible for the standardisation of coded representations of video and audio signals.
MPLS	MultiProtocol Label Switching
MSC	Mobile Switching Center A switch providing services and coordination between mobile users in a network and external networks.
MSP	A general purpose programmable switch.
MUX	MUltipleXer Electronic equipment which allows two or more signals to pass over one communications circuit
NATO	North Atlantic Treaty Organization
NGN	Next Generation Network
NTSC	National Television Standards Committee [of Electronic Industries Association (EIA) that prepared the standard of specifications approved by the Federal Communications Committee in 1953 for commercial broadcasting.] The initials are used to describe the standard method of television transmission in U.S., Canada, Japan, Central America and half of South America.
OSI	Open Systems Interconnection The only internationally accepted framework of standards for communication between different systems made by different vendors.
PABX	Private Automatic Branch eXchange An automatic PBX, i.e. without an operator. Nowadays an obsolete term, as all PBXs are automatic and therefore called PBXs.
PBX	Private Branch eXchange A switch inside a private business.
PDH	Plesiochronous Digital Hierarchy Developed to carry digitized voice over twisted pair cabling more efficiently.
PDN	Public Data Network A public network for the transmission of data
PRI	Primary Rate Interface The ISDN equivalent of a T-1 circuit.
PSTN	Public Switched Telephone Network An abbreviation used by the ITU-T, simply refering to the local phone company.
PVC	Permanent Virtual Circuit A permanent association between two DTEs (Data Terminal Equipment) established by configuration.
PVP	Permanent Virtual Path
QoS	Quality of Service A measure of the telephone service quality provided to a subscriber.
QSIG	An emerging signaling and control standard for PINX-to-PINX (Private Integrated Network eXchange) applications.
RSVP	Resource ReserVation Protocol An IETF (Internet Engineering Task Force) standard designed to support resource (e.g. bandwidth) reservations through networks of varying topologies and media.
SatCom	Satellite Communications The use of geostationary orbiting satellites to relay information.
SDH	Synchronous Digital Hierarchy A set of standard fiber-optic-based serial standards planned for use with SONET and ATM in Europe.
SDSL	Symmetrical Digital Subscriber Line A nonstandard version of HDSL plus POTS (Plain Old Telephone Service).
SIMUX	Name of a multiplexer product family of Siemens
SNA	Systems Network Architecture
SNMP	Simple Network Management Protocol The most common method by which network management applications can query a manag-ment agent using a supported MIB (Management Information Base). It operates at the OSI application layer.

SONET	Synchronous Optical NETwork An optical interface standard that allows inter-working of transmission products from multiple vendors.
SPVC	Switched Permanent Virtual Circuits
SS7	Signaling System 7 It provides two major capabilities: fast call setup, via high-speed circuit-switched connections and transaction capabilities which deal with remote data base interactions.
SSP	Service / Signal Switching Point A PSTN switch (End Office or Tandem) that can recognise IN calls and route and connect them under the direction of an SCP (Service Control Point).
SVC	Switched Virtual Circuit A virtual circuit connection established across a network on an as-needed basis and lasting only for the duration of the transfer.
TCP	Transmission Control Protocol A transport layer, connection-oriented, end-to-end protocol. It provides reliable, sequenced and unduplicated delivery of bytes to a remote or local user.
TCP/IP	Transmission Control Protocol / Internet Protocol A networking protocol that provides communication across interconnected networks, between computers with diverse hardware architectures and various operating systems.
TDM	Time Division Multiplex A technique for transmitting a number of separate data, voice and/or video signals simultaneously over one communications medium by quickly interleaving a piece of each signal one after another.
UDSL	Unidirectional HDSL A variation on the HDSL theme proposed by a small group of companies in Europe.
UNI 3.1 / 4.0	User Network Interface The physical, electrical and functional demarcation point between the user and the public network service provider.
V.35	ITU-T standard for trunk interface between a network access device and a packet network that defines signaling for data rates greater than 19.2 Kbps.
VHF	Very High Frequency The portion of the electromagnetic spectrum with frequencies between 30 and 300 MHz.
VLAN	Virtual Local Area Network Work stations connected to an intelligent device which provides the capabilities to define LAN membership.
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network A public circuit-switched data service offered by IXCs (long distance phone companies) and making use of the PSTN (Public Switched Telephone Network).
WAN	Wide Area Network Uses common carrier-provided lines that cover an extended geographical area.
WDM	Wavelength Division Multiplexing A technique in fiber-optic transmission for multiplexing multiple light wavelengths in order to increase the capacity of the system, much as Frequency Division Multiplexing (FDM) in the analog world of electrical and radio transmission systems.
Web	Abbreviation for the Internet's World Wide Web.

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