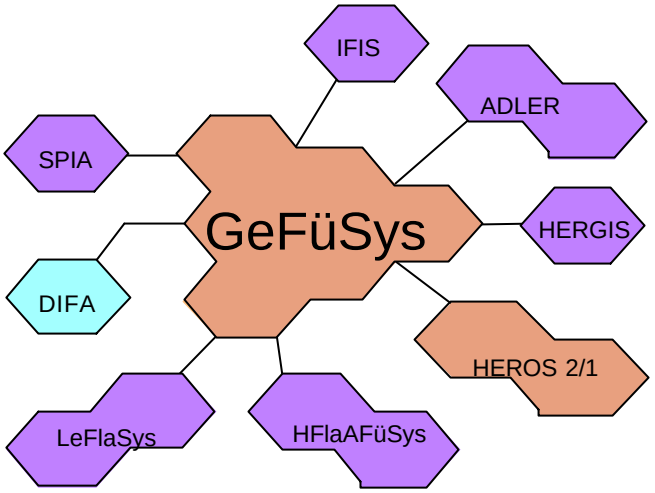
Universal Communications Server for Mobile, Tactical Networks

1. Requirement Situation

Improving the command and communication capability by using data processing systems is a topic pursued with high priority by the Federal Armed Forces and all NATO partners.

In addition to the compatibility and interoperability between different subsystems or types of weapons, the communication capability with the NATO partners is gaining more and more significance. Special efforts with respect to a solution which covers several command and organisation levels are being made in Germany at present.

Practical experience is gained in the "Schwarzer Ritter" field test which started in the year 2000. One of the most important subcomponent of the data processing equipment is the communications server described below.



overview of the communication network of various army C³I and weapon systems of the German Army

2. Characterisation of the Existing Military Environment

In general, it cannot be assumed that optimum equipment conditions with respect to available equipment, computers and software technology exist. Therefore, a system approach is required which can include a heterogenous system and equipment environment and which is open for future requirements.

Characterised by the tactical operational requirements, the high number of different systems introduced with mostly proprietary design, the different prerequisites for integration capability make a universally applicable solution almost impossible at first glance. One faces essentially the following aspects:

- Terminal-dependent interfaces:
  Universally applicable access interfaces can hardly be found with the previously introduced terminals. Differences begin already with cabling and plug technology and extend over the number of signals up to equipment-dependent access protocols.
- Special protocols/transport mechanisms:
  In the past, optimized transmission procedures based on program-specific requirements were developed and introduced at the transport level. This makes interoperable communication impossible already at the lower levels of the ISO reference model.
- Specific message handling systems and message formats:
  Even at the upper layers of the ISO model, uniform features can hardly be recognised. Most of the programs introduced have specific message handling systems and proprietary message formats.

– Different requirements with respect to modular technology and installation capability.
With respect to the usage profile, very different requirements are placed on the hardware of the data processing systems. For example, the mobile soldier – the soldier of the future – requires light-weight, sturdy equipment which is easy to operate.
However, for command posts which possibly also have airconditioning, industry-type data processing equipment can be used as opposed to vehicles and weapon systems on wheels or tracks which have increased requirements on the mechanical configuration. In addition, it must be taken into account that every vehicle and weapon system has specific requirements with respect to installation capability and mechanical load capability (vibration, shock, resonance frequency).

3. Economical Aspects of the Communications Server Concept

It is evident that the investments made for the introduced systems must be protected. In particular, the existing technical communication equipment, e.g. radio equipment, must be included.
This challenge can only be achieved with a solution approach which considers the following asepcts:

– Use of commercial standards

– Universally applicable use of core components

– Modular construction concept with extension and integration capability of existing systems (heterogenous approach)

– Long-term supportability

4. Application Options of Communications Server Familiy MCS 2000 KS

According to the different platform requirements, the presented communications server is to be found for different application options as:

– Autonomous equipment with router function in command posts

– Integrated subsystem in a workplace for small, mobile command posts or commander workplace in a combat tank, observation vehicle or similar (Fig. 1)

– Autonomous equipment with gateway function for creation of interoperability between proprietary national or Nato partner systems

Fig. 1 Command Post Equipment with Communications Server

5. Hardware Architecture and Modular Variants

The use of commercial software standards inevitably results in the following solution methods.

- Open system architecture by means of PC technology
- Use of communications processors which are universally applicable for tactical networks and transmission components
- Determination of standardized interfaces in hardware and software

A PC-based architecture, because of its wide distribution especially in industrial automation technology, offers components which are optimally suitable for compact and ruggedized configurations.
The communications processors used by ATM have already been introduced in various projects and their structure is independent of the host system. This ensures portability and interoperability and represents at the same time an enormous economical advantage and risk minimization in the project.

5.1 Main Characteristics of MCS 2000 KS (Fig. 2)

The physical separation of the processor and the subnetworks relieves, on the one hand, the CPU and decisively ensures, on the other hand, the flexibility with regard to functional extensions and variant formations. The basic concept will be desribed by the example of the MCS 2000 KS which is used as a variant in the "Schwarzer Ritter" field test.

Fig. 2 MCS 2000 KS-D

Properties:

- Intel Pentium processor
- Compact design (300x300x50/95 mm)
- Hard disk or flash disk
- Integrated communications processor KM1
  for simultaneous operation of several interfaces, for example VHF (SEM93, SEM80/90), HF. Autoko II/90, BwGN
- Integrated FA16-K radio link adapter for radio data transmission via SEM 80/90
- Ethernet 10, Base 2
- 2 PCMCIA controller
- 3 free slots for PC boards for more subnetworks
- WIN NT 4.0

5.2 Communications Processor KM1 (Fig. 3 and Fig. 4)

KM 1 is the core of the ATM communications server.

This component which is being used in other projects (LeFlaSys, Gepard, COBRA,...) guarantees with its processor power a high throughput and, in combination with the onboard real-time system, the processing of time-critical protocols and interface signals of the user equipment. With its universal programming capability it provides sufficient flexibility for the connection of proprietary software interfaces, protocols and special functions.

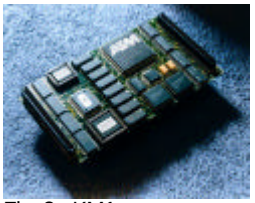


Fig. 3 KM1

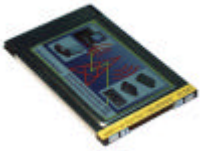


Fig. 4 KM1
as PCMCIA Board

The KM1 processor is universally usable and can be integrated in practically all standard HOST systems.

The protocols which can run on the KM1 are loadable. This provides the required flexibility for the configuration of the subnetworks.

At present, the following protocols can run on KM1 or are being developed

- ECCM, HDLC for VHF equipment SEM93 / SEM80/90
- HF-radio for MAHRS and HRS
- Autoko II/90, BwGN with PPP protocol and modem with dial protocol V25bis
- SatCom (Inmarsat C)

Third-party radio equipment and tactical networks are correspondingly easy to implement. Interface extensions, e.g. ISDN, LAN-Ethernet, GSM, etc. can be integrated with standard components on the free subnetwork positions.

The selection of a PC architecture is advantageous especially when a high number of interfaces/subnetworks is required in command post configurations.

6. Software Architecture

On the software side, a communications server can keep pace with the evolution in the continuously progressing IT environment only when, on the one hand, the special military requirements and situations, and, on the other hand, the innovation of software products which today is brought about by most operating systems, are taken into account.

The figure shows the software architecture, a symbiosis of standards and special adaptations, resulting from military situations.

Today, the de facto standards for the transmission of messages are SMTP and IP technology of which the worldwide Internet is a practical example.
It therefore offers itself to integrate the military world with its special terminals and, to some extent, special protocol mechanisms and message procedures, in the standard world.

ATM, with its KM1 communications processor, has created the basis for integrating special military networks with different physical interfaces and optimized transmission protocols in the IP world.
Standardized interfaces, for example, LAN, ISDN, etc., can be integrated in parallel. Above the TCP/UDP layer, the structure is similar.

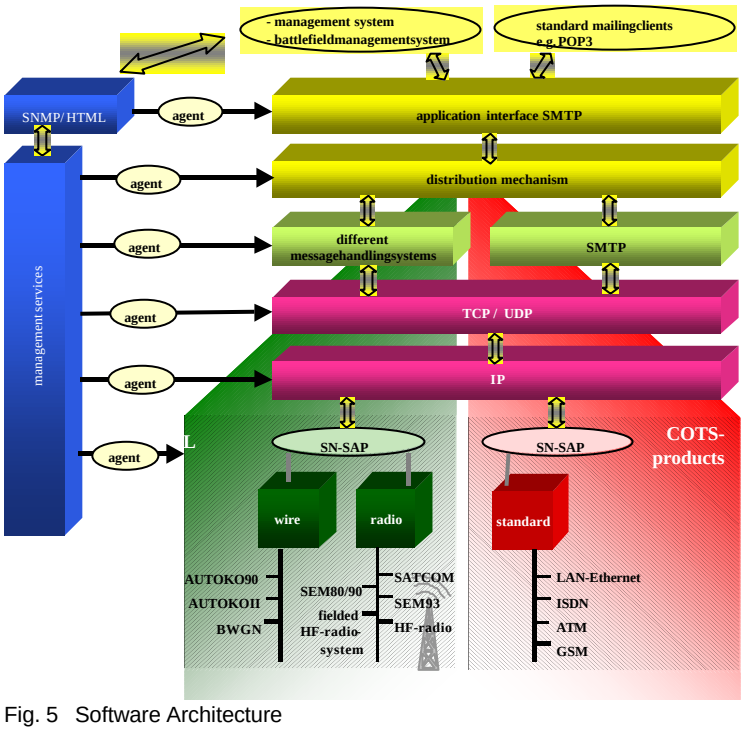


Fig. 5 Software Architecture

Suitable military services, for example, various message handling systems (MHS) meet standards, ESMTP for example, requiring co-existence in the meaning of a global platform. For the radio networks, ATM has implemented here the GOTS[1)] product TMHS[2)] and for the wide-band networks, the ISO message handling system X.400.

To ensure gateway functionalities, a message distributor is integrated above the MHS layer which ensures link mechanisms between the different networks. The communications server thus achieves the elementary function of representing the link between proprietary systems or standards.

As an interface to the superordinate applications, such as standards browsers or command systems, the communications server uses the SMTP standard interface.
To take into account the globality of the communications server, all individual functions have management agents which are provided via a central service to the user via an SNMP or HTML interface.

7. Future Functional Extensions

The PC architecture and predefined software architecture offer the potential for retrofitting very simple additional functions.
Examples: IPV6

IP Security

Voice over IP

Special message handling systems

8. Technical Outlooks

- The miniaturization of electronics will make possible portable, light-weight equipment for the "soldier of the future". This is important under the aspect and with the objective of a universal software architecture in the future Army command system.
- The challenges of the operational duration of batteries and low-temperature discharge characteristics will continue to exist.
- Modular structures can be realized with the communications server concept presented.
- The market dynamcis of the PC products can be controlled with a modular concept with respect to extendibility and product maintenance.

[1] GOTS = government off the shelf
[2] TMHS = tactical message handling

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