HYTAS: The Modular Hybrid Access System
Any bandwidth over optical fibers or copper lines, a system ready to grow
ke – a young company with a long tradition

The roots of ke Kommunikations-Elektronik GmbH go back to kabelmetal electro, which was founded more than 100 years ago as a cable manufacturing company. Later the production of optical fibers was added to the portfolio.

Innovative solutions for the efficient use of electrical and optical transmission media have since then been the special focus of ke.

It all started as a department which was formed within the data transmission section of kabelmetal in 1980. Soon, this department became an important player in a booming market segment. By provisioning its optical line equipment for 34Mbps and 140Mbps along with its line multiplexing systems, even in large quantities, the young and highly motivated team managed to become an established provider of telecommunications equipment.
In 1990, ten years after its foundation, the department became an independent enterprise: ke Kommunikations-Elektronik GmbH was founded as part of the Alcatel group. Only one year later ke started delivering its first 2Mbps transmission systems for the access network.

When in 1994 HYTAS, the first hybrid telecommunications access system, was put into operation the company set a new standard for the transmission of high bitrates over the last mile and for the efficient operation of mixed copper and fiber networks with just one access system.

By 1997 Deutsche Telekom had already connected 3.5 million subscribers with HYTAS, and only one year later, the total number of customers receiving voice and data services via HYTAS had risen to 5 million. Today 30 operators in eight countries use HYTAS technology.

The company continues setting the pace for more effective transmission over the last mile: With their other product line – the LineRunner system family – ke has for the first time developed a comprehensive system family for 2Mbps transmission on all common transmission media and including the latest technology in this sector: SHDSL according to ETSI standards.
Innovative engineering, excellent customer support, and flexible solutions for their customers’ applications: This is what ke stands for.

Full service is one of the chief company goals: ke provides end-to-end support, from the initial planning phase of a project right up to the maintenance necessary for entire networks and including system installation, hardware and software training as well as system commissioning.
Even existing conventional copper networks have the potential for much more performance. HYTAS activates it.

The world of telecommunications is experiencing unparalleled changes. The growing range of services – a response to market demands – is extending the boundaries of telecommunication at ever shorter intervals. Teleworking, telemedicine, telelearning and telepublishing are already taking off. Applications for the home such as e-commerce, fast Internet, telebanking and many other online services make this new form of telecommunications of interest to everybody. The number of new applications as well as their range of services require transmission capacities far beyond 2Mbps. The growing market demand calls for an access network that can be configured according to requirements and that can flexibly allocate appropriate bandwidths. The solution is HYTAS, together with its management system KENOS, which ensures efficient and economical network operation.

HYTAS connects today with tomorrow
HYTAS is a HYbrid Telecommunications Access System. It's transmission components are designed for the use in both fiber and copper networks. Using optical as well as electric transmission technology, HYTAS provides the access to high-bitrate telecommunications services.

KENOS – Convenience in network management
The network management system KENOS rounds up the HYTAS concept. KENOS is a convenient communication and management platform, which provides access to all components of the access network, including the units installed at the subscriber’s premises. Even complex functions such as automated service provisioning or the generation of detailed operation reports are just a matter of a keystroke or a mouse click at the central management server.
A system that grows along with your needs

Any »status quo« in which a network operator finds himself is the right starting point for introducing HYTAS technology. No matter whether a large network is to be made more efficient, an analog network is to be digitalized, or whether you want to extend a small network or set up a completely new one.

HYTAS is the system for networks of all sizes – future-proof technology which has successfully been installed in large area networks as well as in regional and municipal networks. The migration ability is an integral part of the HYTAS concept. Starting from a minimally configured access network, the system grows with the needs of the network operator.

HYTAS unites the transmission capacities for narrowband and broadband in a single system

HYTAS provides the means of introducing fiber optic technology step-by-step into the access network. This allows the network operator to offer flexible subscriber services from the start, while keeping investment at a minimum.

The first step of network expansion with HYTAS is simply making better use of the existing network infrastructures. A decisive improvement in performance is gained just by exchanging the transmission modules:

- Connection of up to 30 subscribers per copper pair
- Wide range of standardized interfaces and protocols of all bandwidths
  ... towards the network
  - 2Mbps, V5.x, ATM, STM-1
  ... towards the subscriber
  - ISDN-BRA/PRA, PMX, HDSL, SDSL, ADSL, POTS, Ethernet 10/100 BaseT, X.21

HYTAS accompanies the network operator way beyond this initial step. The system grows dynamically along with the demands of a modern telecommunications environment and provides the network operator with the right technology for flexible data transmission in all the necessary bandwidths, not only for dial-up lines but also for leased lines.

HYTAS/KENOS – high performance technology that makes your life easier

No more crossed wires, fiddly screws, trial and error installations. HYTAS has a modular design, which means modules are simply plugged into their slots – whether at the subscriber end, in the optical distributor, or in the exchange.

HYTAS modules automatically register in the network management system (autodiscovery) and KENOS puts them into operation.

HYTAS is successful all over the world. Over 6 million people communicate using the world’s most popular access system on the networks of nearly 30 operating companies.
Flexible networks and services:
**DATA TO DEEDS** – at the click of a button
The configuration of subscriber connections is just one out of a wide range of highly automated features provided by the KENOS network management system.

»The last mile« is the key mile – HYTAS is the answer, technically and economically
HYTAS fulfills the market requirements for broad band access and Fast Internet using the latest copper transmission technology: HSDL and SDSL with ISDN inband transmission or standard ADSL.

An intelligent network management system is a prerequisite for any modern access network
KENOS, the network management system for the HYTAS network operation, provides a graphical model of the network structure indicating the current status as well as all the functions, and depicting the transmission elements right down to the subscriber's wall socket. All components in the network are subject to a constant, automatic function and quality control, which ensures that faults are reported the moment they occur, before the subscriber even notices. Trouble-shooting is centralized and carried out online at the operator terminal.

From his terminal, the operator can manage all events in the network, supported by sophisticated automatic features:

■ Locating mechanical and electrical faults in the network
■ Troubleshooting and fault processing
■ Automatic setting up and switching of trails for new subscribers
■ Monitoring and diagnosis of all components

The flexibility of KENOS means it can be adjusted to existing networks. Here the network operator can decide whether management is to be performed centrally or decentrally via remote terminals. Considerably improved network availability results from the comprehensive, automatic online quality control and assurance routines. With the majority of on-site repairs then becoming superfluous, network operation is simpler and more economical, and provides more services and more security. As KENOS has interfaces to hierarchically superior management systems, it is possible to control transport and access networks via a common network management system.
A system **STRINGENTLY HYBRID:**
HYTAS network structure

The typical HYTAS network can be divided into three main functional units:

- Exchange-side Line Termination
- Access network with point-to-multipoint
- Subscriber-side Network Termination

This structure describes all networks, irrespective of the type of transmission technology used. It is the same in pure fiber optic networks, in all copper networks and for hybrid line infrastructure.

1. Line Termination (exchange-side)

The Line Termination (LT) on the exchange side joins the local digital exchange and the access network. The LT components modulate and separate (Multiplex) the incoming data flow originating from the line distributor. Subsequent to separation each individual service is available again with its original bandwidth.

The typical network structure in HYTAS: intelligent technology at all hubs and interfaces from the exchange right down to the subscriber.
2. Access networks and its active components
Access networks can be divided into two different structures depending on their sizes (number of lines and area):

a) Direct connection of subscriber-side Network Terminations (NT/NU) to LT components,
b) Optical fiber link between LT and Optical Line Distributor (OLD).

The OLD has a capacity between 140Mbps and 557Mbps. It converts the incoming signals originating from subscriber network terminations from optical into electrical signals, multiplexes them to a combined signal and forwards this to the exchange via an optical fiber or an existing SDH transport network.

3. Network Termination (NU, NT) subscriber-side
For connecting the network termination units (NUs) to the Line Termination (LT) or the Optical Line Distributor (OLD) either copper lines or optical fibers may be used.

The network termination near the subscriber’s premises combines up to 16 x 2.56Mbps interfaces. HYTAS converts the resulting multiplexed signal and distributes it to the next higher hierarchy level, i.e. the Network Termination (LT) on the exchange side or the OLD.

Cascading OLDs for increased transmission ranges
HYTAS technology incorporates the basics for cascading individual optical networks (OLD domains). One slot in each OLD is occupied by the Optical Multiplex Transceiver System OMTR4-LD: thus, the optical fiber connection can be directed to the next OLD. A maximum of seven OLDs can be cascaded. This way, the «range» of OLT in the digital exchange increases considerably.

Network flexibility is the basis for providing a wide range of services
By adding or swapping Service Units on the subscriber side, a flexible range of services can be offered efficiently and economically. With HYTAS the network operator can thus react quickly to changing demands such as new connections or services.
KENOS supports service provisioning with automated functions. The configuration and maintenance work needed is carried out after with mouse click on the terminal, easily and conveniently.

This is state-of-the-art network management: Virtual movement and action in the network with access to all components.

The modular structure of HYTAS provides the necessary flexibility in modern telecommunications networks. The flexible implementation of HYTAS modules in access networks ensures that the network operator can provide – quite individually – every customer with the services he requires at the right bandwidth. Network terminations (subscriber-side), either optical or electrical, are available in a variety of housings and for diverse locations and climatic conditions: Street Cabinet (SCA) or column, underground container or a choice of housings for installation at the subscriber’s premises (no air-conditioning is needed).

All modules fit in ETSI and 19” racks. By plugging in extension modules, the network operator can simply adapt the hardware configuration to suit changing customer requirements.
Strategic network planning depends on a **FLEXIBLE TRANSMISSION SYSTEM**
HYTAS offers the network operator a solution that communicates with all known switching systems. With its wide range of interfaces, HYTAS opens up all data and transmission protocols to the access network. Multiplexed data streams (for example, V5.x transmission protocol) are split up automatically into 64kbps units in the exchange-side Line Termination (LT).

The path to open telecommunications is via fiber-optic cable – but the starting point is copper

The flexibility of HYTAS in delivering data streams of all bandwidths to the customer is based on intelligent multiplexing and a systematically designed hybrid concept. This means that fiber optics and copper integrated together into the line infrastructure allow bitrates of up to 8Mbps over the last mile to the subscriber via copper pairs.

Thanks to its modular structure, HYTAS is remarkably flexible. Changing services or expanding capacity is done simply by replacing or adding the appropriate boards. Demand-driven growth is the logical basis for the economical development of communication networks:

a) for expanding copper, fiber-optic or hybrid networks of any size
b) for converting copper networks into fiber-optic networks

In both cases HYTAS employs step-wise migration.
HYTAS is your solution for any size of network, offering high bitrates independently of the size of your access network

A typical HYTAS network is characterized by the Line Termination (LT) towards the exchange and the Network Termination Unit (NU) towards the subscribers. This structure is identical for completely new networks and for collocation networks, which make use of the infrastructure of established operators. In any case, HYTAS will provide up to thirty times more transmission capacity for conventional copper networks.

The examples given here show the different types of network structures which are possible with HYTAS, depending on the specific application requirements. With HYTAS, copper and fiber technology may be combined in almost any way, starting with small pure copper networks and going up to huge fiber based networks. Since the transition from one step to the next is gradual HYTAS is an ideal tool for economical access network evolution.

HYTAS in small networks, high transmission capacity for your customers overnight

The base of a HYTAS network may be a conventional small network with copper lines only. Even so, it will be ready for expansion at any time, and it offers the complete range of services for the customers. The copper pairs connecting the LT and NUs can be used for simultaneous transmission of up to 30 subscriber channels. This way, HYTAS can considerably increase the economic efficiency and service flexibility of a pure copper access network.

Combining electric and optical transmission in HYTAS:
With the ELT direct connection of optical network terminations (ONU-V) is possible as well.
Optical network termination on the exchange side

Even for networks with Electric Line Terminations (ELTs) it is possible to integrate optical transmission, in addition to copper transmission interfaces. However, the true optical solution only becomes available by installing the OLT (Optical Line Termination), which uses optical fibers for connecting its corresponding network terminations (here: ONU-VC). The data between the SUs, which are integrated into the ONU, and the customer equipment continues to be transmitted over the existing copper pairs. This type of ONU is usually installed in an outdoor street cabinet. If Optical Line Distributors (OLDs) are used even complex optical networks may be built up.

Fiber to the Door – FTDD

With the FTDD concept optical fibers are used as transmission paths almost all the way to the building where the customers are located. The optical network terminations ONU or ONT are installed in cabinets or outdoor containers at a fairly short distance from the customers. Thus, the length of the copper lines needed to connect the terminal equipment at the customer’s premises is brought down to just a few yards. As a result of this, attenuation losses are smaller and higher bitrates can be transmitted.

Fiber to the Building – FTTB

With the FTTB concept the optical network terminations are installed directly inside the building of the customers, which allows for maximum transmission rates. The entire capacity of an ONT is then dedicated to one single building, making FTTB an ideal solution for connecting customers with high-bitrate data traffic or for giving services to a large number of subscribers.

When a large number of high-bitrate services are required in a particular building it is often more economical to take the optical fiber right up to the building itself.
Market all-rounder: ANY BANDWIDTH YOU LIKE TO ORDER
Telecommunications service providers who wish to keep their customers’ loyalty must consistently focus business policy on what the customer wants – and that includes the cost factor.

This means the provider must give customers a tailor-made bandwidth spectrum and create sufficient capacities so as to be able to react flexibly in the light of the explosive development and widespread use of increasingly powerful subscriber equipment. HYTAS has been designed from the very beginning to be open to future technologies and processes, and the constant further development of the system continuously creates »space for more«.

**Freedom of movement with xDSL**

In the local loop HYTAS allows the integration of broadband technology with high bit-rates, while utilizing conventional network structures. In other words, xDSL can be used for the last copper mile to the customer.
Client connections with n x 2Mbps, more flexibility; the HYTAS wideband concept creates the conditions necessary for economical realisation of need-oriented speed selection.

The HYTAS broadband concept
Capacity enhancement of existing HYTAS networks is always based on the current network topology. Broadband services can then be integrated simply by adding new broadband boards at the exchange and subscriber sides. The main features of the broadband concept are:

- ADSL, HDSL and SDSL transmission boards
- Backbone Network connection via STM-1 interface
One of the applications calling for especially high downstream transmission speeds is Fast Internet. The market demand for this kind of service can be satisfied using the asymmetrical transmission technology ADSL.

Plug & play is an outstanding characteristic of the HYTAS system philosophy. The integration of ADSL into HYTAS networks follows this principle as well. All the operator needs to do is add the new ADSL boards, and the customers can instantly make use of their high-bitrate access.

The new ADSL boards SU8ADSL-V are mechanically fully compatible with all other HYTAS boards, which means that they may be inserted in any free slot of the subracks ONU-VC, ONU-VB, ONU-VE, and ONU-VS.

Each SU8ADSL-V provides eight ADSL interfaces. Up to seven of these ADSL boards may be connected to an SUIMA-V board, which multiplexes the ADSL data into an ATM data stream.

On the LT side SP-4M boards are used as ADSL splitters (passive splitters). They are available for POTS and ISDN (line codes 4B3T or 2B1Q) and can handle four ADSL connections. Thanks to this modular structure ADSL connections can be provided economically and perfectly suited to customer demand. Profitability is guaranteed even in cases of low ADSL penetration.
HYTAS versatility provides powerful arguments for marketing your range of service.
Copper or fiber-optic –
HYTAS brings the full bandwidth
to the customer’s premises
The provision of high transmission
 Capacities in all hybrid network structures
 is one of the primary goals of HYTAS.
 Above all, the aim is to provide everyone
 with access to high bit-rate services – even
 along copper wires.

HYTAS components for use with copper
 wire are functionally identical with those
 for fiber-optic transmission; they also
 both fit into the same type of network
 termination slot. The hybrid concept of
 HYTAS therefore allows for migration
 to fiber-optic technology at any place in
 the copper network. Yet the interfaces to
 the customer remain in service all the time.
 All that needs to be done is to replace
 existing modules by optical ones.
Even in the first stage of installation, HYTAS technology satisfies the needs of commercial as well as private applications with transmission rates between 64kbps and 8Mbps.
ADSL, HDSL, SDSL – HYTAS modules expand the bottleneck of the last mile for high-speed Internet access.

Compared with the high transmission rates of the fiber-optic data highway, the »last (copper) mile« represents a bottleneck. This is where HYTAS shows its real strengths:

- HDSL transmission at 2.3Mbps for distances up to 2.5km (without repeaters) within the HYTAS network on copper pair.
- SDSL transmission: spectrally compatible, 2Mbps symmetrical with additional in-band-$S_0$ channel via copper pairs.
- A wide range of Service Units with two, four or eight analog or ISDN connections; digital 2Mbps connections; and even 2Mbps operation with integrated ISDN channel, provides network operators with a really flexible product range.
- Integrated ADSL interfaces send up to 8Mbps to the subscriber and 1Mbps in the other direction via copper wire pairs. A splitter separates the signals for $S_0$ (via NTBA) and 10BaseT (via ADSL-NT) interfaces.

Voice and data services, e-Commerce, fast Internet and more – in no time at all!

The wide spectrum of service-specific Service Units (SU) within the HYTAS system means that the customer can be provided with the right service at the right bandwidth. HYTAS system technology eases service change for the subscriber: the existing SU is simply exchanged for a new one. The »plug & play« feature means that the SU then registers automatically in the network management system (auto-discovery). The operator uses KENOS to enable communication across the service unit and to allocate a virtual connection with the corresponding SU specific bandwidth throughout the whole access network, thus making the new service available.
Open to a wide range of exchange-side and subscriber-side interfaces

Communication requires a common language, or a translator. As HYTAS has been developed for borderless, open communication, »translators« have been built into the system. These are the interfaces, which provide access to all current transfer and data protocols. HYTAS communicates with 90% of all switching systems and sends its data via 2Mbps or STM-1 interfaces into inter-regional communication networks. HYTAS also provides a wide rage of analog and digital interfaces to meet the service requirements of subscribers.

The HYTAS SU bus

The HYTAS SU bus has a bandwidth of 2.56Mbps, which allows for the connection of up to 12 service units. This way, subscribers can ever be provided with several different services, which they can make use of at the same time, for example a 2Mbps interface, an ISDN connection, and two analog telephone lines. Moreover, the bus technology represents an excellent basis for migration to broadband services. The fourwire bus uses the existing cabling in the building and is as easy to install as an S₀ interface.

Various services are available for simultaneous use with the HYTAS SU bus.

HYTAS services

Dial-up lines
- POTS
- ISDN BRA (Basic Rate Access)
- ISDN BRA with network termination
- PRA (Primary Rate Access)
- Emergency telephones
- Pay phones
- PABX (DDI)

Leased lines
- Analog 2w/4w
- ISDN
- G.703, 64kbps
- G.703, 2Mbps
- X.21 (64kbps – 2Mbps)

Fast Internet
- ADSL
- Ethernet (10BaseT) HDSL, SDSL
KENOS – the intelligent network management system for HYTAS
KENOS automatically detects fault conditions in the network and displays the corresponding alarms at the operator’s management terminal. In addition, the individual subscriber connections are continuously monitored. Service interruptions lead to immediate alarm messages so that alarm relief measures can be taken fast and effectively.

**A proven system prepared for the future**

The concept of KENOS is based on practical experience in telecommunications. It has been successfully implemented in large as well as small access networks giving proof of its efficiency. New functions are continuously being integrated and adjusted to the latest technologies and customer demands. A quality management system ensures constant high product quality.

KENOS includes all aspects of a professional management system: Configuration management, fault management, performance management, test management, and security management, in accordance with the TMN standards ITU-T M.3000 and the X.700 series.

The graphical user interface is based on X-Windows and JAVA and its design follows ergonomical principles. Its handling is very intuitive so that users will get acquainted with the system in a short period of time.

If desired, KENOS may be integrated into OSS applications using the CORBA- and DCE-based Application Programming Interface (API server). Thus, interfaces for central alarming, inventory management, provisioning, and testing will become available.
The KENOS architecture

The KENOS architecture with its main components OS (Operation System) and MD (Mediation Device) complies with the ITU-T standard M.3010.

KENOS is scalable: The OS and MD components may either be installed on the same workstation or on separate servers. For communicating with each other they use standard IP networks, which may be made up of interconnected LANs or TCP/IP-based WANs.

For increased system availability KENOS offers the possibility to connect redundant OS and MD servers or a RAID system, which also makes access to system data faster.

Efficient operation
for any network size

Thanks to its scalability and its modular system architecture KENOS is the ideal management solution for all network sizes, from small work station environments up to large and distributed server configurations for access networks with up to 1 million lines.

Independently of the network size, however, all management functions are available.

KENOS combines convenient
handling, operational reliability,
and economic efficiency

By automating routines, such as the connection of a large number of subscribers at the same time, KENOS brings down the cost of operation considerably right from the start.

Statistics elaborated by Deutsche Telekom AG, which compare HYTAS with traditional access technology, prove that up to 70% savings in network operation can be achieved because functions like service provisioning and changing, software updates and fault rectification are carried out from one central point and require far less field work of the maintenance personnel.

The following list contains some essential characteristics of KENOS out of the wide range of functions available:

- **Operation System (OS):** Provides the management functions for the connected HYTAS system.
- **Mediation Device (MD):** Saves the information of the network elements. The MD is the link between the OS and the LTs (max. 19 LTs).
- **System Management Unit (SMU):** Interface between the management system and the HYTAS transmission boards.
- **SMI II:** Interface for the operation of remote LTs via IP LANs.
**Example: Graphical User Interface**

The graphical user interface of KENOS allows the user to “navigate” in the entire access network just by mouse clicks or key strokes. Its ergonomical design further increases the efficiency in operation.

By means of user profiles the KENOS administrator can give individual access rights to the different users, depending on the tasks they need to carry out.

- Preset and freely configurable access profiles
- Access protection by individual user names and passwords

**Example: Alarming System**

KENOS reports and administrates alarms caused by service interruptions (service alarms) or by faulty operation of individual transmission boards (element alarms).

The system distinguishes between three alarm categories: Critical, minor, and warning. The category an alarm message belongs to can be determined by the operator in accordance with his own priorities.

The alarm list includes information about where, when and why an alarm was triggered. It also shows when and whether the fault has been rectified.

In addition to the on-screen alarm display KENOS offers the following possibilities for alarm processing:

- Automatic alarm forwarding (e.g. via fax)
- CORBA Alarm Forwarding Interface (API)

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**Example: Trail Activation**

Trail refers to the transmission path of the payload data of a subscriber, from the exchange to the subscriber interface at the NU or NT. In order to activate a trail the operator simply needs to enter its starting point (i.e. port of the tributary unit in the exchange) and its end (i.e. port of the service unit). The type of service unit will determine the kind of service delivered to the customer.

The management system will automatically select free paths and transmission capacities in the system and configure the transmission boards and cross connections accordingly. After the trail has been activated it is supervised automatically.

The operator may block subscribers and save additional information in the data base.

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**Interfaces towards HYTAS network elements:**
- Qk, derived from Q\(_{ij}\)

**Interfaces towards higher management systems:**
- Application Programming Interface (API server) – Alarm Forwarding Interface / Inventory Interface / Provisioning Interface based on CORBA specification V2.0

**External interfaces:**
- Alarm forwarding via fax
- Exportation of reporting data
- Exportation of reporting data, see “Reporting Functions”
- Configuration of V-interfaces, file transfer via floppy disk
- Mass configuration of subscriber connections, file transfer via floppy disk

**Hardware Platform:**
- UNIX workstations and SUN microsystems servers, with Solaris 2.6
- Client-server architecture
- Optional: Hot standby for OS and MD
- Optional: UPS for MD servers, terminals and OS
- Optional: RAID

**Further system components include:**
- Locally or remotely operated terminals
- Multi-terminals (may be operated at different OS)
- Mobile terminals (notebooks)
- ISDN terminals (via dial-up ISDN connection)
- Laser and ink jet printers
- Modem for alarm forwarding via fax
Example: Trail Component List
The trail component list shows the status of all components involved in the transmission of a service.

Example: Trail Service View
The trail service view contains information about the trail, i.e. service, as such. In the case of a service failure KENOS immediately provides exact data about the kind of error and when it occurred.

Together, the trail service view, the alarm list, and the trail component list provide the information needed for fast and effective trouble shooting.

Precise error identification ensures increased system availability and improved service quality, two strong arguments for customer loyalty.

Example: Autodiscovery
KENOS automatically discovers all the network elements of the access network and registers new elements when the network is expanded. It represents the network elements in the form of models and then activates the “real” hardware with the corresponding default configurations.

When transmission boards are replaced or changed KENOS automatically downloads their latest settings into the new boards (hardware upgrade) thus ensuring flawless system operation at any time.

KENOS administers the firmware versions of all transmission boards in the network. Each autodiscovery process includes a firmware comparison and an automatic firmware upgrade if there is a deviation from the latest version. Of course, firmware updates may also be carried out manually.

The trail service view displays the alarm state and – if applicable – alarm time for all subscriber connections.
COMPREHENSIVE SERVICE – from the planning stage to the operating network, and beyond

Greater efficiency in network operation: all the HYTAS know-how you need
Aimed at guaranteeing the network operator a high degree of operating security and efficiency, a service package based on HYTAS and its management systems has been prepared for supporting the customer way beyond the provision and commissioning of components.

Provision of quality-assured components
Our components are given the manufacturing go-ahead only after the prototypes have undergone and passed thorough testing under real-life and extreme conditions. You can be sure this is »Made in Germany« telecommunications technology that lives up to its promise.

Setting up and commissioning the network
As part of project implementation, all the necessary work to achieve optimal installation, configuration and extension of network components is carried out; we may call upon authorized sub-contractors for support.

System specialists supervise all phases of network commissioning, install the hardware and software of the KENOS network management system and perform the initial configuration of all system components.

»Switching on« large networks
When networks or parts of networks with a large number of connections are put into operation, subscribers should hear no more than a »crackle in the line« when the connections are actually switched over. We are with you all the way and ensure a smooth start-up of the HYTAS network.

Documentation – an invaluable aid
Our HYTAS service package does not only include the preparation of network drawings and assembly instructions, but also the compilation and updating of technical documentation as well as user manuals.
Complete management of customer networks
If you do not want to manage your HYTAS network yourself, we can do it for you.

Supporting the network operator during operation
At the request of the customer, our specialists carry out everything necessary to optimize the configuration of the network components and the network management system.

Service telephone
We support our customers smooth network operation. If your operating routine has not quite been perfected, you can always contact our specialists by phone for help.

Support services – online and on site
Our support and consulting services are targeted at the needs of each individual network operator. In addition to the online system support, the consulting package includes on-site employee supervision, for example when introducing new functions or helping solve specific problems.

Training network operator personnel
Practical and theoretical training with HYTAS technology as well as with the KENOS network management system put the network operator in a position to operate, manage and extend his HYTAS network.

Hotline – a 24-hour service
Telecommunications services must be available around the clock. We are ready to listen to your queries at any time and give you exactly the support you need, 24 hours a day.

Reviewing quality assurance
What can you improve? What can we improve? The quality of your service is your most important asset. And of course that’s true for us, too. So let’s sit down together and see how we can make good services even better.

Rapid dispatch of spare parts
You want to replace boards, extend a configuration? It is important for you to react quickly to the needs of your customers. We have to as well. And that’s why any spare components you order will be on your doorstep within 24 hours.

Downloading updates and new software modules to the network
Constant updating of all software and firmware versions ensures that the network functions smoothly and keeps peripheral equipment up-to-date.

Adapting and extending your network
Your HYTAS network can keep pace with market demands. If you need help planning and implementing your network extensions you can call upon us for know-how and active support – at any time.
Ten good reasons for choosing HYTAS for your network of the future!
Facts, not promises, should form the basis of any sound decision. A good choice for your start into the digital network would therefore be a system which is proving its performance and reliability every single day – with more than six million lines throughout Europe.

HYTAS creates a whole new range of opportunities for network operators by opening up the world of future services from the very first day of installation. Step by step you can then adapt your network efficiently and economically to the prevailing market requirements.

■ 1. Efficient and economical hybrid concept
HYTAS telecommunication components have been designed for use in fiber optic as well as copper networks. This creates the technological basis for mixing fiber optic and electrical transmission as well as for expanding access networks according to market and customer demands.

■ 2. High transmission rates over the last mile via copper wire
2Mbps HDSL/SDSL transmission over just one copper pair and ranges up to 2.5 km without repeaters form part of the standard features available for hybrid HYTAS networks.
3. Modular design, high degree of network and service flexibility, easy to use
Changing services or expanding capacity is just a matter of replacing or adding the appropriate board.

4. Wide range of interfaces
HYTAS communicates with all known switching systems and has interfaces for protocols of all bandwidths – on the network side (2Mbps, STM-1, V5.x, ATM), and on the subscriber side (ISDN-BRA/PRA, HDSL, SDSL, ADSL).

5. Narrowband and broadband services via optical fiber or copper »over night«
HYTAS is the system for narrowband and broadband services in the access network. Transmission rates can be scaled according to the type of service.

6. Growth along with your needs
Step-by-step expansion is an integral part of the HYTAS hybrid concept. This is the basis for economical expansion of the telecommunications network and for growth according to market demands – regardless of whether extending copper, fiber optic or hybrid networks of whatever size, or converting copper networks into fiber optic networks.

7. Excellent reliability thanks to the use of redundant components
Additional slots are provided in HYTAS subracks for housing back-ups of all important modules. This redundancy ensures high network and service availability.

8. Powerful network management system with a large proportion of automatic functions
HYTAS and its network management system KENOS make up a perfect team. The automatic job control processes, detailed operating data protocols and pro-active management make KENOS the convenient communication and monitoring platform for all components of the access network.

9. Economical network operation
Evaluation of existing operational access networks have shown that HYTAS/KENOS system characteristics alone result in major cost savings for the network operator as well as increased flexibility of services and network availability.

10. Future-proof thanks to state-of-the-art technology
HYTAS and KENOS are constantly being extended and adapted to satisfy market demands. Every future-oriented development in DSL transmission technology is fully integrated into the systems. Interfaces for communication with SDH systems are just as much a part of HYTAS as the ability to communicate with all known switching systems.
**OLT – Optical Network Termination** · **ELT – Electrical Network Termination**

**Characteristics:** OLT/ELT
- **Location:** Indoor
- **Mechanical size:** ETSI and 19”

**Network interfaces**
- **Voice services:**
  - V5.1: EWSD, S12, AXE, E10B, 5ESS, DX220
  - V5.2: EWSD, S12
  - V5.2A: E10B
  - V5.2R: S12
  - V95: S12
- **DATA services:** E1 IMA Groups (ATM)
  - E1 (TDM)
- **Physical layer:** 2 Mbps / STM-1 (electrical)
- **Channelbank:** Analog 2-wire/4-wire
  - Leased lines
  - ISDN, G.703 64kbps, X.21
  - (64kbps - 2Mbps)

*not for ELT*

**OLD – Optical Line Distributor (Splitter funktion), cascading is possible**

**Characteristics:** OLD
- **Location:** Outdoor
- **Mechanical size:** ETSI 19” and special street cabinet variants

**Operational mode:** activ
- **Splitter rate:** max. 1:32

**NU: Network Unit** – system unit with integrated subscriber interfaces/Service Units (SUs)

**NT: Network Termination** – system unit with interfaces for the operation of remote Service Units (SUs)

**ONU/ONT – Optical Network Unit/Termination**

**General characteristics:** ONU/ONT
- **Location:** Outdoor or indoor
- **Mechanical size:** ETSI, 19” and special street cabinet variants
- **Network interface:** electrical (HDSL) and optical (single mode)
- **Bandwidth:** n x 2Mbps, 10Mbps and 40Mbps

**Subscriber interfaces**
- **Voice services:** POTS, ISDN BRA (Basic Rate Access), ISDN BRA with network termination, PRA (Primary Rate Access), Emergency telephones, Coin boxes, PABX (DDI)
- **Leased line services:** Analog 2w/4w, ISDN, G.703 (64kbps), G.703 (2Mbps), X.21 (64kbps - 2Mbps)
- **Fast Internet services:** ADSL, Ethernet (10BaseT)

**ONU-V – Optical Network Unit Type “V”**

**ENU-V – Electrical Network Unit Type “V”**

**ONU – Optical Network Unit standard type**

**ONT** – Optical Network Termination

**SMX – Service Multiplexer**

**Characteristics:**
- **Location:** Customers premises
- **Network interfaces:** HDSL and SDSL
- **Bandwidth:** 2.3 Mbps

**Subscriber interfaces**
- **Voice services:** 1 x S0
- **Leased line services:** 1 x G.703 (2Mbps), X.21 (64kbps - 2Mbps)
- **Fast Internet services:** 1 x Ethernet (10 BaseT)
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