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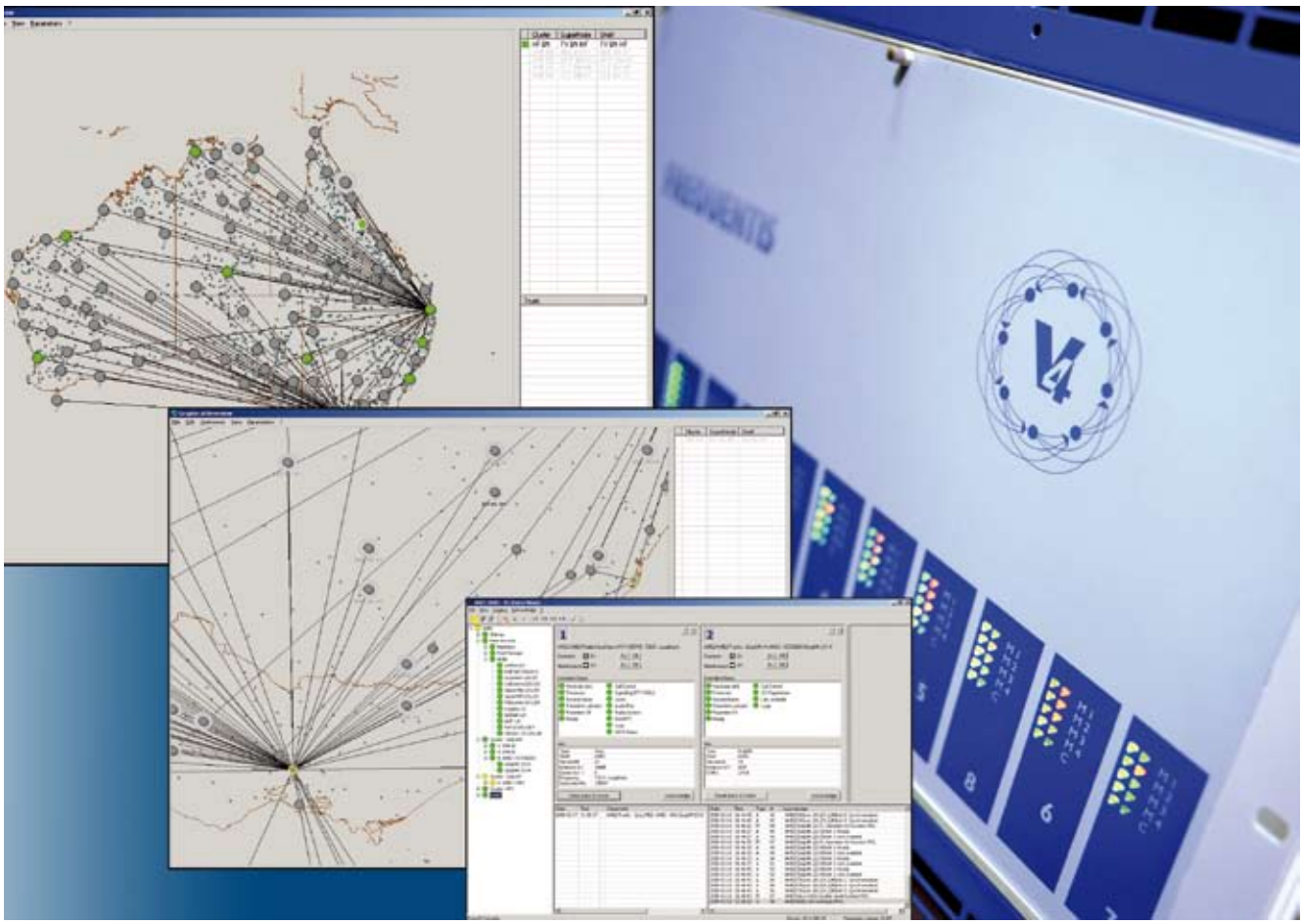
Communication evolution



How can advancing technology support air navigation service providers and their ATC networks in coping with current service provision challenges?

Technological progress continuously enhances systems and improves the quality, reliability and user-friendliness of all types of communication service. In the field of ATC communications this progress translates into extended performance of existing services and enabling of new services for users and providers.

ANSPs are confronted with increasing cost pressure and demands for more safety. These requirements, which at first seem contradictory, pose a challenge that calls for improvements in communication and information systems. Boosted safety of systems means increased availability on one hand and procedures that support safer operations on the other, e.g. checkback of voice commands. These challenges can already be responded to. Modern solutions incorporate the latest available technology:

- Network integration of new and existing systems;
- Optimising networks to reduce costs;
- Multimode information transport.

The Frequentis VCX network infrastructure product addresses the challenges that ANSPs currently face. Frequentis's VCX enables ANSPs to integrate safety-critical data and operational voice shared between air traffic control centres and remote sites and to build countrywide communication networks step by step. This facilitates the integration of ATC applications that have so far been separated.

The Frequentis multiprotocol router VCX was specifically developed for safety- and mission-critical ATC applications. Compared to standard telecom equipment, the Frequentis VCX offers services tailored to fit the needs of ATC environments. The above-mentioned challenges were addressed during all design and development phases, making the VCX the best product for ATC communication infrastructures. The VCX is based on a highly available architecture with duplicated and triplicated critical resources designed to fulfil ATC-specific safety requirements; it comprises standard hardware and components especially developed for ATC.

The Frequentis VCX is the link that interfaces ATC services to various backbone networks. Standard and ATC-specific interfaces ensure flexible connections to various types of equipment for data and voice applications. Additionally the Frequentis VCX offers network features such as gateways between various domains (e.g. TDM-voice to VoIP and radio to telephone), an integrated Remote Control and Monitoring System (RCMS) and an advanced management system allowing central monitoring and control of countrywide networks down to individual devices.

Network integration

Merging separate entities into larger units increases operational efficiency and allows higher flexibility in terms of workload distribution. Network integration facilitates a virtual merger of facilities into larger units, therefore allowing combined operation without physically moving any existing ATC units. Merging air traffic control entities into bigger facilities also translates into reducing the number of operation centres an ATC structure requires. This in turn requires enhanced availability, which is met by using highly available system platforms.

Contingency concepts for resuming business are essential for maintaining continuity of services during emergencies or major disasters. Network integration of existing systems provides the basis for implementing network-centric operation. From the system side, operations can then be resumed by another ATC facility. By definition the network has a higher physical granularity than the end systems, which increases the availability and flexibility of the overall service. A wide-spanning distribution of resources can be reached when services are already provided by the network itself. Examples for these services are radio conferencing for simultaneous access of radio stations or radar data distribution/filtering within the network.

The Frequentis VCX is based on a highly available platform and allows network integration of currently separated systems from different vendors. Various intelligent and powerful routing algorithms for data and voice applications (e.g. fast re-establishment of connections, network flexibility with special routing strategies, priority levels for data and voice, etc.) make the network self-healing and maintain continuous operation even if single links or entire backbones fail (e.g. by re-routing via satellite connections).

Reduce costs

To ANSPs, the network infrastructure poses a significant cost element. Cutting infrastructure costs means great savings for service provision and a higher return on investment. The latest technology provides the possibilities necessary to achieve reductions in this area while enhancing safety.

Compression algorithms already allow significant cost reduction within TDM-voice networks. However, communication services in air navigation require special characteristics, especially when it comes to air-ground communications. A big issue – especially for HF-communication – is noise, which stresses compression algorithms to their limits. If standard implementations are used, noise can overlap operational voice and deteriorate the voice quality. Deteriorated voice quality poses a significant risk to safety. Special adaptations of standard compression algorithms, which are adjusted to the special demands of the ATC environment, are essential for the required quality characteristics.

Furthermore ATC requires low latency generated by the compression algorithm (leading ATC authorities restrict latency to 200ms for communication between an ATC controller and an airborne user), which requires proper selection and optimisation of the applied algorithm.

The Frequentis VCX applies specifically adapted compression algorithms that meet the high-quality and low-latency requirements of ATC. Additionally this product offers special PTT/SQU signalling methods for the TDM and IP domain for failsafe and fast signal transmission.

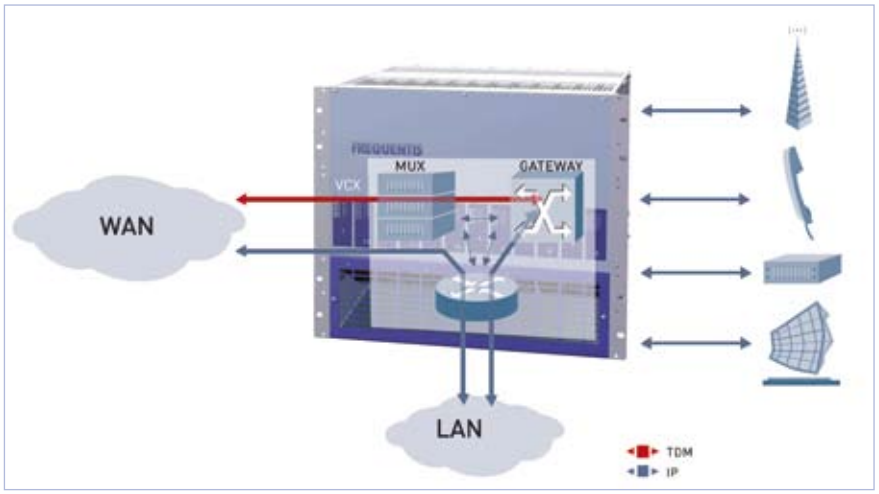
Within the transport network the convergence of information transport for (voice and data) services has a high potential for cost savings. Hence separated networks can be merged. This is already accomplished within an integrated TDM data/voice network. IP offers a prerequisite for voice/data integration: since all the information is transported via the same channel, only the IP addressing/port address of the specific packet defines the application that information is routed to.

A combined transport of data and voice services via the same network in ATC raises the requirement for enhanced reliability of the network. The access nodes have to provide very high availability figures and have to manage the path diversity within the network. Furthermore, during the network design it has to be ensured that redundant communication paths do not run on the same link within the backbone, which would undermine all efforts undertaken at the access points.

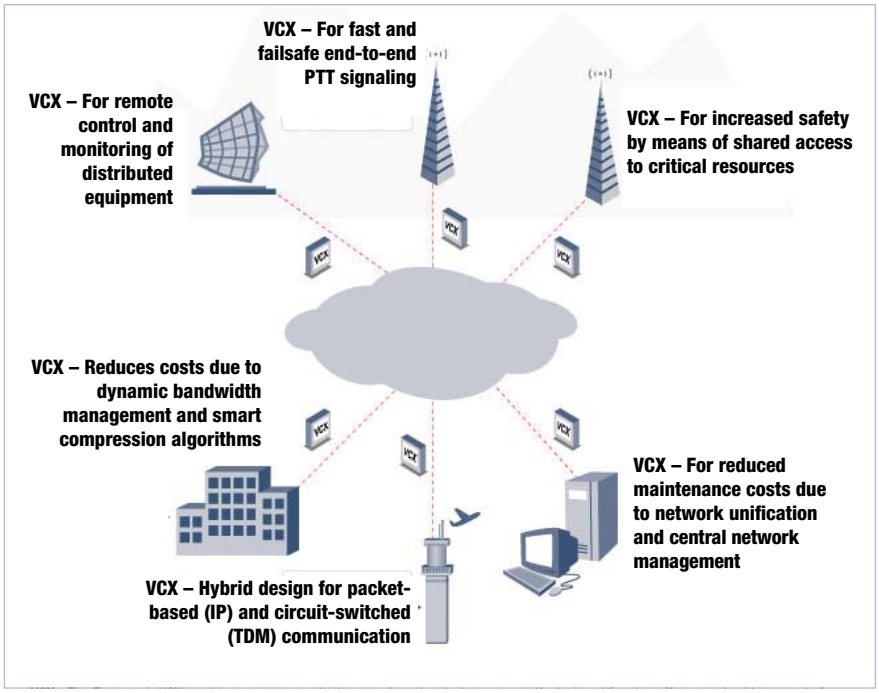
Based on a highly available system platform, the Frequentis VCX provides the availability figures required in ATC. As far as path diversity is concerned, the Frequentis VCX offers special methods such as dynamic bandwidth management, on-demand connections and self-healing characteristics. These features keep operational infrastructure costs (line costs) to a minimum while achieving and maximising safety requirements.

MIGRATION TO IP IN ATC

Migration to IP actually refers to two topics. First, it looks at migration to IP in the transport layer, i.e. information is transported via a packet-based backbone instead of a circuit-switched bearer network. Second, the migration to IP is reflected in the services, i.e. features work with the IP-protocol for intercommunication and addressing. IP is then used to provide services to the operator. This enables additional features and the convergence of voice and data applications at the terminal (e.g. users can work on the same human machine interface for interaction with the communication and the information systems).



VCX combines IP routing/switching facilities and distributed TDM switching



The Frequentis VCX combines gateway, multiplexer and routing devices within one platform

Each individual network transport mode shows certain strengths. These characteristics have to be taken into account when offering services to the end users (see Transport Modes fact box). Furthermore, the availability of specific transport modes (especially at remote sites) is a decisive factor. Systems offering multimode information transport facilitate freedom and flexibility referring to the backbone, i.e. the best transport mode can be chosen for each desired quality of service and each location.

The underlying Frequentis system 'i-volution' design concept enables the benefits of different transport technologies on one single platform. The Frequentis VCX is designed according to the i-volution concept and combines IP routing/switching facilities and distributed TDM switching. This allows free choice in terms of backbone connection and facilitates future migration to other transport modes, e.g. IP. Furthermore the Frequentis VCX offers gateways between the different domains.

The Frequentis VCX has been on the market since 2002, with the first network going operational in the same year. Customers like AustroControl, Airservices Australia, Airways New Zealand, DFS (German ATC Authority) and Skyguide Switzerland have already chosen the VCX for implementation of their respective ATC networks.

In these projects the Frequentis VCX handles all types of ATC communications from data traffic (radar, AFTN, ATM information, IP office data) to operational voice communication (radio, intercom, telephone services). The sizes of the networks range from single gateways to continent-wide networks (with more than 160 sites), with long-term implementation plans showing the modularity of this product. All the applications provide air traffic controllers with reliable end-to-end communications platforms.

TRANSPORT MODES

Modes for information transport within the backbones are:

- Circuit-switched (e.g. Time Division Multiplexed);
- Cell-switched (e.g. Asynchronous Transfer Mode);
- Packet-based (e.g. Internet Protocol).

Each of these modes has certain characteristics that have to be kept in mind when providing a service to operators. TDM currently has the best figures regarding delay from the source to the target, since the circuits are switched through direct.

IP is an environment for voice/data integration and increases the mobility of users due to its addressing scheme.

Depending on the transport mode and the required quality of service, measures have to be undertaken in the system so that a service and/or an access node to the backbone can achieve the desired characteristics.

Summary

Compared with standard telecom equipment, the Frequentis VCX offers the following advantages:

- Integration of all types of communication equipment including legacy systems and third-party products into one unified network;
- Cost reduction due to efficient bandwidth management, reduced line costs via intelligent voice compression algorithms, and reduced maintenance costs due to network unification and central network management;
- Increased safety by means of shared access to critical resources and the high availability of the Frequentis VCX-network node architecture;
- Future-proof concept (Frequentis i-volution hybrid-design; the Frequentis VCX combines IP and TDM technologies in one platform;
- The modular system architecture of the VCX allows easy future extensions of the network. ❖