



# Mission-critical Communications

## Let's connect

ABB's reliable and quantum-safe hybrid communication portfolio provides mission-critical connectivity, uniquely addressing air traffic management (ATM) application needs and 21st century aviation challenges.



- **Designed for air-traffic management reliability, safety, and efficiency requirements**
- **Delivering real-time precision and secure deterministic connectivity as backbone of solutions based on complex Air Traffic Management and Control technologies**
- **Are you ready for the challenges of tomorrow?**

# Reliable, quantum-safe and future-proof connectivity

ABB is a leading supplier of reliable and cost efficient communication and security systems for air traffic management.

01 Air traffic management communication, navigation, and surveillance (CNS) technologies.

Each year air transportation directly and indirectly contributes trillions of dollars to the global economy. According to International Civil Aviation Organization (ICAO), global air traffic has doubled every 15 years since 1970s and will continue to do so for the decades to come. The air traffic management plans must support the projected air traffic increase, including the addition of future unmanned aircraft systems (UAS), while meeting superfluous challenges in safety, security, environmental impact, operational and cost efficiency.

Safe and efficient air traffic services rely on the air traffic management operation wide area network (WAN) backbone and access connectivity, delivering main functions in ATM communication, navigation, and surveillance (CNS). The CNS functions need

application-specific connectivity and redundant networking plans amongst many air traffic control (ATC) CNS equipments (see Table 01) at diverse geographical locations at airports, IT/ operation centers, and remote locations (e.g. radars, radios, and remote towers).

While many IT communication needs in the aviation industry can be met by commercial-off-the-shelf (COTS) IT equipment, only mission-critical communication systems, such as ABB XMC20, are built from ground up to meet ATM regulation-compliant and application-specific communication needs. ABB's XMC20 communication portfolio guarantees compliances and delivery of quality of service requirements set by ATM standards from ICAO, EUROCAE, and others.

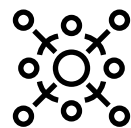
### Uniquely addressing air traffic management application needs



**Safety and availability**  
 99.999% availability  
 50 year MTBF\*  
 -25°C - + 60°C operation  
 Built-in Quantum-Safe Security



**Real-time and deterministic**  
 <150 us jitter  
 <10ms network delay  
 Near zero μs encryption

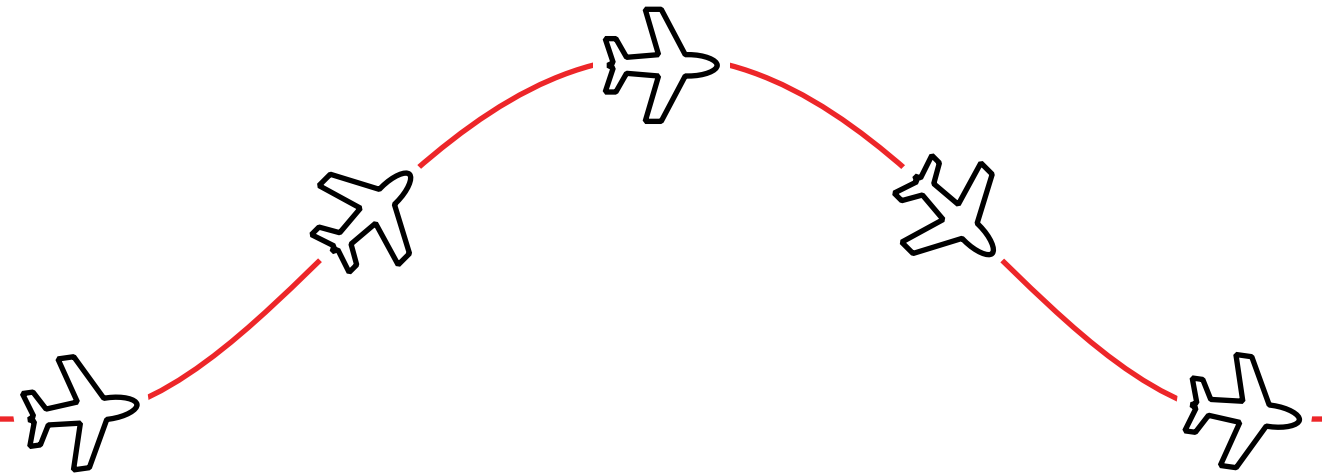


**Digital future and legacy**  
 MPLS-TP and L2/3 VPN and hybrid  
 Analog voice, V-series, E1  
 High precision PTP timing/sync



**Scalability and lowest TCO**  
 10's-100's nodes  
 1000's of services  
 Heterogeneous network  
 20+ year: long life-cycle

\* A number of parameters can impact the values.



Communication	
AFTN	Aeronautical Fixed Telecommunications Network
AMHS	ATS (Air Traffic Services) Message Handling Services
VSAT	Very Small Aperture Terminal
AIDC	Air Traffic Services Inter-Facility Data Communications
AeroMACS	Aeronautical Mobile Airport Communications System
LTE	Long Term Evolution
VHF	Very High Frequency (VHF) Voice
HF	High Frequency (HF) Voice
SATVOICE	Voice Communications through Satellites (SATVOICE)
CPDLC	Controller Pilot Data Link Communications
VDL	VHF Data Link
Navigation	
PBN	Performance-Based Navigation
WGS	World Geodetic System-84
NDB	Non-Directional Beacon
DME	Distance Measuring Equipment
VOR	VHF Omni-directional Range
TACAN	Tactical Air Navigation
ILS	Instrument Landing Systems
MLS	Microwave Landing System
GNSS	Global Navigation Satellite System
ABAS	Aircraft Based Augmentation System
GBAS	Ground Based Augmentation System
Surveillance	
PSR	Primary Surveillance Radar
SSR Mode A/C	Secondary Surveillance Radar
SSR Mode S	Secondary Surveillance Radar
MLAT	Multilateration
PAR	Precision Approach Radar
ADS-C	Automatic Dependent Surveillance - Contract
ADS-B OUT	Automatic Dependent Surveillance - Broadcast Out
ADS-B IN	Automatic Dependent Surveillance Broadcast IN
ADS-B IN	Traffic Information Service Broadcast



# Many factors to consider for Air Traffic Management

The implications of losing connectivity, violation of service quality, or breach of security, even for a short period, is substantial.

Ever busier airports and higher air traffic can increase communication failure risks. More complex CNS environment and heterogeneous networking also play a role.

During the entire journey of an aircraft from one airport to another, operational efficiency as well as safety and security of its passengers and crew critically relies on real-time deterministic transmission, reception, and interconnection of huge amount of CNS information. Solutions must be robust to handle harsh environment, including extreme temperature, exposure to electro-magnetic field, as well as exceptional severe networking events.

XMC20 offers a highly available robust solution, with proven performance, especially under exceptional and extreme conditions. ATM cost-efficiency criteria includes both CAPEX and OPEX. While uniquely addressing ATM critical communication needs, XMC20 remains cost competitive and through its hybrid architecture, operational simplicity, and very long life cycle provides significant total-cost-of-ownership advantage over COTS and other alternatives.

## Stringent ATM-CNS application needs

Current and future CNS applications critically depend on advanced reliable real-time communication with requirements hardly met by best COTS communication equipment (especially when simultaneous application needs such as network robustness, resiliency, real-time requirements, and encryption are combined). For example, secure CNS radio air-ground and ground-ground migration of voice over IP communication rely on guaranteed low end-to-end delay and jitter under all conditions (traversing VHF radio link and optical fixed WAN communication link). Other than CNS communication services, CNS surveillance functionality of reliable and accurate tracking of aircraft position, using current primary and secondary radars or complementary multilateration or automatic dependent surveillance (ADS-B), rely on

deterministic stringent real-time connectivity. CNS planned technology roadmap (e.g. EUROCONTROL) furthers the criticality of reliable application-specific communication backbone. CNS communication ongoing migration to VoIP will move over time toward data links as primary means of exchange within more hybrid radio-satellite-ground communication. Similarly, CNS conventional navigation enablers such as DME/VOR and Instrument Landing System (ILS) are augmented with GNSS constellation and over time performance-based navigation (PBN) will be rolled out.

Finally, CNS surveillance roadmap calls for cooperative ADS-B systems and increased situation awareness. All these technologies exasperate critical dependency on even more precise and reliable real-time robust networking.

## Smooth modernization and simplicity

Modernization and replacement of legacy ANSP communication networks is well underway. Nevertheless, due to factors such as practical rollout planning and cost-efficiency, the migration must be gradual and flexible. ABB's XMC20 is a true hybrid (legacy and packet) platform that uniquely supports this smooth migration.

XMC20 wide spectrum of supported interfaces are proven in ATM applications. XMC20 support ATM applications using a variety of legacy and packet interfaces. XMC20 also offers integrated legacy-packet conversion functionality, all under an easy-to-use network management (UNEM). The comprehensive physical interfaces include analogue, serial, sub-64 and Nx64 kbps TDM, PDH, SDH 1/4/16, as well as Electrical and Optical Ethernet (10/100/1000 and 10 Gbps). Unlike typical COTS IP-MPLS routers, using dynamic and less predictable control protocols, XMC20 packet strategy fulfils deterministic and microsecond-millisecond real-time application and networking goals by using IP MPLS-TP technology.



## Resiliency & Heterogeneous networks

XMC20's resilient and simple-to-operate packet connectivity is based on deterministic MPLS-TP technology with sub-50 guaranteed failover time. It is designed for end-to-end ATM application service quality, while supporting interoperability across heterogeneous ATM networks (including service provider networks).

Timing and synchronization functionality in packet networks is one of fundamental building blocks for robust delivery of real-time applications. XMC20 delivers this functionality robustly and in combination with other critical features such as redundancy, security and built-in hybrid timing/synchronization interworking.

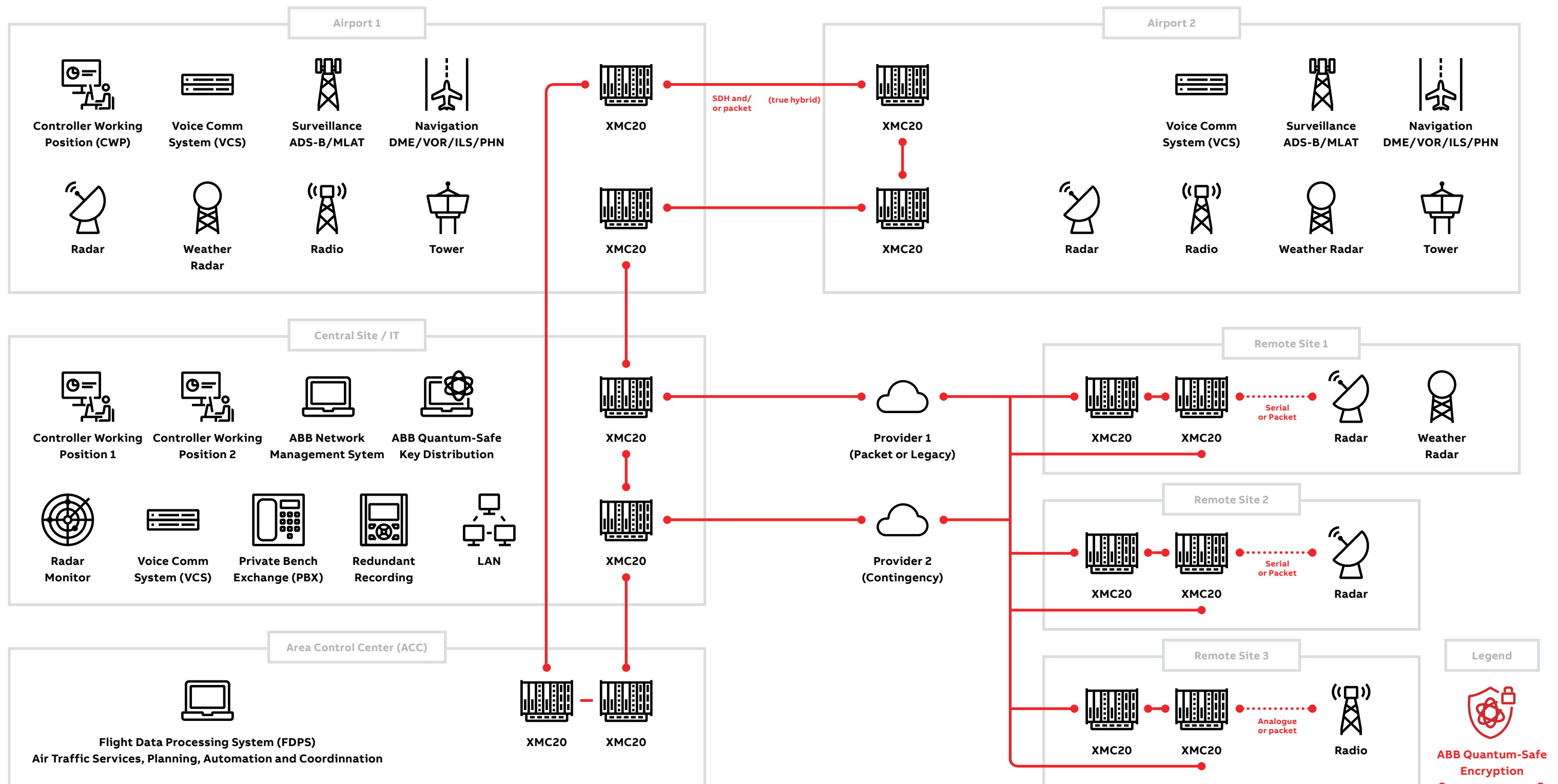
## ATM-apt security

Security needs in ATM critical communication are of utmost importance. Encryption is one of many security functionalities required. However, encryption as a simple add-on, as offered by typical COTS solutions, ignore combinational application-specific (ATM) needs such as encrypted traffic, demanding very low delay and jitter. XMC20's quantum-based encryption is designed from ground-up, without adding any additional delay affecting real-time applications. Hardware-based separation of OAM and data encryption means service-quality guarantee under extreme conditions and under combinational requirements such as redundancy (below sub-50 ms traffic interruption). XMC20 delivers "permanent key management" through support of centralized and quantum-safe distributed key management.

# Example Air Traffic Control

## Operational network using ABB XMC20

Reliable, quantum-safe, future-proof, and efficient communication for air traffic management





# More than 100,000 mission-critical nodes\*

## Safely serving millions of air passengers

Providing safe, robust, secure and reliable communications in a rapidly changing air traffic control environment requires proven experience and focus. ABB has been at the forefront of mission-critical air traffic management communications for nearly three decades.

### Modernization and digitization relies on communication

Proving robust, secure and reliable communications in a rapidly changing world takes ability. Take a look at some of the air traffic management projects ABB has already delivered.

#### Barajas Airport, Madrid

ABB delivered SDH connectivity for air traffic control and management for Madrid Barajas airport including future-proof capabilities for migration to MPLS-TP. Diverse services including ground-to-ground and air-to-ground voice, radar, SDH Protected services and synchronization, as well as protected inter-site E1 connections.

#### Dakar Airport, Senegal

ABB delivered the mission-critical telecommunications network for the new airport in Dakar, Senegal. Inclusive of an SDH network with Ethernet and legacy user interfaces, network management system, engineering support, remote support for deployment, technical training and 30 months warranty.

#### Aeronautical Radio of Thailand (AEROTHAI), Thailand

Aeronautical Radio of Thailand (AEROTHAI) selected ABB to deliver its mission-critical communication network including additional services of building the fiber optic infrastructure at the airport and installation and commissioning of radio navigation equipment. Additionally, ABB provided the transmission network with Ethernet over STM 16 SDH and legacy user interfaces (E&M, POTS, nx64 Local Data Interfaces) used to connect radio navigation equipment and delivered a long-term maintenance of TDM-based services and transmission links while assuring the possibility of migration to packet based network concept.

#### Deutsche Flugsicherung DFS, Germany

DFS ATM network is one of the world most advanced an complex networks. ABB connected the German airspace, when the state-owned air traffic control company DFS selected ABB to implement their mission-critical communications network. DFS connects their four area control centers across the country, 16 international German airports and manages 10,000 aircraft movements every day in German airspace.

\* Deployments include global ATM networks. ABB mission critical applications also include Power Grid, Railways, Oil & Gas, and Authorities applications.

# Ubiquitous airport connectivity

## Intra-airport resilient wireless and wired connectivity

Many factors to consider for intra-airport wireless communication.

02 Intra-airport airport communication, serving operational needs of airport staff, includes the following services:

- Voice/Audio
- Video streaming
- CCTV and Video surveillance
- Push-to-talk (PTT) voice
- Data communication, including text, graphics, images, files, databases, audio and video
- VPN

### ABB mesh wireless Tropos and industrial Ethernet AFS product Lines

Airport communication on the ground used by ground operation and security personnel require resilient, tough, and secure connectivity. Rugged Tropos mesh wireless products are designed for better than 99.999% resiliency with airport security requirements in mind (Firewall, AES encryption with US government certification).

The Tropos mesh offering is built on a number of innovative features such as self-organizing and self-optimizing. Robust and high performance Intra-airport communication networking benefit from Tropos multiple communication paths, frequency channels and bands, dynamic routing, power control and data rate control. Tropos is industrial strength shock and vibration certified, meeting the harsh outdoor environment requirements for airports.

It is proven to withstand extreme heat, cold, wind, rain, snow, ice and humidity, including hurricanes. Tropos mesh supports dual-radio (2.4 GHz & 5 GHz) and next generation wireless standards. Tropos Mesh OS leverages multiple paths, channels and bands to create robust, high performance networks.

The diverse AFS Ethernet product line are resilient, compact, rugged, and support multiservice requirements including built-in security. AFS and EDS500 are product families of ruggedized industrial Ethernet and Ethernet/SHDSL switches and FSK modems especially designed to support critical infrastructure connectivity by enhanced robust communication technology offering minimal downtime, predictive failure notification and encrypted management.

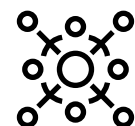
Intra-airport communication can combine the benefits of Tropos, AFS, and XMC20 product lines.



**Resilient**  
Fully distributed self-optimizing  
99.999% availability  
Fully redundant mesh



**Secure**  
FVPN and firewall in every device  
FIPS 140-2 certified (AES 256)

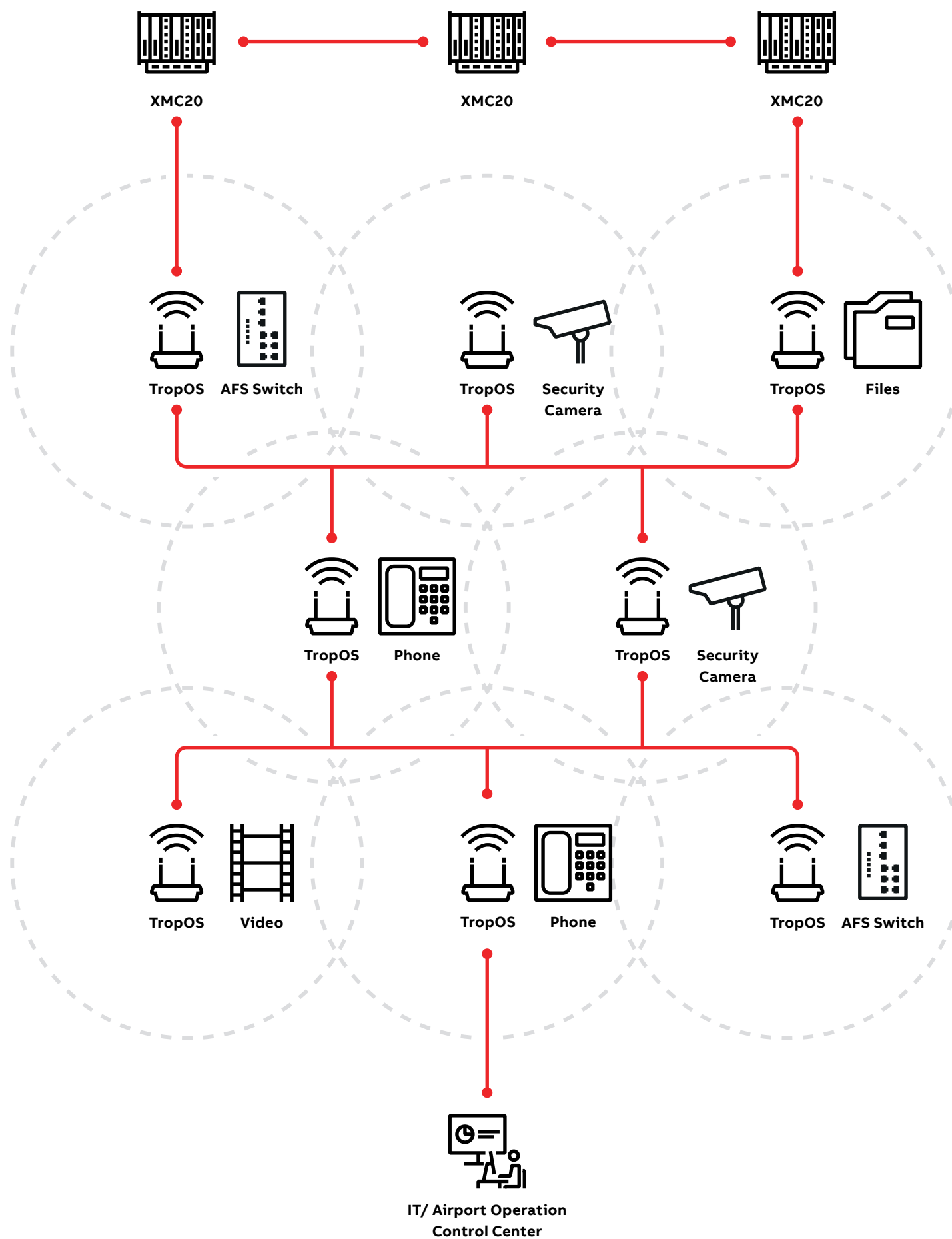


**Ubiquitous**  
Indoor/outdoor robust  
BB Comm. to fixed facilities  
PTP:90 Mbps, PTMP: 48 Mbps



**Rugged**  
Industrial strength certified  
Indoor/outdoor (IP67 weather tight)  
Operation: -40°C to 55°C

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## Ready for the challenges of tomorrow

Today, ABB is managing mission-critical communications for more than 100,000 nodes, including numerous ATM networks from leading Air Navigation Service Providers (ANSP's) in Europe, Asia, Americas, and Africa. ABB communication products are deployed in some of the busiest airports worldwide, safely serving 100's of millions of passengers with ever increasing number of departures and arrivals.





# Mission-critical communications for Air Traffic Management

## Ready for the challenges of tomorrow

ABB's mission-critical communication solutions for air traffic management offer a broad range of world leading products for local and wide area communication networks.

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03 XMC20

### XMC20

ABB believes that nothing is more important in mission-critical communications networks than guaranteeing the highest availability of each connection and the highest security for transferred data against attacks from outside. With mission-critical data, downtime and manipulation can mean risk to safety. The systems developed and produced by ABB stand apart due to their extreme reliability. From the outset, ABB global developers have placed the highest priority on achieving this goal.

Key attributes were confirmed during the developmental phase of the manufactured systems. These included top availability, maximum service life, simplicity of operation, easy maintenance, a good eco footprint, as well as being thoroughly future-proof.

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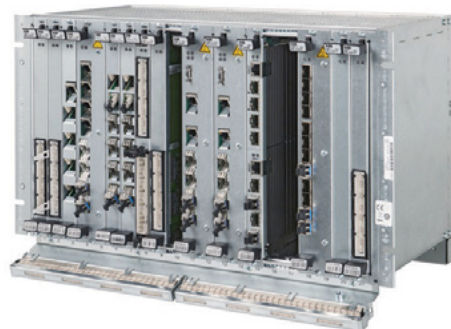


ABB products, based on decades of experience, bring solutions that meet the stringent access & transport networks requirements for mission-critical communications networks in the areas of clock synchronization, scalability, protection, reliability, ultra-long lifecycles and backward compatibility. In addition, they are highly flexible providing multi-service access for a wide range of applications and the simultaneous availability of circuit-based and packet-based technologies e.g. PDH/SDH and MPLS-TP (full hybrid).

ABB addresses the evolution of mission-critical communications networks from TDM-based to packet-based services with its state-of-the-art full hybrid multi-service platform XMC20. The full hybrid concept allows for the co-existence of native TDM and packet-based access services within the same node, providing a perfect future-proof solution for mission-critical communications applications. This encompasses typical ATM/ ATC networks that include operation across redundant Service Provider legacy or packet leased line.

### Highlights

- Full hybrid concept for coexistence and interworking of native TDM and packet services within the same node
- Protection, redundancy and Quantum-Safe encryption functions for secure data transmission and highest availability
- Wide range of applications and access interfaces supported
- Support for various transmission interfaces and protocols, including 10 Gbps, SDH STM-16, MPLS-TP and many others
- Guaranteed long lifecycles due to state-of-the-art FPGA technologies and own manufacturing plant
- Wide array of services which include 3rd party equipment integration and maintenance
- All ABB equipment and selected 3rd party equipment are managed under one Network Management System

# Network Management System

## Operational simplicity, security and reliability

ABB's Network Management Suite answers the strong need for making simple the integrated management of complex and hybrid mission-critical networks.

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04 UNEM Network  
Management Systems

Former 'point to point' communication based architectures could be easily managed with simple tools such as equipment craft-terminals and element managers. However, today's networks form complex meshed structures, comprising a wide range of technologies. These are based on various communication media, including fiber optics, wireless service provider network interworking. Moreover, mission-critical communications need to ensure network performance and high-availability of service based on well-known traffic protection schemes existing for PDH/SDH networks, as well as for MPLS-TP (e.g. sub-50 ms protection).

ABB NMS enable reduced operational costs for ATM networks by reducing the complexity in network operations and planning, as well as enhancing the reliability and the availability of services. UNEM provide a comprehensive range of tools, technologies and enable the integration of XMC20's equipment through its corresponding network management systems.

In addition, they also allow real-time monitoring of the performance of the network, alarms surveillance, and configuration management.

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Element &  
Network Management



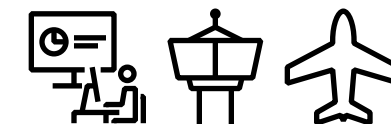
UNEM

—  
Network Equipment



XMC20

—  
Segment  
Specific Focus



Air Traffic Management



# Quantum-safe security without compromise

## Strict ATM delay, jitter, resiliency, and timing

05 Application requirements based on ATM Standard documents from EUROCAE WG67, including ED 136, ED 137, ED 138, and ED 139

06 ABB Quantum-Safe encryption in the context of simplified air traffic control backbone network. En-to-end (MPLS-TP tunnels and path) encryption includes connections over Service Provider network. ABB Permanent Encryption provides Quantum-Safe security even in case of Key manager server link failure

Cyber security in mission-critical applications has many layers. Building from the ground-up the cyber security system means no compromise on critical service requirements. In the case of ATM operational network, we must carefully consider requirements with all associated functionality and applications in current and future Air Traffic Control operation.

These general mission critical security layers include:

- Security assessment & monitoring
- Backup & recovery
- Security updates & hardening
- Strong encryption + Authentication
- Procedures & policies
- Malware protection

A key element of security needs in ATM critical communication is end-to-end encryption without compromising and violating strict requirements such as high-availability (network resiliency with full redundancy) as well as precise timing and very low delay, jitter and packet loss needs (e.g. air-ground voice communication).

The table below shows EUROCAE ED-137/138 example ATM application requirements. Migration of ATM operational network to packet poses great challenges in attaining the strict requirements while enabling encryption and other security features. ATC private network, traversing across public service provider network, increases the challenges of this objective. ABB mission-critical grade encryption, including quantum-based key generation, is purpose-built to meet these challenges. ABB's innovative SECU solution in XMC20 practically reduces additional delay due to

encryption to nearly zero, while utilizing MPLS-TP (layer 2.5) tunnels encryption to ensure end-to-end segregated service encryption. Programmable hardware-based solution includes special process for the encryption of Timing (PTP) and OAM traffic. This is part of overall innovation approach to deliver on the promise of no-compromise resilient and future-proof secure networking.

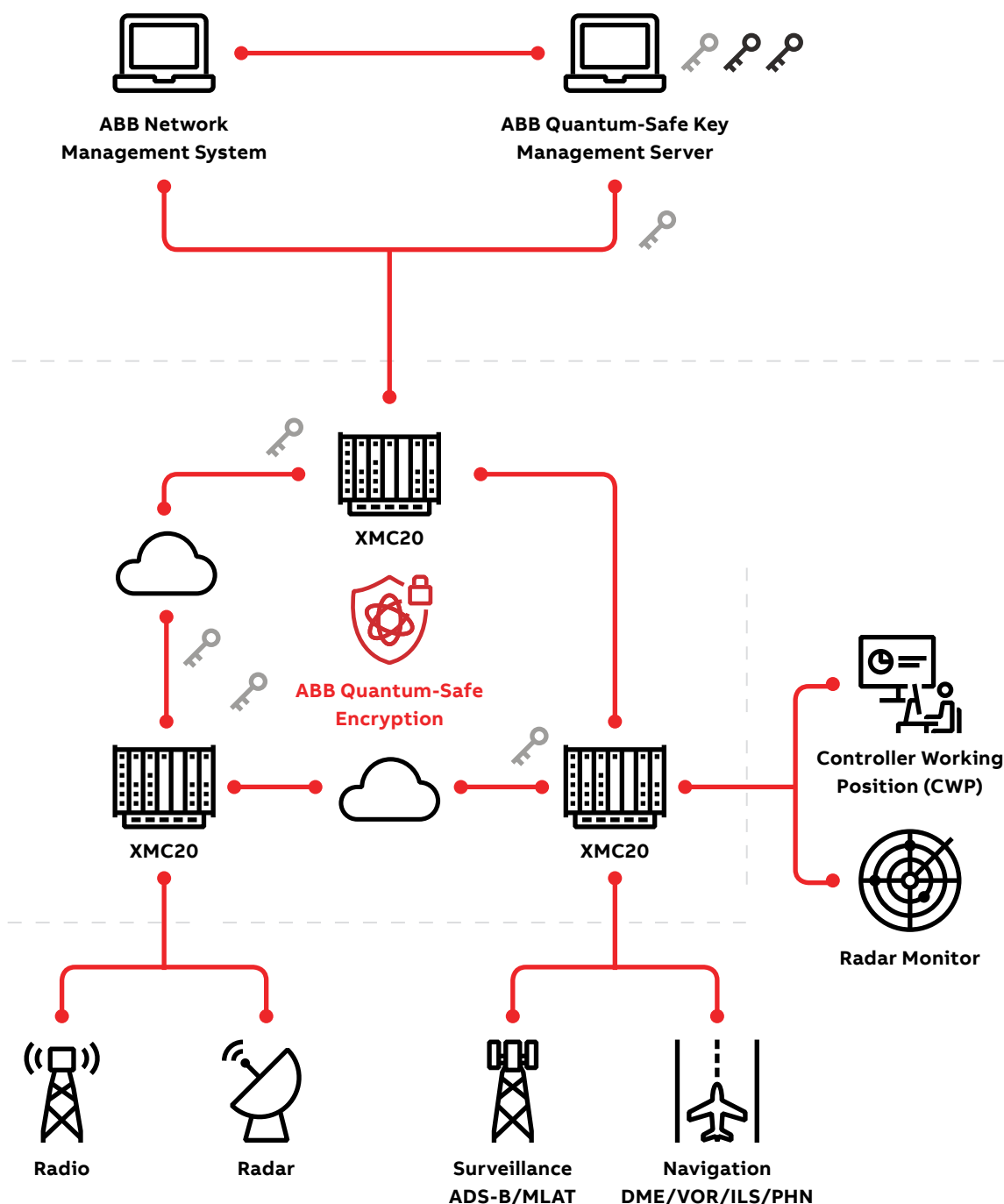
ABB FPGA-based encryption uses strong certified AES-256-GCM encryption. SECU's use of Quantum-based random number generation (QRNG) is a first and is integrated in every network node, creating highly reliable session keys and hence strong distributed key benefits. In combination with strong QRNG-based master key architecture, ABB delivers "permanent" strong key management, even under exceptional network incidents such as link failure between nodes or connection to QRNG-based key management server. Finally, very long life design of the XMC20 platform is extended to the SECU and security functionality. Security update and field programmability makes the solution future proof and cost and operationally efficient. End-to-end application and ATM-CNS functionality remains deterministic and easy to use with little risk of compromise on strict other requirements.

XMC20 end-to-end encryption architecture is shown in the adjacent graphic. Segregated services can use their own dedicated end-to-end encryption, even when traversing 3rd party (public service provider) network. This means at no time the traffic traversing foreign semi-secure network domain is at security risk.

05

Application	Typical Packet Length	Acceptable latency <sup>3</sup> (without jitter)	Acceptable Jitter <sup>3</sup>	Acceptable Packet Loss rate
Default (best effort)	N/A	N/A	N/A	N/A
Telephone voice	Payload only - 160 Bytes With CRTP - 164 Bytes With CRTP and IPsec - 212-222 Bytes	100ms	15ms	0.5%
Radio voice	Payload only - 160 Bytes With CRTP - 164 Bytes With CRTP and IPsec - 212-222 Bytes	50ms	15ms	0.5%
Telephone signalling		100ms	50ms	0.5%
Radio signalling		50ms	50ms	0.5%
Recording		100ms	50ms	0.5%

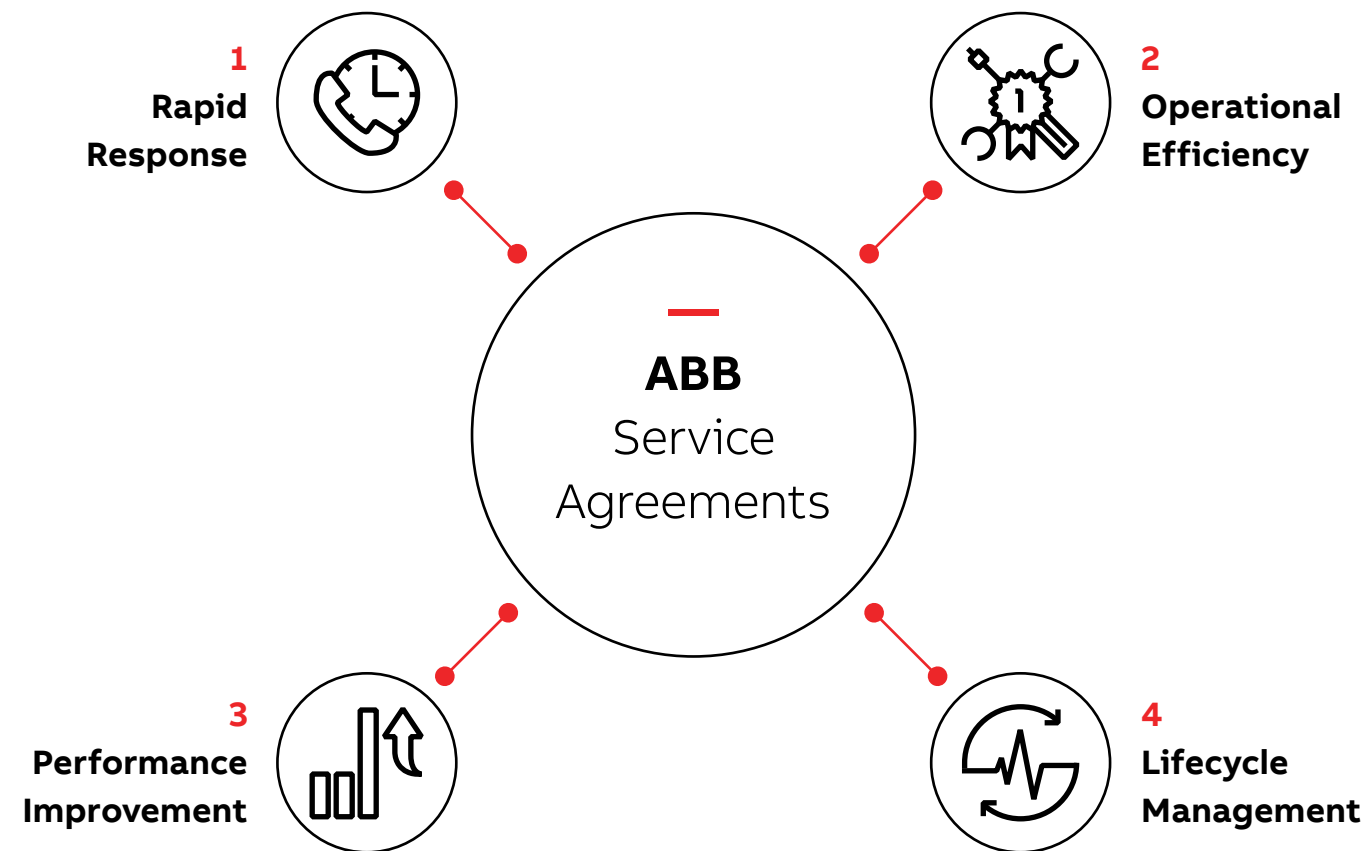
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# The future is agile and collaborative

## Assessing your needs, implementing and sustaining for impact

ABB are your strategic partner for a changing world, through our four key pillars we provide ongoing technical and functional support for your air traffic management and airport projects.



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07 ABB service Teams are with you around the globe.

### Rapid Response

When something goes wrong, you need it fixed fast! Whether it's spare parts, replacement equipment, or repairs, our care agreements are tailored to your needs. Our remote services and 24/7 call center also provides quick troubleshooting and root cause analysis services so you can identify the most effective course of action and address problems before they grow.

### Operational Efficiency

Need to modernize or address a sticky issue? Our consultants can help you assess the challenge and design cost-effective, fit-for-future solutions. In addition, we offer a wide range of commercial and proprietary enterprise-level applications to help you improve operational efficiency.

### Performance Improvement

Hitting key performance targets can be tough to do when you're trying to keep renewables' costs under control. Our team can devise solutions that help you hit your targets as well as provide software applications that deliver actionable insights for future performance improvements.

### Lifecycle Management

Cradle to grave, Grid Automation Service is there to help you take care of your assets by providing installation and commissioning services, maintenance, replacements, spare parts and consumables, and training. We can also help you extend the life of your assets with extensions, upgrades, and retrofits. When it's time to retire an asset, we offer end-of-life services that help you do so cost-effectively and responsibly.

### We are with you around the world

ABB Service has more than 150 customer care centers strategically located around the globe. These one-stop shops are staffed by 6,000 professionals with extensive industry and service experience on a wide array of mission-critical equipment and systems. Our team of mission-critical experts and analysts can help you address today's toughest mission-critical communication challenges and prepare you to meet the challenges of future.





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