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5G FOR AIRPORT OPERATIONS

Pioneering Intelligent Industry

Powered by Data

COVID-19 has added complexity to the passenger journey. Airports face bottlenecks in operational processes as a result. 5G can help control pandemic risks while reducing congestion and optimizing ground operations.

COVID-19 signals a historical shift in the aviation industry, raising new challenges for airport stakeholders. Public health measures introduced in the pandemic impose new constraints on the flow of passengers through airports. Pre-COVID, airport operators, airlines, and handlers already dealt with bottlenecks on above-wing and below-wing processes (apron and turnaround operations, baggage flows, airplane maintenance, and passenger flows) that increased operational costs for each stakeholder of the aviation value chain.

The passenger journey process is twice as long today as it was in the pre-COVID era. Airport operators must therefore anticipate the resumption of activities in the medium term and the accumulation of bottlenecks on processes.

Much like the advent of remote working, which was enabled by the digitization of tools (apps and SaaS), improvements in network quality and IT sturdiness, new technologies, and telco innovations in connectivity will make it possible to fluidify operational processes at airports and address identified pain points in the value chain. The rise of 4G private networks and 5G in aviation can be a game changer for early adopters to control pandemic risks and optimize hygiene processes at airports while reducing congestion and optimizing ground operations.

The entire value chain can be reshaped to increase operational excellence, both during the COVID crisis and in the post-pandemic era. The incremental features in the application layer of 5G, such as network slicing and multi-access edge computing, are unique assets that enable connectivity excellence, leveraging reduced latency, faster transmission, network management, a greater number of connected devices, accurate geolocation, and reliable information.

PREVENTION OF PUBLIC HEALTH RISKS AND CONTROL OF DEGRADED PROCESSES WITH 5G

COVID-19 underscores the need to fluidify processes; to make them as smooth as possible and eliminate direct contact with airport staff or passengers. To these ends, it is necessary to fully digitize the entire process to minimize the impact of COVID-19 restrictions on congestion levels.

The COVID-19 crisis has impacted the passenger journey by necessitating strict hygiene control of passengers for signs of infection. Thermal imaging and automatic fever detection empowered by a 5G network (4K camera or AR thermal glasses) is a thinning lever for this new operational constraint. This solution, combined with facial recognition and access to passengers' travel records (health passports), may detect critical cases (based on body temperature and travel history), accelerating case detection and responsive engagement of virus screening, thereby reducing the time impact of this bottleneck. However, thermal screening is inefficient in detecting incubating passengers without fever or other symptoms. In this context, other complementary digital initiatives enabled by 5G can be considered.

Preventive measures and good practices can be supported by 5G-empowered technologies. For example, passenger-tracking systems and flow management solutions (e.g., XOVIS), currently used to measure waiting times in queues and to solve capacity constraints, can detect congested areas where social distancing needs improvement. Finally, AGVs dedicated to full disinfection of strategic points at airports, based on real space occupancy, can be implemented using 5G networks.

BOTTLENECK THINNING IN THE PASSENGER PROCESS FOR AN OPTIMAL CUSTOMER EXPERIENCE

Customer experience execution is crucial since the best way to increase non-aeronautical revenue is to increase customer satisfaction. Indeed, according to a study by the Airport Council International (ACI), A rise of 1% in global passenger satisfaction can generate, on average, 1.5% growth in non-aeronautical revenue. If they are to meet the rising expectations of passengers and accommodate growing numbers of VIP clients, airports cannot focus only on one element or touchpoint. Customer experience is a holistic concept that, given increasing numbers of millennial passengers, requires more digital engagement. Therefore, airports must be able to provide a 360° view and leverage digitization to enhance all touchpoints. This is where 5G can be a game changer for airports, triggering a new wave of digitization and innovation in customer experience while limiting the operational impacts of COVID-19 measures. Applications harnessing image recognition and artificial intelligence will be boosted by the implementation of a 5G network and their expansion will simplify all passenger tasks.

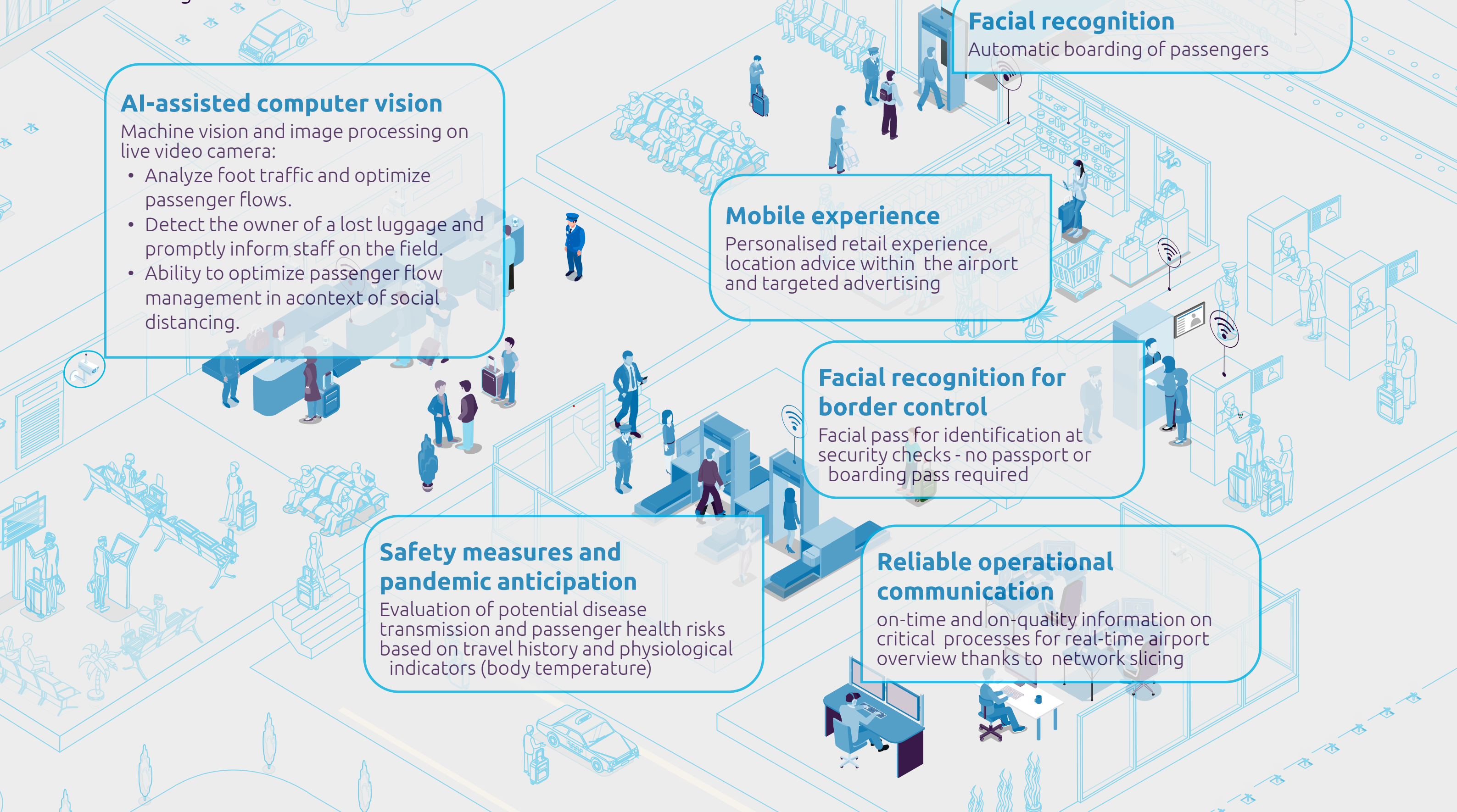
Facial recognition is the first key use case to transform the customer journey. This technology will dramatically shorten queuing for check-in, luggage drop-off, identity checks, etc. The latest IATA survey highlights that cutting waiting time is a major passenger requirement, as 80% of passengers don't want to wait more than three minutes to drop off their luggage or get through security and 70% are willing to share their biometric information to do so. China Eastern Airlines has already experienced the potential of 5G and made it possible for passengers to go from check-in to remote boarding gates within 20 minutes using 5G + AI-based boarding.

AI-assisted computer vision is another key use case that will benefit from the implementation of a 5G network. HD cameras will continually scan all airport areas to predict different scenarios. Examples of issues that could be anticipated by AI-assisted computer vision:

- Detect the owner of a lost luggage and promptly inform staff on the field.
- Identify a passenger who is late for boarding and guide him through the terminal.
- Predict capacity issues for hand luggage on flights and enable staff to act accordingly before boarding.

Intelligent robots deployed in airport facilities will also capitalize on 5G assets, from sharing information in the user's native language to guiding passengers to the right terminal.

By combining data exchanged from the various applications and interactions with the building and objects, airports will be able to provide passengers with relevant, contextualized information and services to assist and entertain them: HD films will download in seconds, entire series will be available offline almost instantly, and passengers will be able to live stream sports events in crystal clear quality – no matter how busy the airport.



OPTIMIZE GROUND OPERATIONS FOR EFFICIENT TURNAROUND

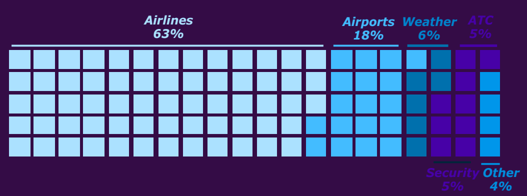
Improving punctuality through operational excellence in the turnaround process is one of the main key success factors when it comes to lowering spending for airlines. A positive correlation exists between efficient and smooth ground operations and D0 (perfect punctuality). It can be achieved with the use of new technologies, and there are multiple options available today to reach this goal. However, ultimately 5G will become the backbone and main digital lever for operational excellence and control over costs in ground operations (see below: 5G impact on D0 case study). Twenty percent of flight delays would be addressable through 5G-exposed data in the short term and some key use cases have already been identified where 5G will bring high added value for airlines, airports, and handlers in relieving the primary pain points and bottlenecks (case studies to be found on the following page).

5G impact on D0 – The case of a megahub airport in Europe

By giving airports new tools to tackle process bottlenecks, 5G will be a critical enabler of punctuality and operational excellence in future.

Most departure delays are directly related to operational issues…

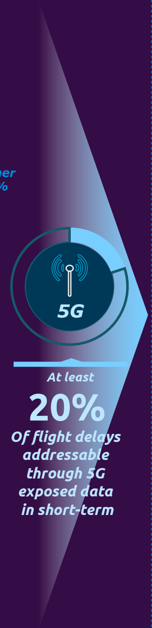
Airlines and airport operational issues are the main causes of delays in the study



Source: Eurocontrol, 2019

On average, the 235 000 departures from the airport are 18 minutes late (long and short haul)

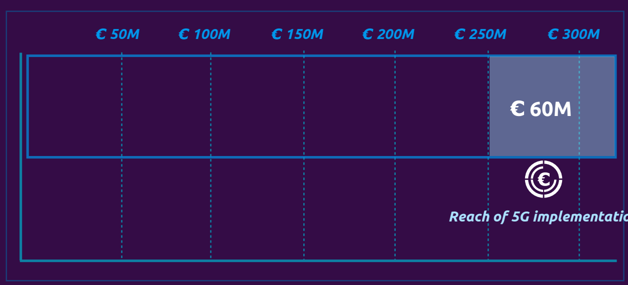
Source: CAA, 2019



…which can be tackled by 5G-enabled use cases including AGVs, real-time geolocation, and video analytics

€ 315M

Estimated operational costs caused by delays on departures in the study (per annum)



*Source : Capgemini Analysis, 2020**

€ 60M
per annum

Estimated costs of delays for airport stakeholders within the reach of 5G implementation

**Methodology and assumptions : The total cost of delays is calculated by multiplying the number of flights per delays intervals (CAA, 2019) with the average cost of delays (all type of aircraft included) per delays intervals (University of Westminster, 2015). Our analysis consider that at least 20% (based on analysis of issues of turnaround operations generating delays. Capgemini, 2020) of delays and induced costs are addressable thanks to 5G. This 0.2 ratio is then used to calculate the operational cost addressable with 5G implementation.*

UNPRECEDENTED PRECISION

Autonomous vehicles are one practical application. While some non-5G initiatives have already been launched, 5G will bring these use cases to the next level, with unprecedented reliability and precision of autonomous driving and manipulation of ground support equipment (GSE). All things being equal, as the number of flights increased in the pre-COVID era, more and more turnaround operations took place at distant aprons, sometimes more than a 15-minute drive away from the epicenter of ground activities. Autonomous tugs using 5G networks will accelerate the luggage process and make it more reliable. The quickest path from the baggage handling system to the apron will automatically be used, allowing airports to focus on value-added tasks and on reaching turnaround operations milestones.

Accurate geolocation of GSE – to the nearest centimeter – and 4K video real-time analysis of aprons enabled by 5G networks will bring a high level of GSE track and trace for apron managers and airport control centers (ACCs). First, 4K camera real-time analytics of aprons will clarify existing blind spots and enable accurate flow monitoring. Both ACCs (real-time flow management dashboard) and apron managers (use of tablets) will be able to oversee, in real time, the on-time provision of necessary GSEs in ramps for an efficient turnaround, from services provider activities (refuelers, water trucks, lavatory service vehicles, catering vehicles, etc.), to luggage flows (ULD and belt loaders, tugs and dollies, etc.), and other key operations (pushback trucks, APU, buses, cargo platform transporters, etc.) for accurate target off-block time (TOBT) and potential estimated time of departure (ETD). In addition, apron operations can be monitored with 4K video analytics to provide full visibility of turnaround processes.

At the same time, operational communications between the ACC, the operation control center (OCC), and field agents, a well-known pain point in the industry, can be prioritized according to the criticality of processes thanks to high-speed connection and network slicing technology enabled by 5G. In the near future, all the turnaround operations actors will be reachable without any technical issues, and flawless information on critical processes will become an industry standard with the possibility to analyze massive data from the field in real time. Big data and analytics for flow monitoring for ACC reliability will be improved, with perfect real-time vision of the airport.

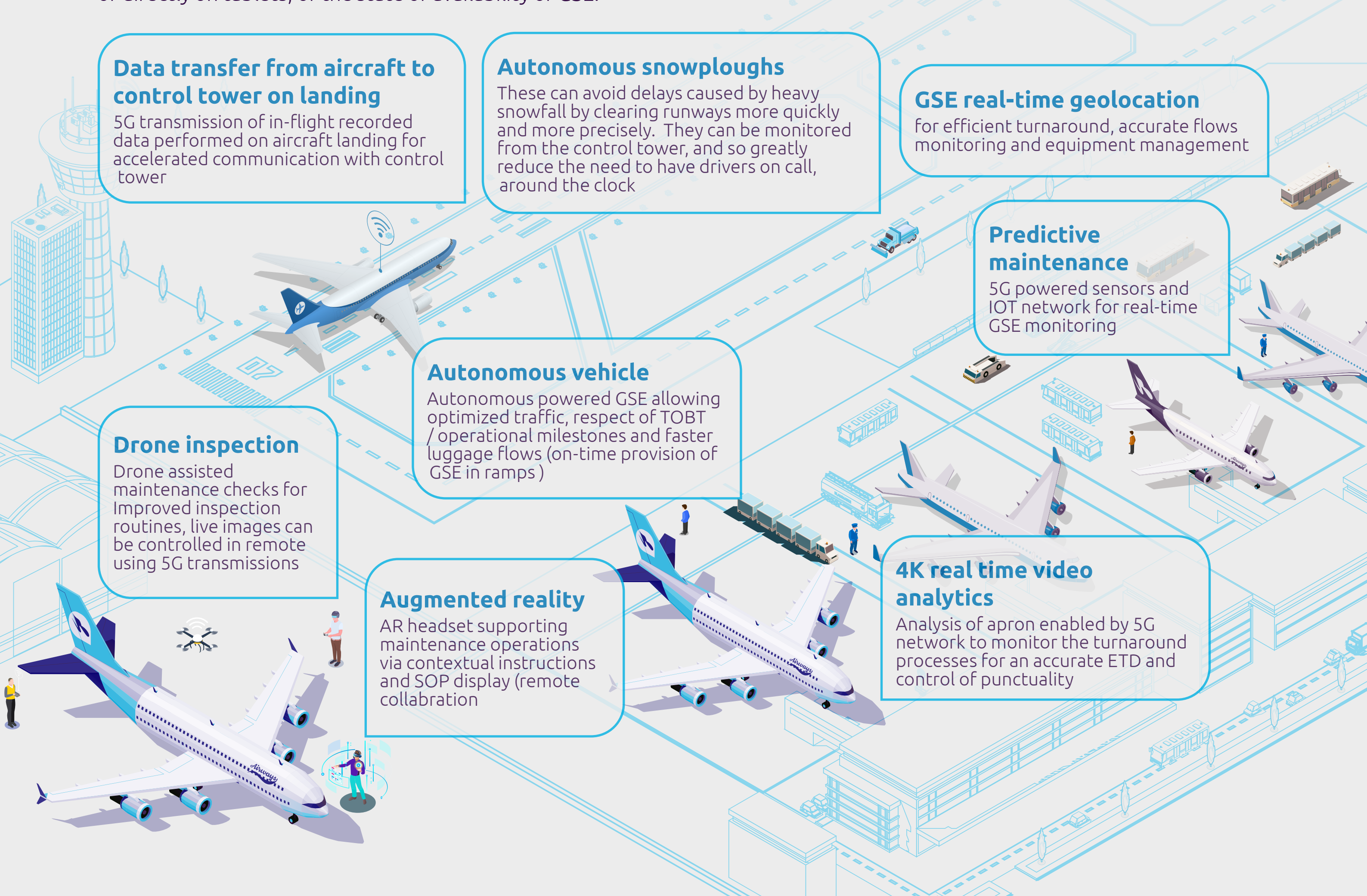
Unmanned aerial vehicles (UAVs) empowered by 5G constitute another use case that is solving critical operational issues and reducing blind spots for airport operators and airlines, especially in mega hubs. GSE inventory on ramps and dedicated storage areas can be implemented, improving tidying services performance and limiting allocated time to this task. Airport inspections for infrastructure checks can easily be executed with autonomous drones. Moreover, this technology is a key enabler to prevent from bird strikes and reduce maintenance costs induced by these frequent events. In 2018, almost 15,000 bird strikes happened in the US, 5% of which caused significant damage to the aircrafts.

MAKE MAINTENANCE EFFICIENT

In addition to ground operation efficiency and passenger experience, there is still room for improvement when it comes to GSE maintenance activities in the scope of better flight punctuality. In a just-in-time environment of turnaround operations, where all the flows are constraints and every second counts, GSE downtime and unavailability (due to failure or shortages) may have severe consequences for D0 and operational costs. Two objectives must be reached by GSE maintenance in this context: maximization of the asset availability (reducing the mean time between failure and improving overall equipment effectiveness) and control over maintenance spending by upgrading interventions from corrective and periodic maintenance to predictive maintenance, adapted to the real usage rate of the equipment. 5G will help airlines, airports, and handlers to adopt advanced predictive maintenance of GSE but also to reduce GSE downtime and streamline maintenance interventions according to usage rate and real technical needs. To illustrate, 20% of the GSE maintenance tasks of a leading European legacy carrier are undertaken based on false positive alarms.

The number of connected devices in airports and the number of monitored parameters on assets will increase thanks to 5G and the accuracy and reliability of real-time data collection will be improved. These improvements make the collected data clearer and more accurate, rendering the implementation of AI easier. In addition to having this information, field agents will be aware, either from dispatch or directly on tablets, of the state of availability of GSE. This will save time when they collect necessary GSE before block time and ensure timely presence of GSE in the apron for better time effectiveness of turnaround processes. The benefits of 5G for airports and airlines can also be considered in an aircraft maintenance perspective with two valuable use cases, augmented reality, and autonomous drones. Significant savings can be reached in this area, where leading legacy carriers such as Delta Air Lines maintenance expenses reach $1.75 billion (2019).

5G will bring value to airlines by addressing expertise and training issues. In case of technical issues or shortcomings in the apron or on the shop floor, technicians can call a remote expert by giving full visibility of repairs and problems with headsets (real-time sharing of 4K image and 3D reconstruction). This solution saves time (improvement of mean time to repair), prevents experts from moving in the apron or shop floor, and makes them available for more technical requests. The main technical shift triggered by 5G for AR is the ultra-high-speed connectivity, reliability, and quality of video streams. These network advances will enable autonomous drones to bring additional value with real-time analytics from A-checks to D-checks, the four different levels of aircraft maintenance checks, suppressing difficult, sometimes dangerous, inspection tasks usually undertaken by technicians (rudder, flaps, winglets and wings, slats and spoilers, etc.), decreasing the total lead time of inspections and reducing the amount of FTS allocated on checks.



5G INITITIATIVES UNDERTAKEN BY LEGACY CARRIERS AND INTERNATIONAL AIRPORTS

The added value of 5G is widely recognized by manufacturing and asset intensive companies. Seventy-five percent of these organizations believe that 5G is a key enabler in their digital transformation, while 65% are willing to implement 5G for operations within two years of availability and 33% already have integrated 5G in their connectivity roadmap and are considering applying for a local 5G license.

Regarding aviation, airport capital expenditure for 5G is expected to increase significantly, from €0.5 billion in 2021 to over €3.9 billion in 2026. Airport operators and airlines have quickly been able to identify many use cases and develop them in line with the technological evolution of 5G (see below).

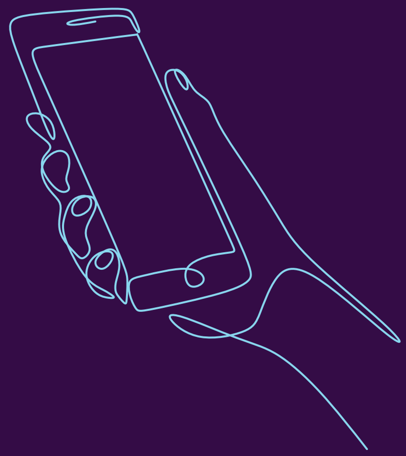
5G initiatives at smart airports

The airport sector has massively developed partnerships with telecom players, leading to the deployment of private (or semi-private) networks and the launch of 5G-empowered initiatives

Key Players	Airports	Use cases	Categories of operations: Terminal	Apron	Maintenance	Sanitary
CHINA EASTERN, HUAWEI	PKX	Intelligent travel system – facial recognition From check-in to boarding, the whole process is fully digital, without paper or ID PAX entry authorizations to lounges are filtered by AR goggles worn by staff Luggage tracking based on airport camera and RFID tracking	●			
Lufthansa Technik, NOKIA	HAM	Remote inspection of engine parts (Customers can remotely visualize engine parts with a virtual table) AR visualization of 3D cabin interior in empty fuselages			●	
KDDI, KDDI Research	HND/NRT	Remote assistance on maintenance operations, using AR/VR and 4K video transmission empowered by 5G			●	
NOKIA	BRU	Implementation of a 5G private network to improve operational excellence and reliability driven by technologies: autonomous GSE, track-and-trace system, increase of IoT capacity		●		
veovo	KEF	Passenger forecasting solutions, flow and density management to maximize distancing between passenger with real-time signal processing and virtual queuing (4G private network)	●			●
HUAWEI	IST	Intelligent travel system – facial recognition Smart screening helmets with thermo-scan sensors for PAX (real-time connection to OCC) Smart robot to park car	●			●
AIRFRANCE, ERICSSON, Hub One, ATHONET	CDG/ORY	Implementation of a 4G private network (future 5G network) to anticipate the resumption of activity and to launch use cases for airport operations optimization (autonomous GSE…)	●	●		

HOW TO SUCCESSFULLY DEPLOY YOUR 5G NETWORK

As introduced in 3GG standards of 5G, several deployment models can be considered with non-public networks (NPNs):



Private network model:

A full private solution where the airport owns its spectrum, its radio and edge/central core networks; this solution is called the stand-alone non-public network (SNPN). With it, the airport has the full control of its network and can easily fulfill the SLAs required by its services (via network slicing, multi-access edge computing) and handle its own devices (smartphones, IoT, cameras, AIVs, etc.) and applications.

Mobile network operator-based network model:

A solution hosted, partly or completely, on the network infrastructure of the mobile network operator (MNO), called the public network integrated non-public network (PNI-NPN). In this model, the airport's private network consists of one MNO's sub-network and one or more private sub-networks.

The deployment scenarios for a PNI-NPN can consist either in RAN-sharing with the MNO and some private edge core solution (mainly the user plane part) with all airport's applications owned by the airport, or in a network slice of the MNO's network. With this solution, the airport has a full control on its applications but might lose the full control over SLAs considering the MNO's network dependency.

OUR CONVICTIONS

Current 4G+ networks enable many efficient use cases for smart airports, but airport operators will soon face network capacity issues and an infrastructural glass ceiling. Indeed, 4G networks cannot empower low latency use cases (<10 ms) and the massification of IoT devices, from numerous sensors to 4k cameras. Deprived of slicing network architecture, 4G cannot ensure scale-up and satisfactory SLA in the long term in a context of connected devices expansion and more stringent connectivity requirements (including mobility, upload / download, geolocation precision, reliability and latency). Early 5G adopters will undoubtedly have a competitive advantage, and private 5G solutions already exist. Network slicing, edge computing, low latency use cases and massification of connected devices can be initiated now.

Therefore, we have three main convictions in order to implement efficiently 5G and benefit from early adoption competitive advantages:

Conviction 1 – Take control: set-up a private network – or a hybrid network with a MNO

A private network provides the most guarantees in managing the wide range of business and safety critical airport needs. It allows airport stakeholders to have full control over their data, network security, performance, quality of service and launch high added value services and functionalities: AR/VR, AIV, security, IoT, interconnection to existing WiFi networks and narrowband IoT networks. Partnering with a MNO on a hybrid network – for instance in the form of RAN-sharing (MORAN / MOCN) with a private Edge core – can generate efficiencies: mutualization with public network assets like cell towers and spectrum, telco support in network operation and maintenance. Therefore, the airport operator can lower the network TCO, retain the right level of control and data privacy and focus on delivering high-value use cases for airport operations.

Conviction 2 – Leverage 4G on the road to private 5G

The 4G network enables a smooth and low-risk transition to a fully 5G connected airport: the 4G core network can support first 5G NSA roll-out and be upgraded to a 5G SA core network, protecting initial investments. As such, rolling out 4G first, or in parallel to 5G, is a smart move: it supports both initial high-value use cases now (eg. advanced mobility and broadband use cases, replacement of PMR on TETRA networks with richer mission-critical voice/data/video services) and prepares the ground for 5G. As the maturity of 5G increases (availability of advanced network features, wider ecosystem of compatible devices, deployments of local telecom operators), the airport operator and other stakeholders can gradually scale up its own private 5G roll-out, migrate use cases onto 5G and support more disruptive airport automation use cases.

While 5G is still maturing, compatible technologies such as 4G can already be leveraged to deliver continuous value while investing steadily in 5G

Connected and autonomous vehicles

- Mid band 3.5 GHz required
- One cell per 1–2 km on runways to support V2N communications
- V2V, V2I, V2P communication enabled by LTE Direct Mode/5G D2D

Mission-critical voice, data and video

- Potential exists to replace TETRA with 4G
- 4G could be rolled out instead of TETRA
- 5G can bring additional capabilities when available

Indoor data and telephony

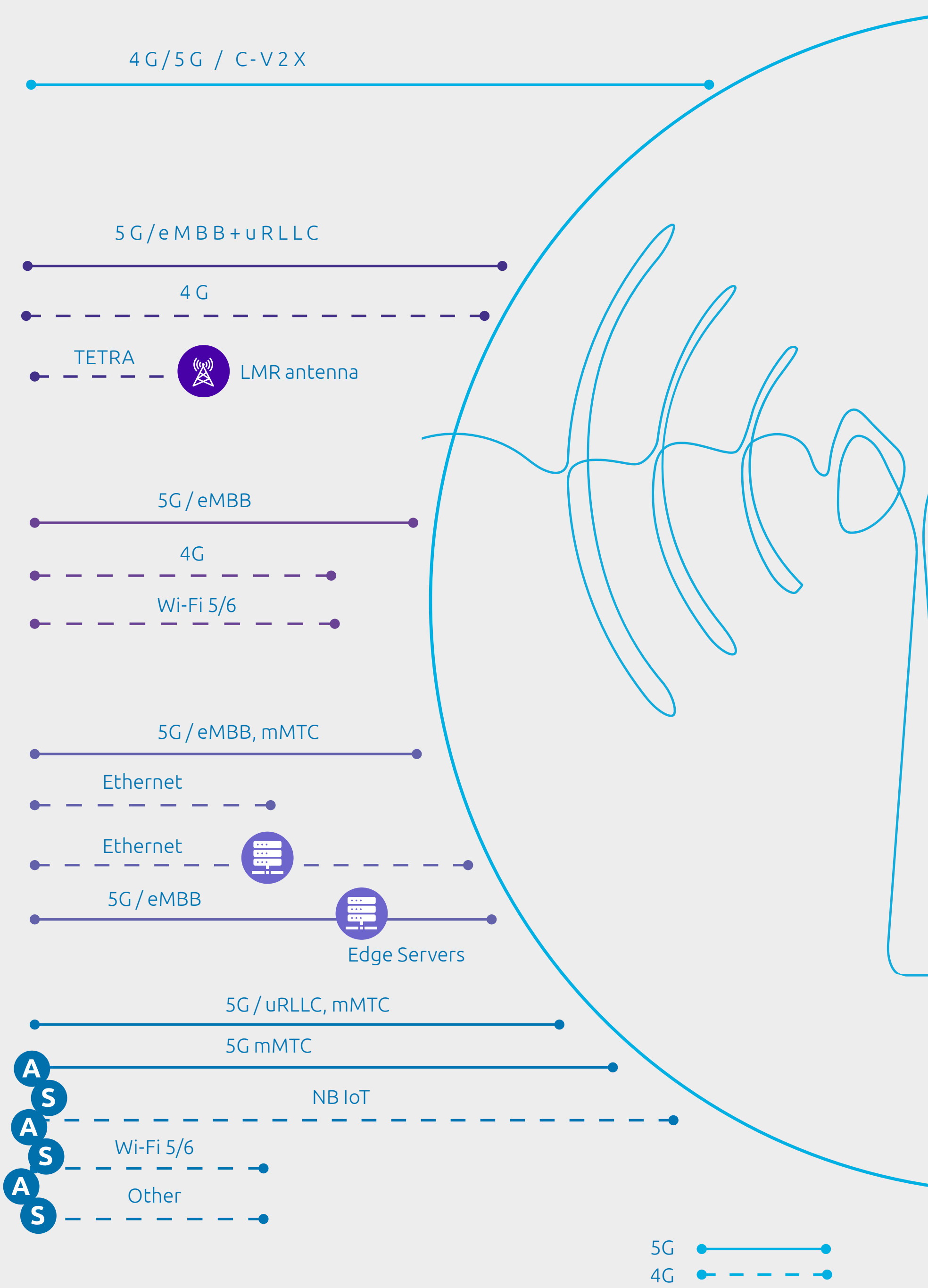
- Use synergies between Wi-Fi and 4G
- Progressively enable 5G according to demand
- Indoor 5G coverage requires approx. 100 dots
- Leverage Wi-Fi for passengers

AI video analytics

- Indoor static cameras connected with ethernet
- Remote and moving cameras connected with 5G when equipment is available (~2021) or installing a 5G modem on the cameras

IoT, GSE, GIS, and geofencing

- New IoT cases to be enabled by 5G from the time 5G devices are commercially available (~2021)
- Current IoT cases to be a) migrated to NB IoT if compatibility or upgrading possibility exists or b) maintained with current solution if no compatibility exists until replacement is needed



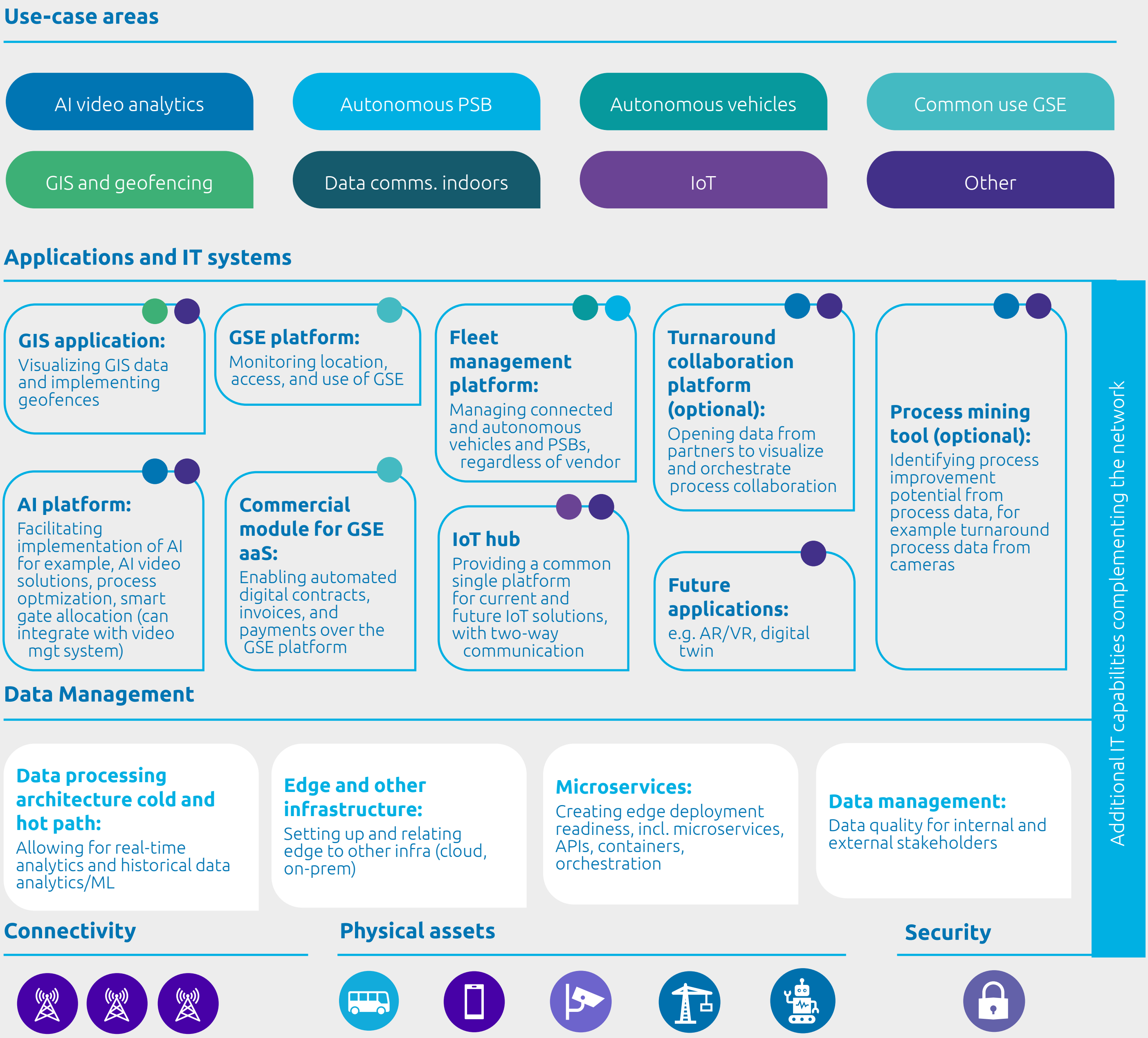
Conviction 3 – Upgrade IT and service platforms to benefit from advanced 5G and Edge features

5G and Edge introduce a software-driven architecture, providing customized and on-demand network services and exposing in real time network data (including devices, user and network status, and geolocation). This context-aware network can support the development of advanced use cases. But to benefit fully from those advanced use cases, airport operators and stakeholders need to carefully look at how this network will be integrated with the airport IT landscape and what additional IT capabilities need to be designed and implemented. From fleet and GSE management platforms, GIS application to AI platform and data management solutions, airport operators and other stakeholders (airlines, ground handlers etc.) must be equipped technically to get the most from 5G opportunities.

Future 5G adopters must test and learn from deployment models based on private / hybrid networks in order to tame the technology, its functionalities according to the R15/R16 standard releases (network slicing, edge computing…) and bring the operators' requirements and security features under control.

5G is still at a maturation stage both for operators and suppliers. While the best is yet to come regarding its technological and operational excellence potential for smart airports, early adoption is the best conceivable strategy.

Progressive buildup of IT infrastructure enables continuous value while investing in a target state with rapid scaling up of new solutions



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