EUROPEAN AVIATION NETWORK
Online Press Conference
5th February
WORLD’S FIRST INTEGRATED SATELLITE AND AIR TO GROUND CONNECTIVITY NETWORK

EUROPEAN AVIATION NETWORK

COMPLETED!

06 ‘17
NOW
A world-leading connectivity platform specifically designed for Europe’s busy airspace

The world’s first fully integrated satellite and air to ground connectivity network

- First European-wide mobile network
- Unprecedented performance
- Most efficient spectrum usage
- High scalability

- Low Latency
- High and adaptable capacity
- Consistent and reliable connectivity

- Massive bandwidth exclusively for Aviation
- Best passenger experience in the highest flight density in the world
WORLD FIRST THROUGH UNIQUE CROSS BORDER COLLABORATION

16 DT NatCo & LBU Subsidiaries
30 Countries with coverage
50+ Local Loop & Tower Companies
160+ DT Team Members delivering EAN

3.100 Kilometers biggest span (West-East)
292 LTE Network cell sites
2.646 Rollout milestones tracked

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ONE OF THE WORLD’S BUSIEST AIRSPACE: EUROPE

22,500 FLIGHTS PER DAY

4.5% P.A. STRONG AND RESILIENT PASSENGER GROWTH

500 MN PASSENGERS PER YEAR

+80% OF EUROPEAN PASSENGERS ARE EAGER TO HAVE HIGH-SPEED CONNECTIVITY ON BOARD

54% WOULD CHOOSE IN-FLIGHT CONNECTIVITY OVER AN IN-FLIGHT MEAL

69% OF PASSENGERS ARE WILLING TO PAY FOR IN-FLIGHT CONNECTIVITY
## EAN DISTINCT ADVANTAGES – ACROSS THE BOARD!

<table>
<thead>
<tr>
<th>BANDWIDTH &amp; CAPACITY</th>
<th>CONNECTION LATENCY</th>
<th>SCALABILITY &amp; GROWTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAN PROVIDES &gt; 75 MBIT/S PEAK RATE TO THE AIRCRAFT.</td>
<td>EAN CONNECTIONS PROVIDE TYPICALLY &lt; 100 MILLISECONDS LATENCY – UNPRECEDENTED IN AVIATION.</td>
<td>EAN’S NETWORK CAPACITY IS CONSTANTLY UPGRADED TO MEET TRAFFIC DEMAND.</td>
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<table>
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<tr>
<th>SYSTEM AVAILABILITY</th>
<th>INSTALLATION &amp; MAINTENANCE</th>
<th>WEIGHT &amp; DRAG</th>
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<tr>
<td>EAN’S COMBINED SAT/LTE NETWORK PROVIDES HIGHER AVAILABILITY THAN THE COMPETITION.</td>
<td>EAN EQUIPMENT INSTALLATION TIME IS DRASTICALLY SHORTER – 4X MORE COST EFFECTIVE THAN WITH THE COMPETITION.</td>
<td>EAN EQUIPMENT IS SIGNIFICANTLY SMALLER &amp; LIGHTER – 3X LESS ADDITIONAL KEROSENE CONSUMPTION THAN COMPETITION.</td>
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**AVIATION EXCLUSIVITY**

AIRCRAFTS ON EAN DO NOT SHARE NETWORK CAPACITY WITH ANY OTHER INDUSTRY OR USER-TYPE.
WITH DEUTSCHE TELEKOM, EVERYWHERE
ALWAYS BEST CONNECTED
EUROPEAN AIRLINES COULD BENEFIT FROM AN EXTRA $8.2 BN IN ANCILLARY GENERATED REVENUE BY 2035
THE CHALLENGE

AMONGST THE BUSIEST AIRSPACE IN THE WORLD
- EAN is the world's first integrated network for inflight Wi-Fi
- S-Band satellite successfully completed in-orbit tests in 2017
- Satellite working seamlessly with the EAN ground network
- EAN aircraft system is now being tested in a fully integrated way
EAN NETWORK IS READY TO GO:

- SUCCESSFUL FLIGHT TRIALS
- EAN MEETING ITS DESIGN PERFORMANCE IN REALITY
- FIRST CLASS INFLIGHT INTERNET
- RESILIENT, LOWER COST TO OPERATE
- UNMATCHED PERFORMANCE & CAPACITY
NOKIA LTE AIR-2-GROUND SOLUTION

- Special LTE-Solution for the EAN based on Nokia’s Air-to-Ground technology
- Special requirements:
  - Works at speeds of up to 1200 km/h
  - In 10 km height
  - Requires large cells of up to 150 km in range
- Developed special up tilt antenna to cover sky
- Base solution includes baseband unit, adapted Nokia LTE radio heads, antennas and GPS module
NOKIA LTE AIR-2-GROUND TECHNOLOGY CHALLENGES

LTE connection despite high speed

- Nokia Bell Labs algorithms provide robust Doppler estimation and compensation caused by aircraft high speed (up to 1200 km/h)
- Results in stable signal
NOKIA LTE AIR-2-GROUND – TESTING AND ROLLOUT

- Rollout of 300 base stations
- Built first integrated network across Europe
- Network planning tools for ideal site locations
- Operation and maintenance of EAN ground network

End-to-end live testing at Nokia lab in Stuttgart

First successful flight tests in commercial network in November 2016 – throughput beyond 75 Mbit/s
LTE AIR-2-GROUND: END-TO-END TURNKEY SOLUTION

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<th>End-to-end responsibility</th>
<th>Services</th>
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<td>Integration</td>
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<td>Network implementation</td>
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<tr>
<td>Network and field operations</td>
<td>System engineering</td>
</tr>
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<td>(predictive) Care</td>
<td>Network planning and optimization</td>
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<tr>
<td>OBE specification requirements</td>
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<td>OBE integration</td>
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### Network

#### Service platform
- WLAN Controllers
- AAA
- CDN
- Application servers

#### Core
- Management
- HSS
- SGW
- PGW
- PCRF
- MME
- IP/MPLS Aggregation & Access

#### LTE
- LTE baseband
- Customized radio module
- Specific antenna
- Air-to-ground features

#### On-Board Equipment Partnership
- LTE OBE
- IFEC Server
- WLAN AP

Thales aircraft terminal system and Nokia LTE network are an integrated end-to-end system that connects to the Connectivity Server and the Wi-Fi access points in the cabin, transfers the passenger traffic to the ground, has a throughput beyond 75 Mbit/s, and is scalable for future upgrades.
LTE AIR-2-GROUND - SUMMARY

FIRST AND ONLY

- Unique LTE solution created with special Air-to-Ground algorithms to work with Satellite
- Solution thoroughly tested

TURNKEY END-TO-END

- Built and integrated the EAN ground network across Europe on behalf of Deutsche Telekom

IN THE NEXT YEARS

- Operations and maintenance it on behalf of Deutsche Telekom