



# Boeing Airport Wireless

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# Agenda

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- E-Enabling Vision and Applications
- Current and future of wireless on Boeing airplanes
- New Airplanes – New Operations
- Retrofit
- Service Ready
- Airport R&D



# Airport Wireless Requirements

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- Market Requirements
- Historical Client Development
- Televisions and Selling Advertisement
- Intel, WiMAX and Client Development
- Airplanes that are linked to the back office.
- Data Growth

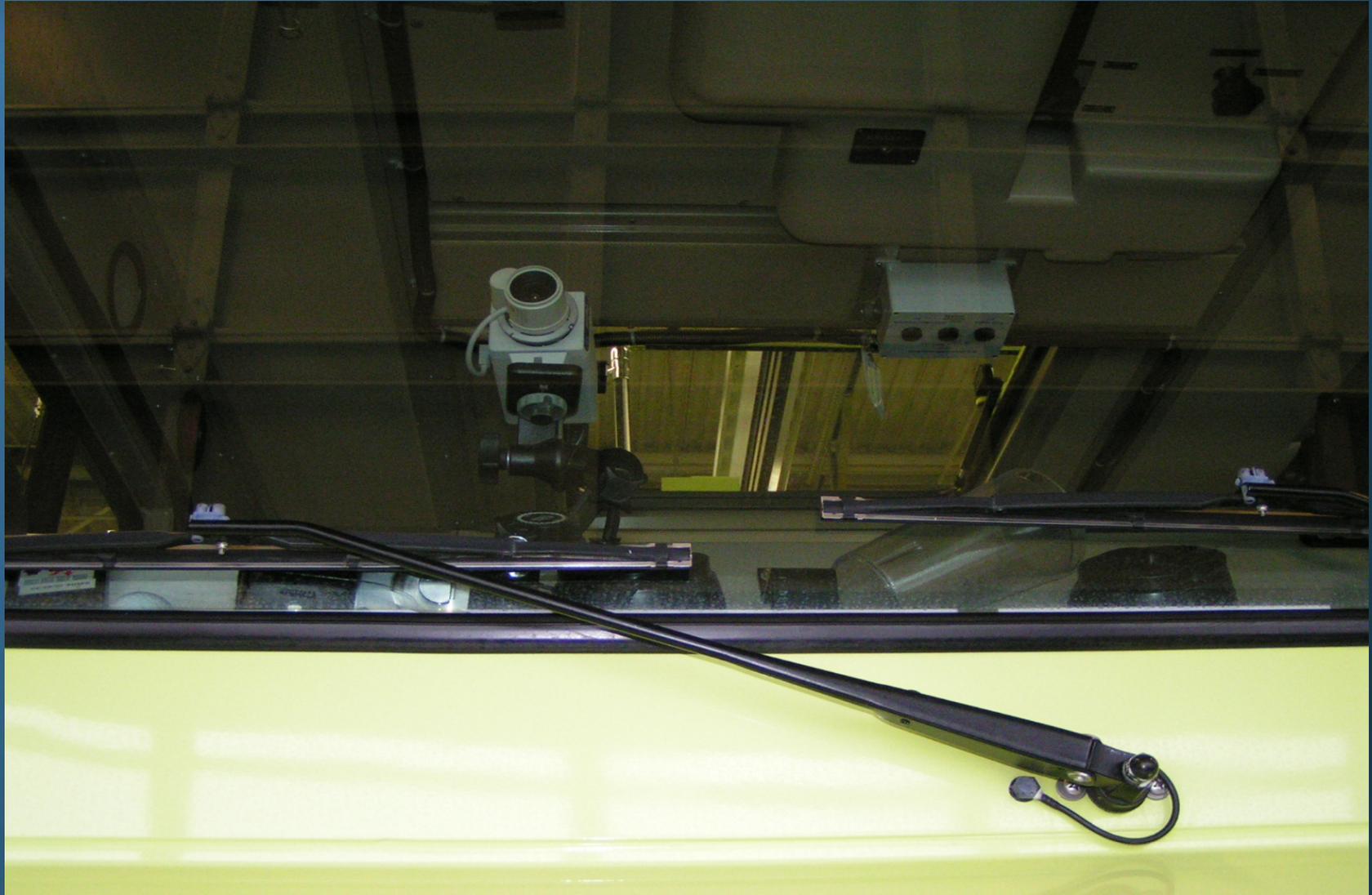


# Other Client – Same Infrastructure





# Streaming Video & Vehicle Position



# E-enabling Vision



**Major benefits for passengers & crew**



**Airplanes are always connected,  
sending & receiving valuable  
information**



**Increased  
revenue**

**ATM**

**Real time monitoring...  
predictive rather than  
reactive**

**Improvements in  
airline operational  
efficiency**





# e-Enabled Value

Value

Efficiency



Availability and Reliability



Safety, Security, Environment



Passenger Experience



Applications

Enterprise One



iAOC



Electronic Logbook



Taxi Positional Awareness



Cashless Cabin



Video Surveillance



Airplane Health Management



Electronic Charts



ISDP



Maintenance Performance Toolbox



Infrastructure (Hardware & Software)

MyBoeingFleet



Wireless Ramplink



Cabin Wireless



Electronic Flight Bag



Network File Server



Core Network



Technologies

Web Services



XML

Internet Protocol



Wireless Networking



Data Factory



Information Assurance



Advanced Antenna



Improve Processes

Work Simulation

Value Engineering

Business Architecture

Strategic Process Improvement

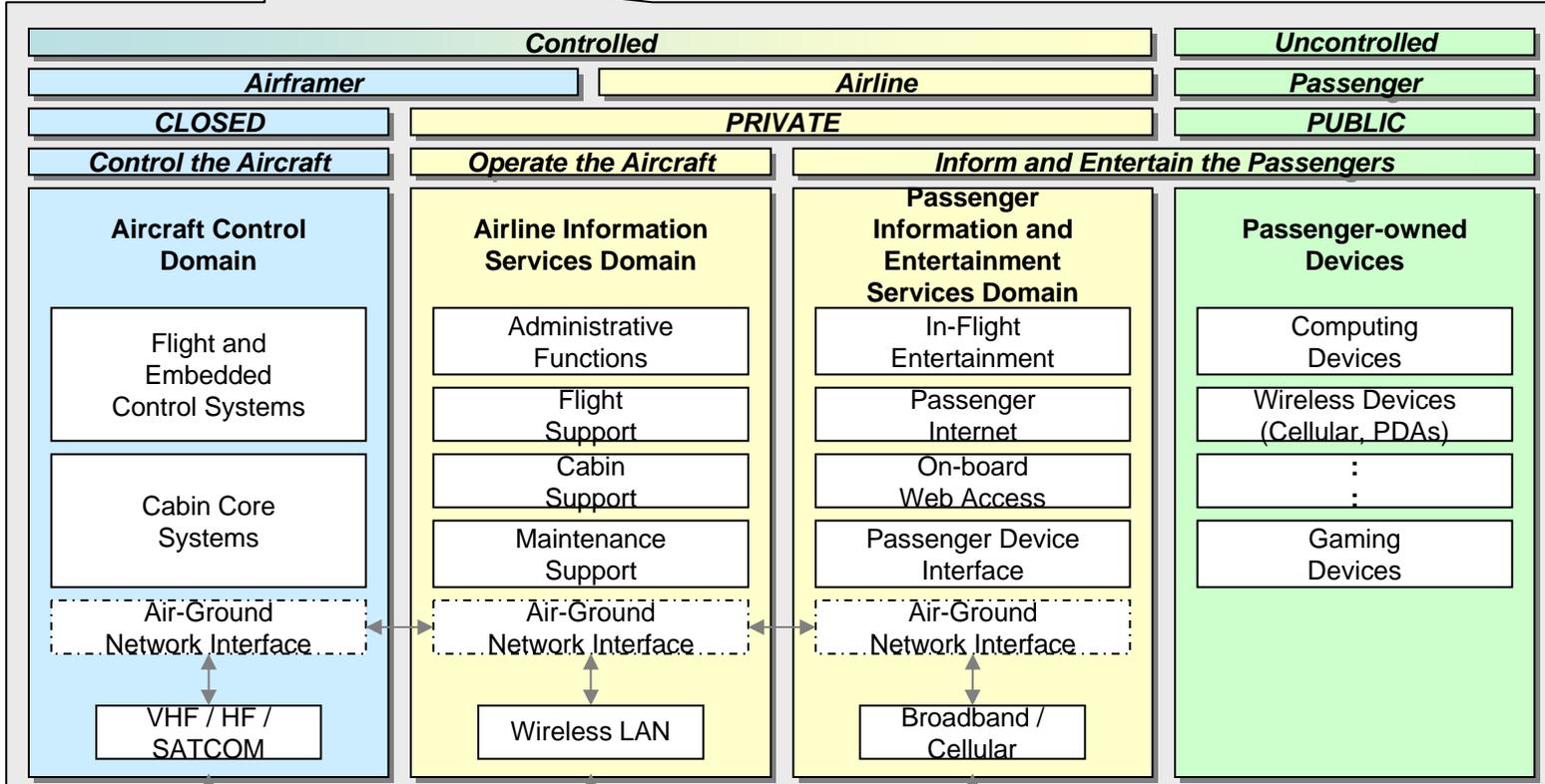
Lean

Information Architecture

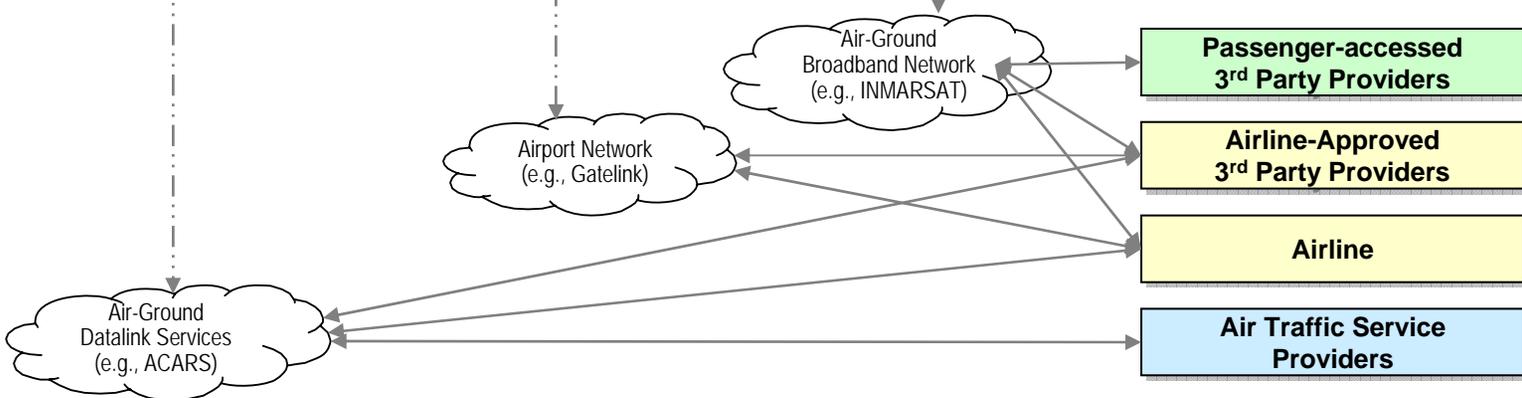
Business Modeling



**Aircraft**



- Views**
- Security
  - Responsibility
  - Airline Ops
  - Roles
  - Functions





# e-Enabled Service Ready Environment

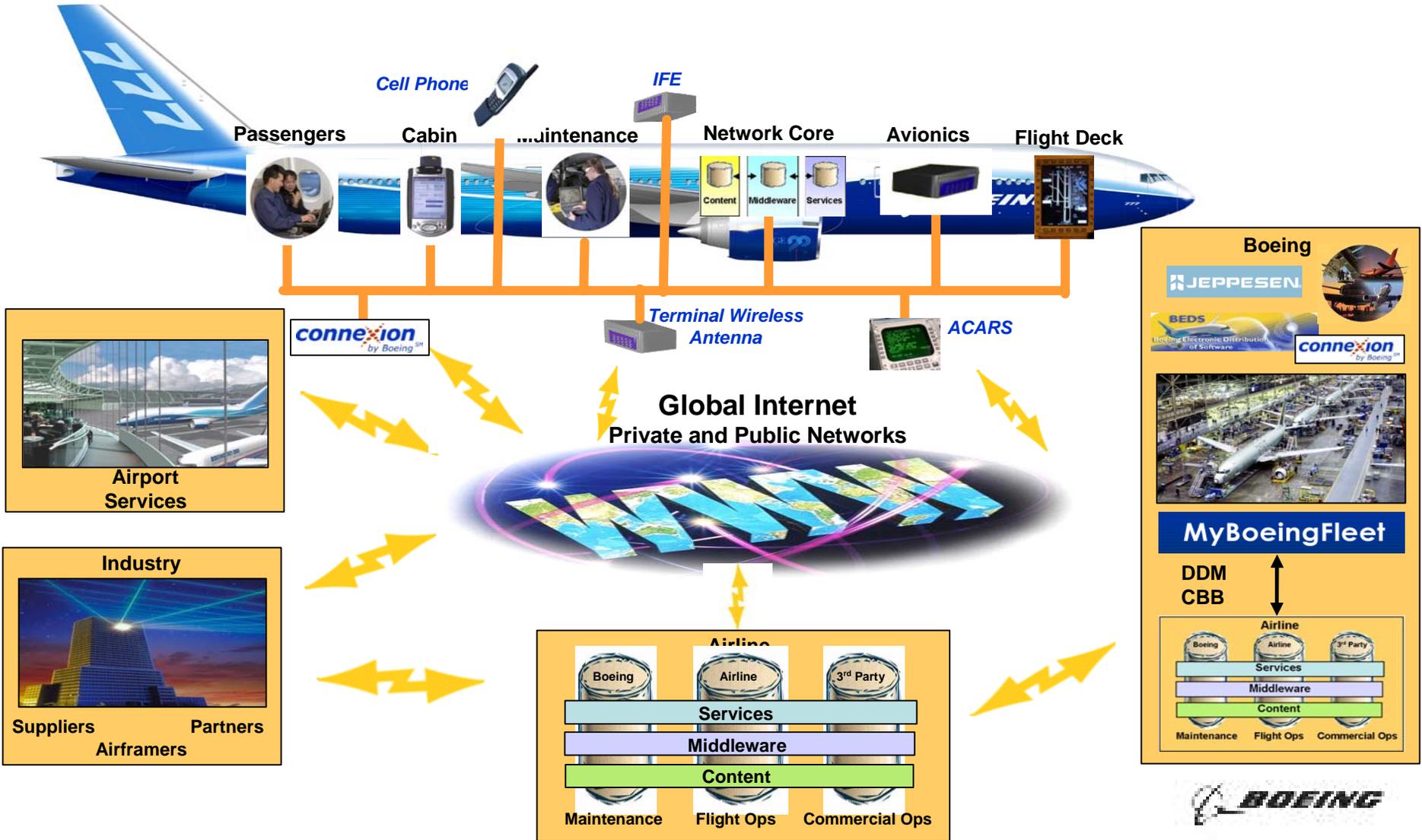
- The strategic connection and integration of business processes, people, airplanes, information, assets, and knowledge *into a single focused business system*
- Centered on breaking through operational constraints





# 777 e-Enabled Environment

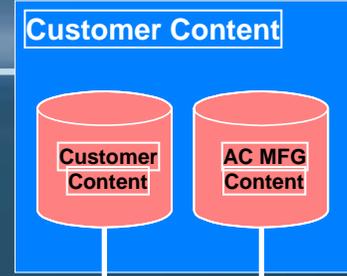
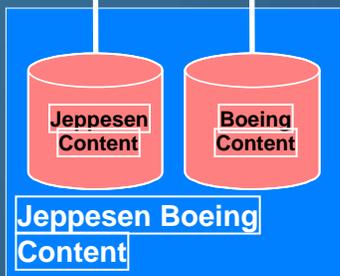
PARTNERS IN FLIGHT



# Basic DDM Service with Customer Content capabilities

**Jeppesen Boeing DDM Architecture**

- Content Management Security Administration
- Packaging Scheduling Delivery
- Network architecture, High Availability, Business Continuity



• Customer control of DDM process

• Wireless Gatelink  
• Connexion by Boeing



# Airport Wireless - Operations

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## *Benefits Airlines*

- Low cost substitute for current ACARS capabilities
  - OOOI data, ACMS reports, flight plan updates, etc.
- New capabilities
  - QAR data downloads
  - IFE data uploads
  - On-board database uploads (e.g. EFB, FMC, LRUs)
  - Maintenance log upload/download
  - Data communication between ground users and airplane

## *As well as Airports*

- Data communication and coordination between airport ground users
  - Baggage handling and reconciliation
  - Security operations
  - Surface vehicle tracking and communication (text/video)

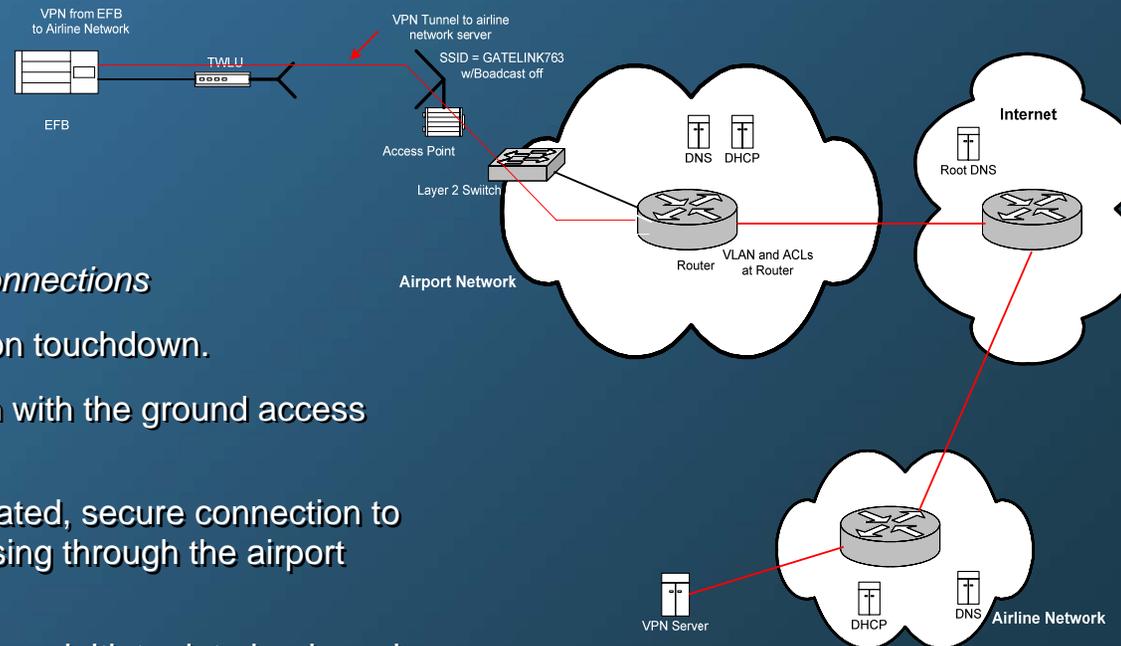


# Airline Wireless - Characteristics

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- Aviation grade
  - Availability
  - Reliability
  - Interoperability with aircraft & airport systems
    - AEEC ARINC 821, 822 & 763 committee
  - End-to-End integration
    - Aircraft/airline operations/maintenance centers
  - Security
    - VPN from EFB to airline network over insecure network
  - Integrity
  - Airline Operational Regulatory Constraints
    - Part 121 Approval for system

# Wireless Operational Concept



- Airplane initiates all *connections*
- TWLU is activated upon touchdown.
- Establish a connection with the ground access point.
- Establish an authenticated, secure connection to the *airline* host, traversing through the airport system.
- *Airline* ground system can initiate data loads and allow *communications*.
- Retained until the airplane takes off.
- No additional workload for the flight crew since there are no pilot interactions required in this design.



# Airport Requirements

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## Requirements

The 777 and 787 are both 802.11b/g

- SSID's of GATELINK822 for WPA capable devices will support both WPA and WPA2, GATELINK763 for EAP-TLS w/o airlinK encryption, and GATELINK for Open Authentication devices with no EAP-TLS or encryption.
- GATELINK822 will be required.
- GATELINK763 and GATELINK will support both WPA and WPA2 called out as optional to maintain consistency with past documents.
- The two "legacy" SSID's will not be *required*, but will be called out to support all possible aircraft/TWLU combinations.

\*Control access to/from AP via the Access Control Lists on the AP

- Dynamic Host Configuration Protocol (DHCP) and Domain Name Service (DNS) at the airport



# Airport Considerations

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- Coverage area – Consider gates, hangars, extended tarmacs and taxiways
- RF environment at the airport
- Existing Infrastructure – Power, Dark Fiber and Access
- Antenna design and layout
- Other Operations – Catering, Fuel, Security, Fire & First Aid



# RF Discipline Avionic System Integration



## Changi Airport Site Survey



Site physical survey for identifying access point location

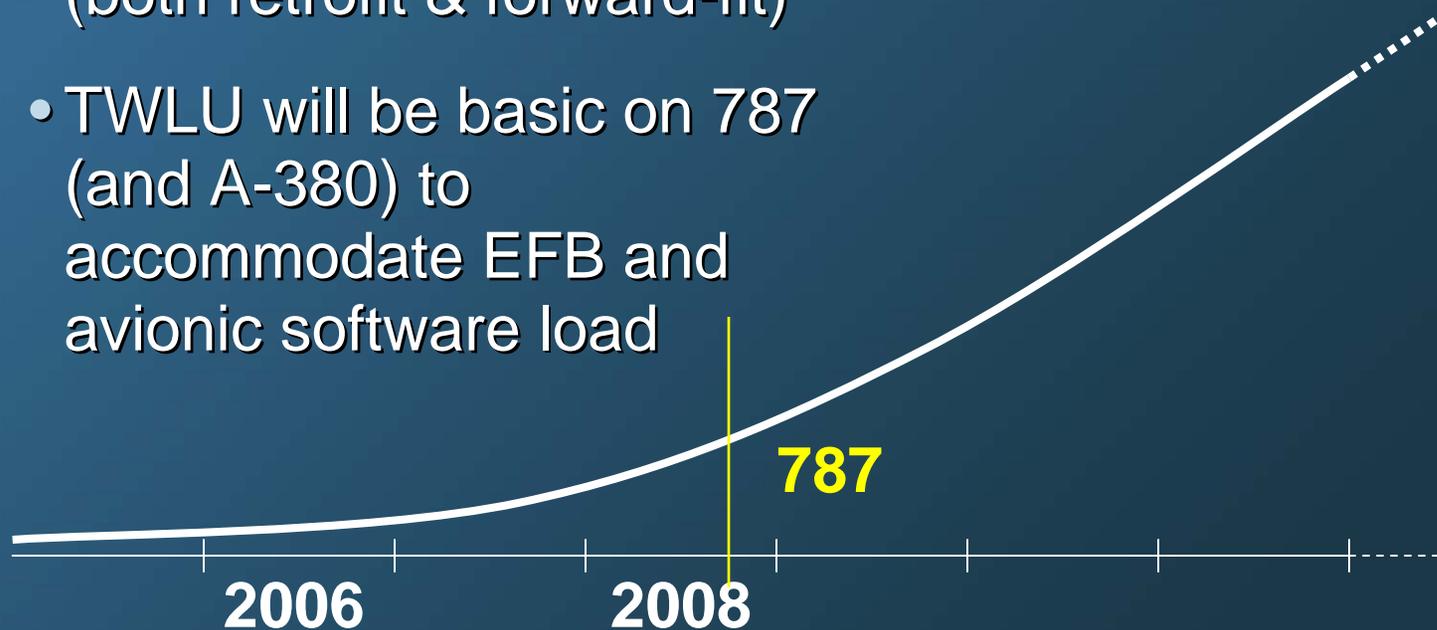


RF site survey



# Airport Wireless - Adoption

- For near-term foresee continuing moderate roll-outs of EFB installations (both retrofit & forward-fit)
- TWLU will be basic on 787 (and A-380) to accommodate EFB and avionic software load





# Connectivity Plans

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- Currently offer 802.11b/g wireless capability via Miltope TWLU
- TWLU is BFE for 777
  - Suppliers are responsible for development
  - Qualify new LRU's with Boeing
- Two other suppliers are developing new TWLU's with added capability for availability in 2006
- Suppliers have approached Boeing with plans to certify these new TWLU's
- Industry Coop - Boeing is studying 802.16 (WiMax) for applicability to airplane use at airports



# 802.16 WiMax

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- IEEE standard in development
- 802.16e addresses mobility for 802.16
  - 802.16e standard completed 4Q05
- Claimed capability of 70Mbps and 30 mile range was over hyped but technology still has significant value.
  - Many attributes are ideal for airport surface operations
- Boeing plans on deploying at BFI as soon as it Q306
- Adoption a function of compatibility with airplane antenna and wiring



# Bandwidth concerns 787

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**Flight Data Downloading**  
**Maintenance Downloading**  
**Nav Database uploads**  
**Electronic Techlog**  
**Chart updates**  
**Specific aircraft documentation uploads**  
**Pre-flight data uplinking**  
**BEDS/OBEDS**  
**Engine trending**

**Video server uploads**  
**IFE Content uploads**  
**IFE server maintenance**  
**Point-of-Sale transactions**  
**Weight and Balance and other performance applications**  
**Fuel data transfer and modified dispatch**  
**VoIP**



# Bandwidth concerns

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- We are starting with 802.11b for Gatelink
  - ~5.0 Mbps/AP,
  - EFB db updates 7-28 days, 4MB – 130MB
- When file server added, more users, bandwidth issues at hub airports
  - 802.11g
  - 802.16
  - 3G
  - Priority of users and services
- One solution is to provide extended coverage, to allow connection at touchdown and transfer during taxi
- Airplane will be slowest adopter, many generations co-exist because of certification and cost issues.

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# Airport R&D



# Aviation Week Article 7-28-03

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## Boeing Commercial Airplanes Results

### Taxiing Bandwith

Providing a broadband link to aircraft on the ground is part of Boeing's service strategy

MICHAEL MECHAM/SAN FRANCISCO

In partnership with Singapore Airlines, Boeing Crew Information Services has begun field testing the functionality of its wireless gatelink technology at Changi Airport.

Boeing has been developing a wireless (WiFi) gatelink high-bandwidth ground-based system for about two years at Boeing Field in Seattle. But that effort has been largely a laboratory exercise to learn how best to manage the large data loading that the system promises for airline and airport customers. The work is also evaluating switching technology, spectrum issues and where to place antennas.

The Changi test brings the effort to an operational level and comes about because the Singapore Economic Development Board sees an opportunity to begin offering airlines and airport service providers with WiFi links. After being selected last year, Boeing spent six months setting up a demonstration system at Terminal 2 in partnership with the Civil Aviation Authority of Singapore (CAAS) and Singapore Airlines (SIA). The carrier is providing a 747-400 for tests using a prototype of Boeing's Electronic Flight Bag (A<sup>W&ST</sup> Dec. 2, 2002, p. 64).

The effort is part of Boeing's broad



Engineer Tim Mitchell's laptop computer screen shows current heading and position on a taxi positional awareness map to Singapore Economic Development Board CEO Teo Ming Kian.

AVIATION WEEK & SPACE TECHNOLOGY/JULY 28, 2003 45

2 Aviation Week  
July 28, 2003  
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# BFI Wireless Laboratory

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- Boeing Field currently has wireless capability.
  - Testing both 2.4 Ghz and 5 Ghz systems for:
    - Security
    - Operational Stability
    - Interoperability
    - Through-put
    - Hand off
    - Data Reliability
  - Simulation of Customer Airport installations
  - Testing of new technology
    - 802.11g/i/n, 802.16, cellular



# Experience at Boeing Field



Distance	Typical Throughput, Mb/sec							
	802.11b	Boeing Enhanced		802.11g	Boeing Projected		802.11a	Boeing Enhanced
50 Meters	5	4.7		20	20		10	18
100 Meters	2.5	4.6		7	10		4	18
200 Meters	2.5	4.6		5	10		4	15
300 Meters	1	4.7		2.5	5		0	15
400 Meters	0	4.7		0	5		0	10
500 Meters	0	2.2		0	2.5		0	8
750 Meters	0	1		0	2.5		0	5.7
1000 Meters	0	1		0	1		0	1
1250 Meters	0	1		0	1		0	1



# Summary

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- e-Enabling will allow airlines to operate more efficiently
- Value-building software applications are here today and more are on the way
- BOTH Airline and Airport operations will benefit
  - For some, business case may only close with common approach
  - Airport authorities need to be proactive to maximize usage synergy in a win-win manner
- Airline operations require aviation grade wireless
- The time to begin coordinating and planning is now
- Boeing is assisting with standard develop and is available to consult on a variety of aspects