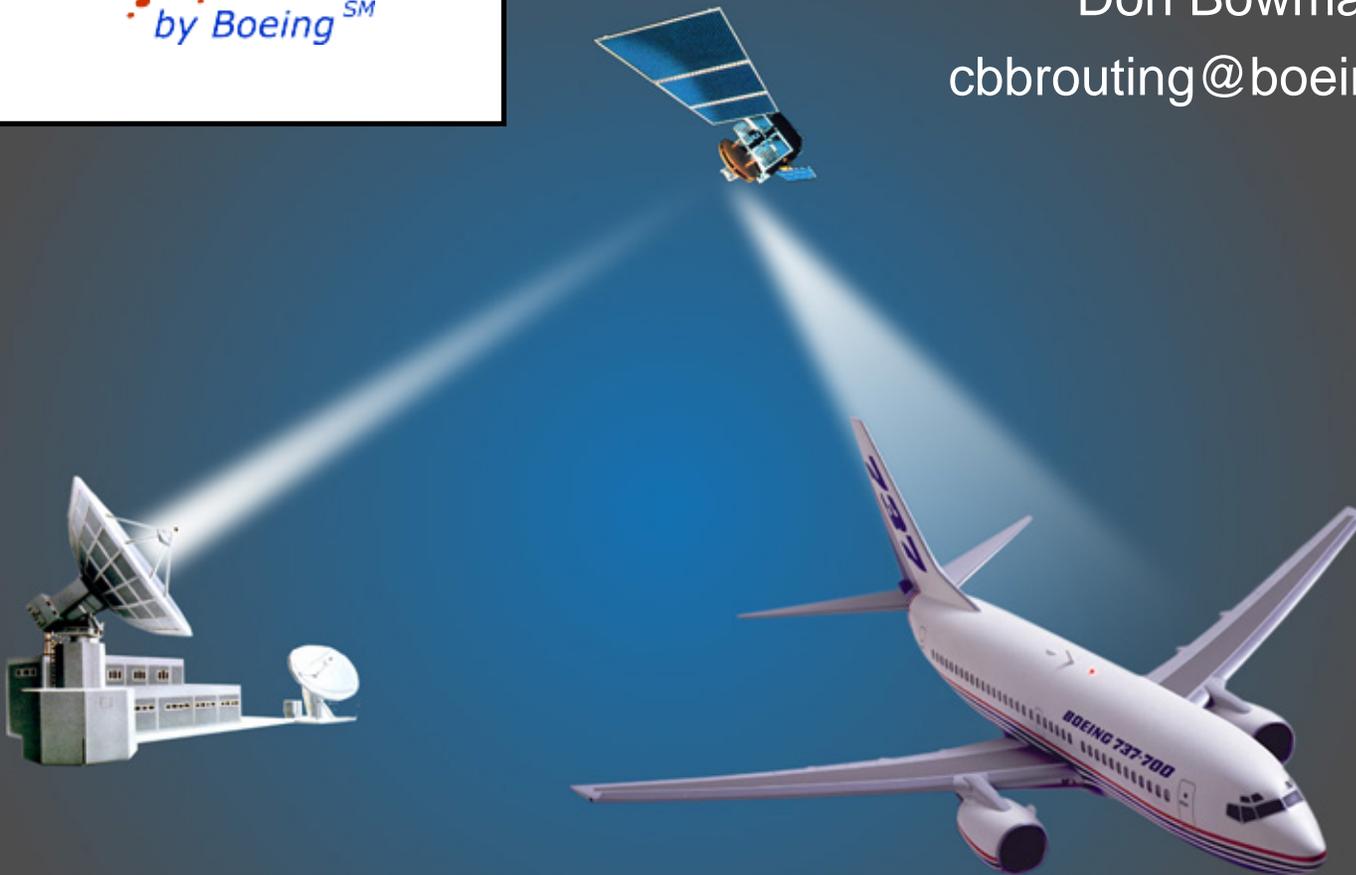




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Global Network Mobility

RIPE – 48

Implementing Network Mobility

- Summary
- What is Connexion by Boeing?
- Network and Service Challenges
- BGP as a mobility solution
- Questions

Implementing Global Network Mobility Summary

- Traditional approaches
 - Target host mobility
 - Require mobility support in protocol stacks
 - Do not provide “intuitive routing” over a wide geographic area
- Internet access on mobile platforms
 - Hosts remain stationary with regard to the platform
 - Hosts may number in the hundreds
- Our solution: BGP
 - Uses the global routing table
 - Selective announcements and withdrawals as platforms move

What is Connexion by Boeing?

- Division of The Boeing Company.
- Mobile Internet Access Provider
 - commercial airlines
 - maritime vessels
 - and other mobile platforms.
- an 802.11b “hot spot” at 39,000 feet.
- Partners include Lufthansa, SAS, JAL, Korean Air, Singapore, & ANA.

Both Passengers and Airlines Want 2-Way Onboard Communications Services...



Passengers:

- Home/Office-like experience
- Real-time, high speed connectivity
- Personal and corporate e-mail
- VPN Support
- Personalized content
- Seamless, secure access
- Connectivity throughout their travel experience



Airlines:

- Simple cabin design
- Reliable and robust system
- Less weight and power
- Real-time crew information services
- Enhanced operational efficiencies

Current and Potential eEnabled Applications

Maintenance

- Maintenance documentation
- Aircraft Health Monitoring
- Electronic logbook
- Data loading
- e-Mail (real-time)
- Flight Operations Quality Assurance download
- Equipment List

Cabin Crew

- Passenger data base
- Crew e-Mail
- Cabin E – Logbook
- A/C Documentation
- Cabin inventory
- Quality monitoring
- Reservations
- Security

Passengers

- e-Mail (real-time)
- Intranet / Internet
- News/Sports/Sat. TV
- e-Commerce



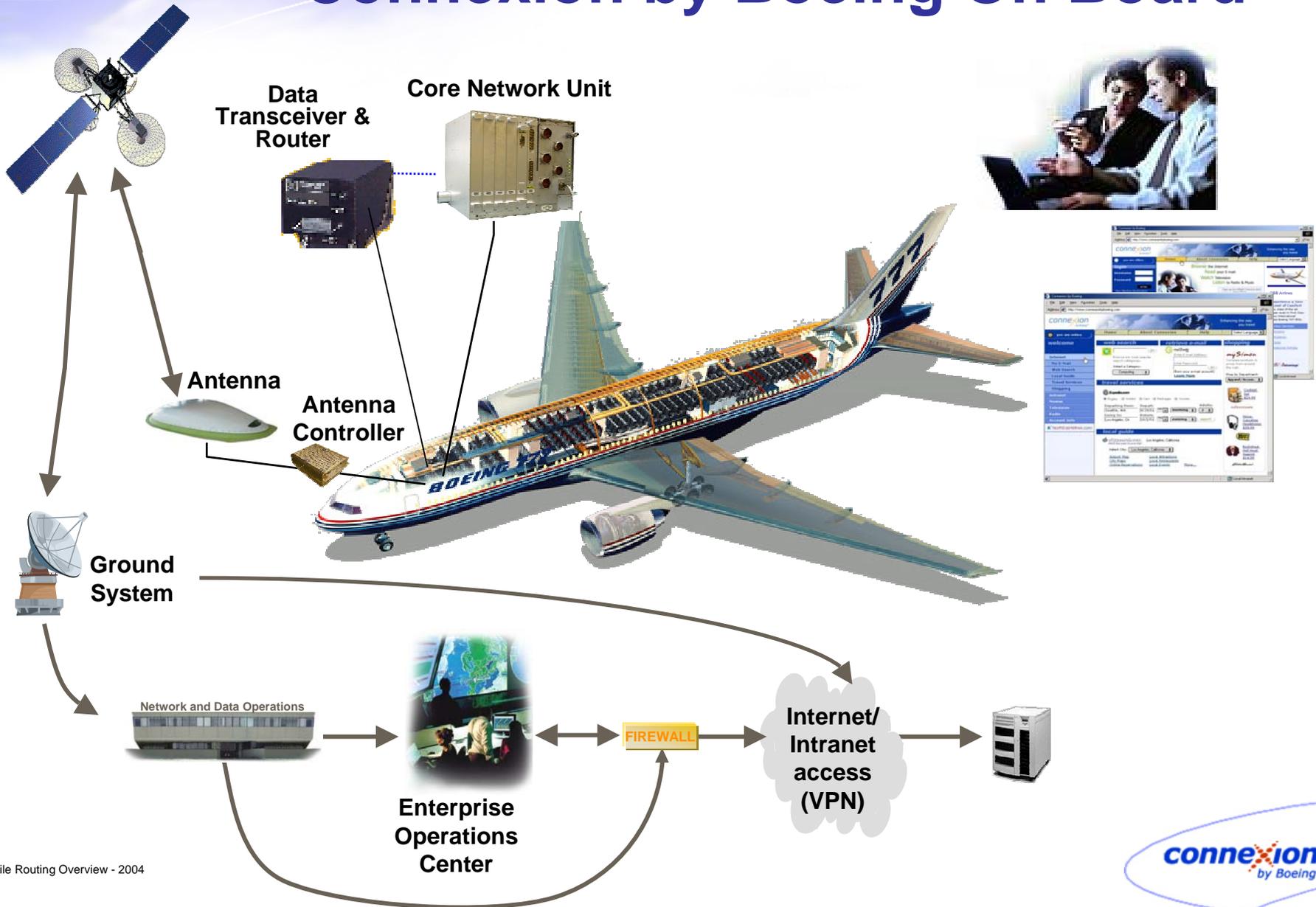
Flight Operations

- Electronic Flight Bag
- Performance Data
- Operational Checklists
- Access to Flight Information services
- Charts and Maps
- Security

Cargo

- Customs Clearance
- Cargo/Baggage monitoring

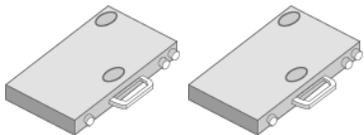
Connexion by Boeing On Board



A Natural Extension of Ground-based WiFi Access

- Continuing proliferation of wireless portable electronic devices
- Cabin simplification
- Reduced weight
- Convergence of low-bandwidth mobile and high-bandwidth fixed communications is driving growth of high-bandwidth mobile services

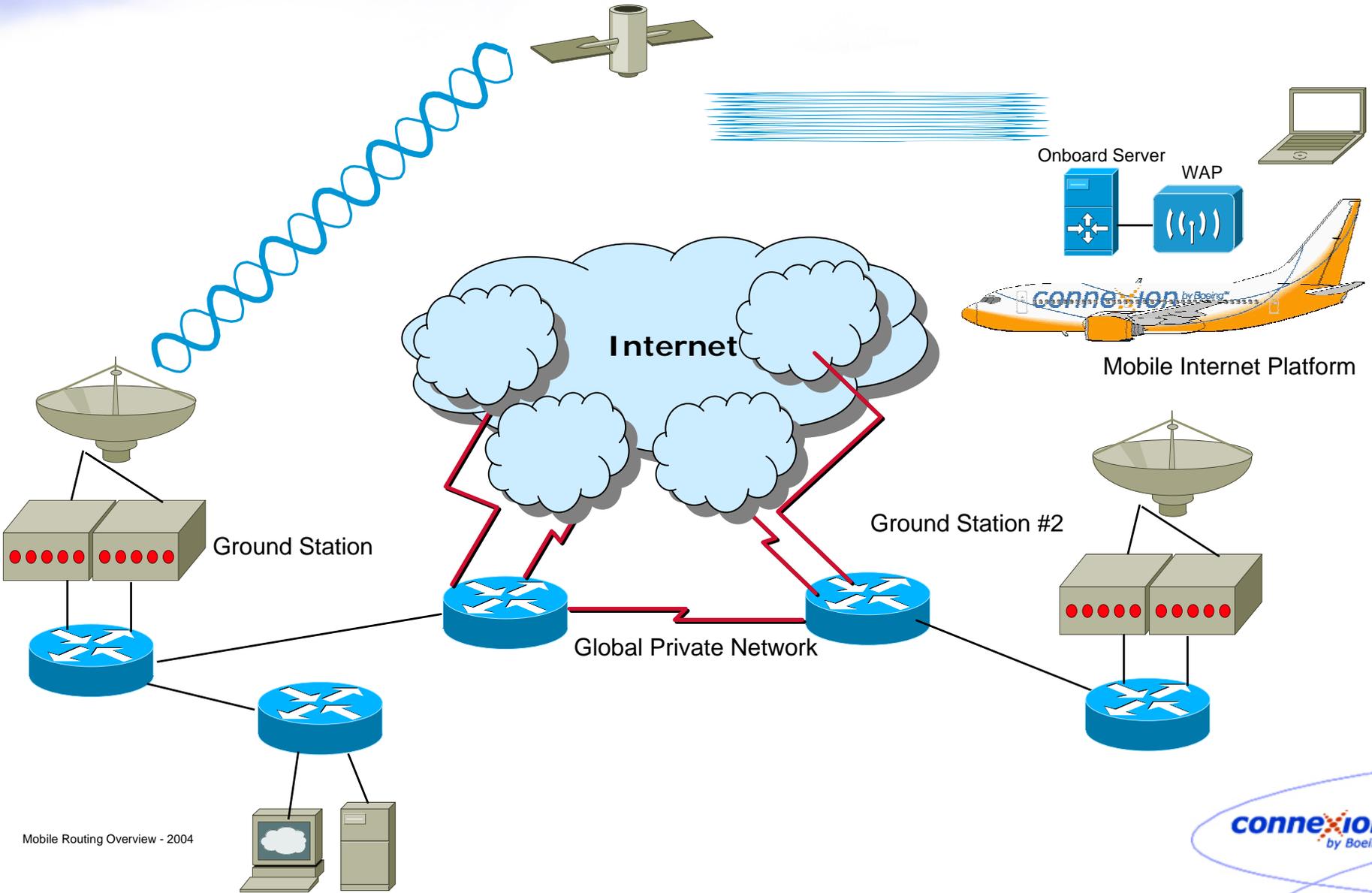
Wireless Access Points



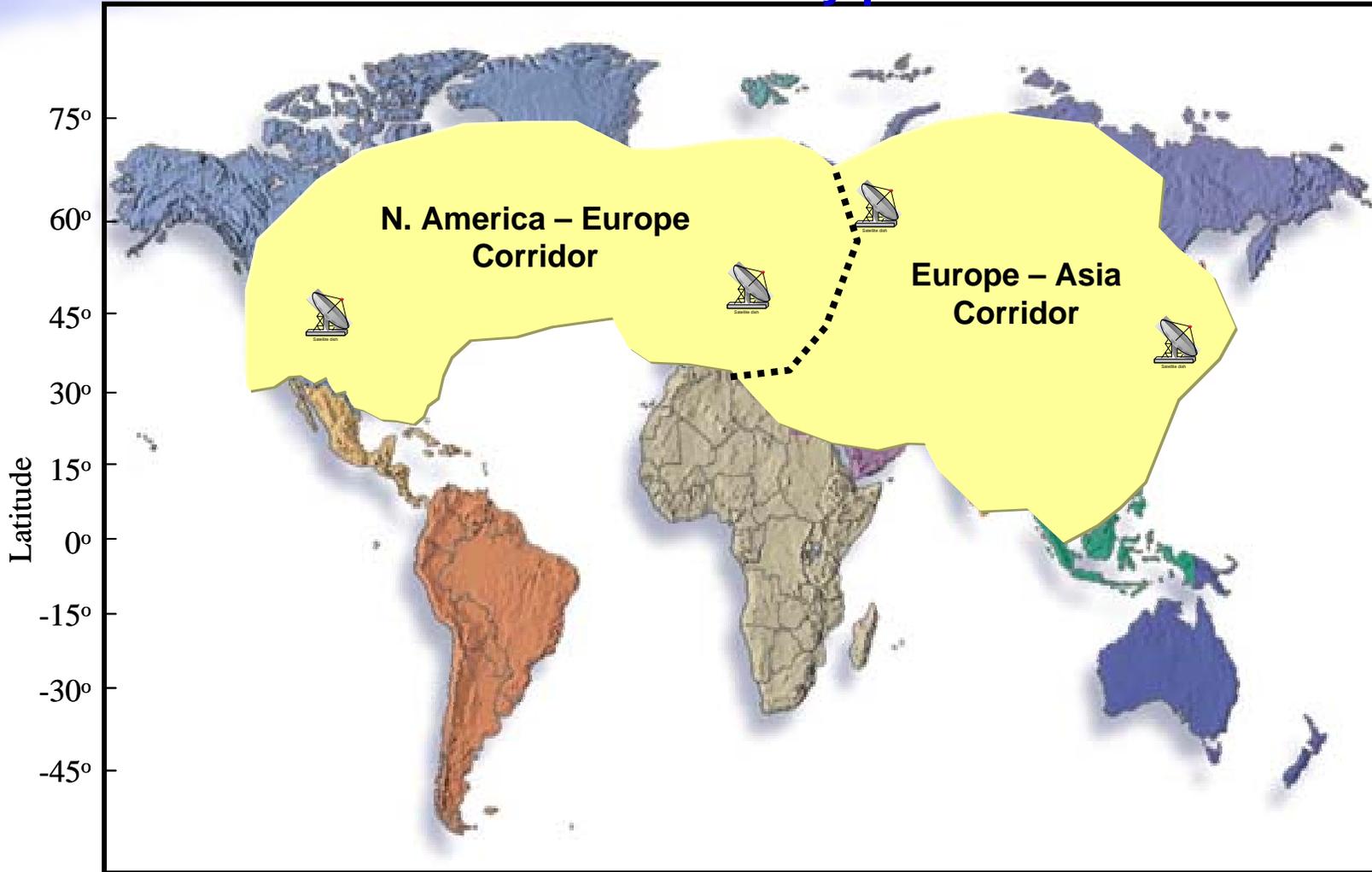
802.11b Wireless



Connexion Network Architecture



Where do we currently provide service?



90° maximum scan angle with 5° Angle of Attack margin. Coverage is notional.

Network & Service Challenges

- Our network challenges are unique in a number of areas
 - Mobility
 - Our platforms move, but not just a little...
 - They also move fast
 - Hardware
 - Deploying hardware on commercial aircraft
 - We can't just put a commercial router on a plane.
 - Quality of Service
 - Need to insure good performance over an expensive limited bandwidth pipe

Mobility Challenges

The Latency Tax

- Most Mobile IP protocols do not take into account the vast distances that a jet aircraft normally travels in a single day.
- Non-intuitive routing: tunnel traffic from a home router to a mobile router. Tunneling traffic from a home router adds large latencies when platforms are globally mobile and not always near the home router.
- For Example: Latency with tunneled mobile IP – aircraft homed in US currently over east-Asia to European website - one-way
 - 300ms - Aircraft -> geo-synchronous satellite -> ground East Asia
 - 130ms - Asia -> North America
 - 70ms - Across North America
 - 80ms - North America (home) to Europe
 - 80ms - Europe to North America
 - 660ms Total
- Almost 2 seconds to complete a TCP 3-way handshake!!!

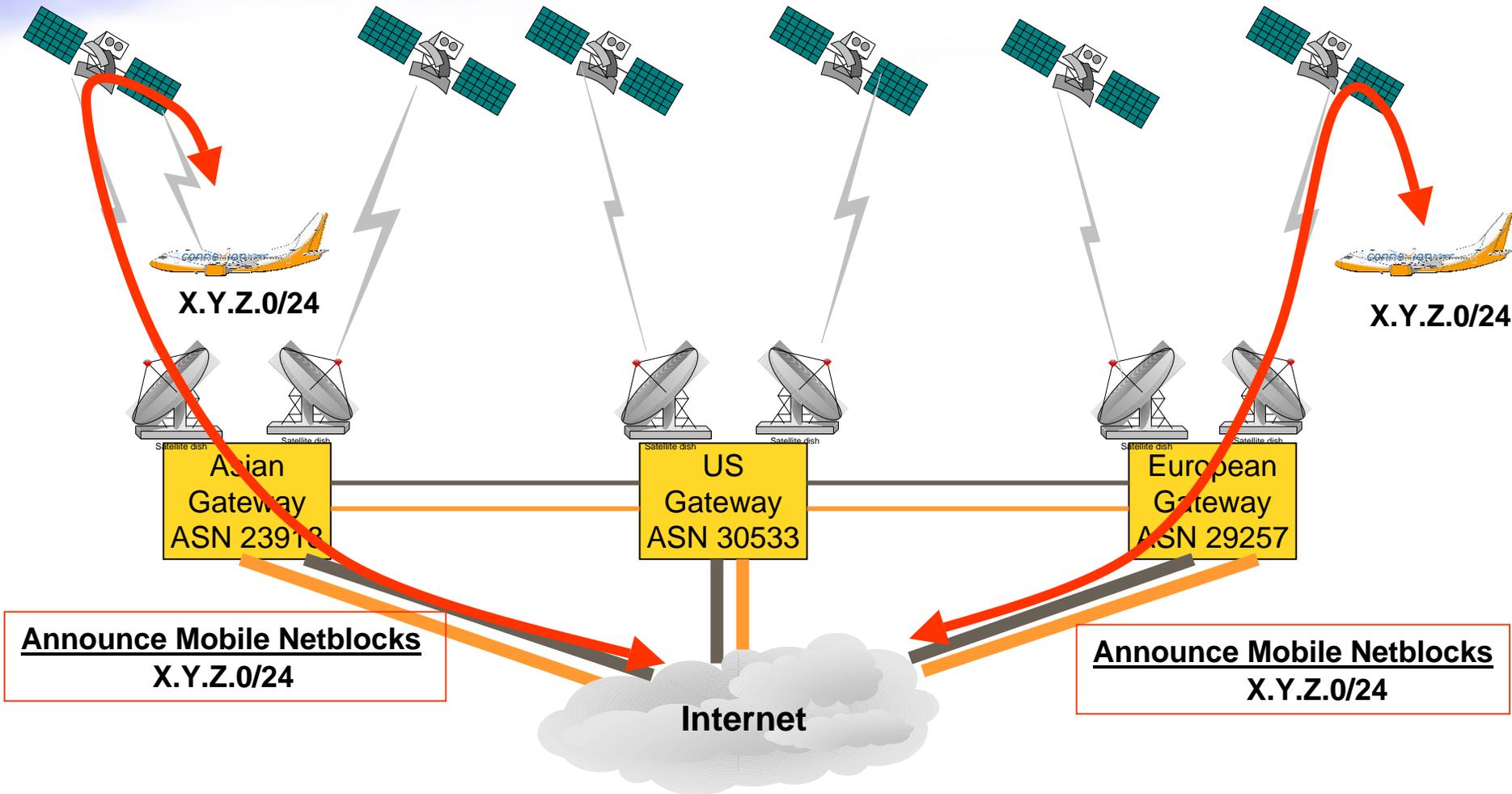
Finding a better path through the ether...

- We wanted to find a better way to reduce latency, improve network reliability, and allow for global connectivity.
- The solution needed to allow seamless user connections throughout a flight...
- ...while leveraging existing routing technology to allow for easier implementation.
- Traffic flows should follow geography!

Fighting Latency Back

- Instead of having mobile platforms homed to a specific region release the traffic to the Internet at each satellite ground station.
- Example: Aircraft currently over Europe to European website - one-way
 - 300ms - Aircraft -> geo-synchronous satellite -> ground Europe
 - 30ms - across Europe
 - 330ms Total
- <1 second to complete a TCP handshake
- Improvement over original latency

Using BGP for mobile routing



Commercial passenger traffic is released at each Ground Station
Each Ground Station only advertises the IP's for the planes it is serving.
When a plane leaves a region, that gateway stops advertising its IP's.

Challenges using BGP for Mobility

- /24 network propagation
 - Concerns about the growing number of BGP routes in the global default free zone have caused some network providers to filter smaller route announcements.
 - We currently advertise a /24 address block for each mobile platform. Testing of route propagation found that most providers will accept and propagate our /24 announcements.
 - In the event that some providers don't accept our /24 announcements we are advertising a larger aggregate containing all of the mobile platforms.

Challenges using BGP for Mobility

- BGP convergence vs. handoff time between ground stations
 - Our testing has shown that the period of time required to achieve 2-way communications on a new satellite transponder is complementary to the time BGP will converge on global providers
- Provider concerns
 - Prefix churn
 - route changes happen only a few times a day
 - During testing, our prefixes did not turn up on the RIS top-talkers
 - Prefixes may have a “inconsistent” origin ASN
 - Currently originates at the active ground station
 - Changes when platform moves...
 - ... but does not originate from two places at once

Route Flapping and Dampening

- Route Flapping and Dampening
 - Will our routes being dampened by some providers?
 - Testing & research has shown that a single route update is unlikely to cause a route to be dampened. We see some dampening after about 5 changes within a short period of time.
 - We always announce a stable aggregate “safety net” for our mobile platforms to ensure a stable path from the dark corners of the Internet.
 - Satellite handoff within a ground station: A ground station may serve more than one satellite transponder. When a hand off occurs within a ground station we do not propagate a route withdrawal beyond our autonomous system.

Dynamic Prefix Management

- Dynamic Prefix Management
 - Our system that will allow for mobile platforms to “lease” address blocks for the duration of a “flight”. Similar to DHCP for hosts. This will allow for more efficient use of address space.
 - Mobile platforms will request address space when joining the network and will continue to use address space until the “flight” ends. After usage address space will be placed into a pool for reuse.
- Regionalization of address space
 - Address blocks can also be regionalized. Certain “flights” generally stay within the service of a single ground station.
 - By noting which “flights” will be served by a single ground station we can then assign address space from a larger aggregate which is tied to the ground station. This will allow us to not announce specific blocks for flights when they are not needed.

BGP as a Mobility Solution

- Does not require special IP stacks on customer hosts
- Does not require special routing onboard the mobile platform
- Does not require any special treatment of BGP attributes
- Does not require special operational support from peers
- Only suitable for /24 and bigger networks

Thank you



<http://www.connexionbyboeing.com>