connexion by Boeing SM

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Global Network Mobility

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Implementing Global Network Mobility

- What is Connexion by Boeing?
- Summary of the problem
- Network and Service Challenges
- BGP as a mobility solution
- Questions/Comments

What is Connexion by Boeing?

- Division of The Boeing Company
- Mobile Internet Access Provider
  - commercial airlines
  - maritime vessels
  - and other mobile network platforms
- An 802.11b (WiFi) “hot spot” at 35,000 feet, moving 600 mph
- Our partners include Lufthansa, SAS, JAL, Korean Air, Singapore, & ANA

Summary of the Problem

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

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

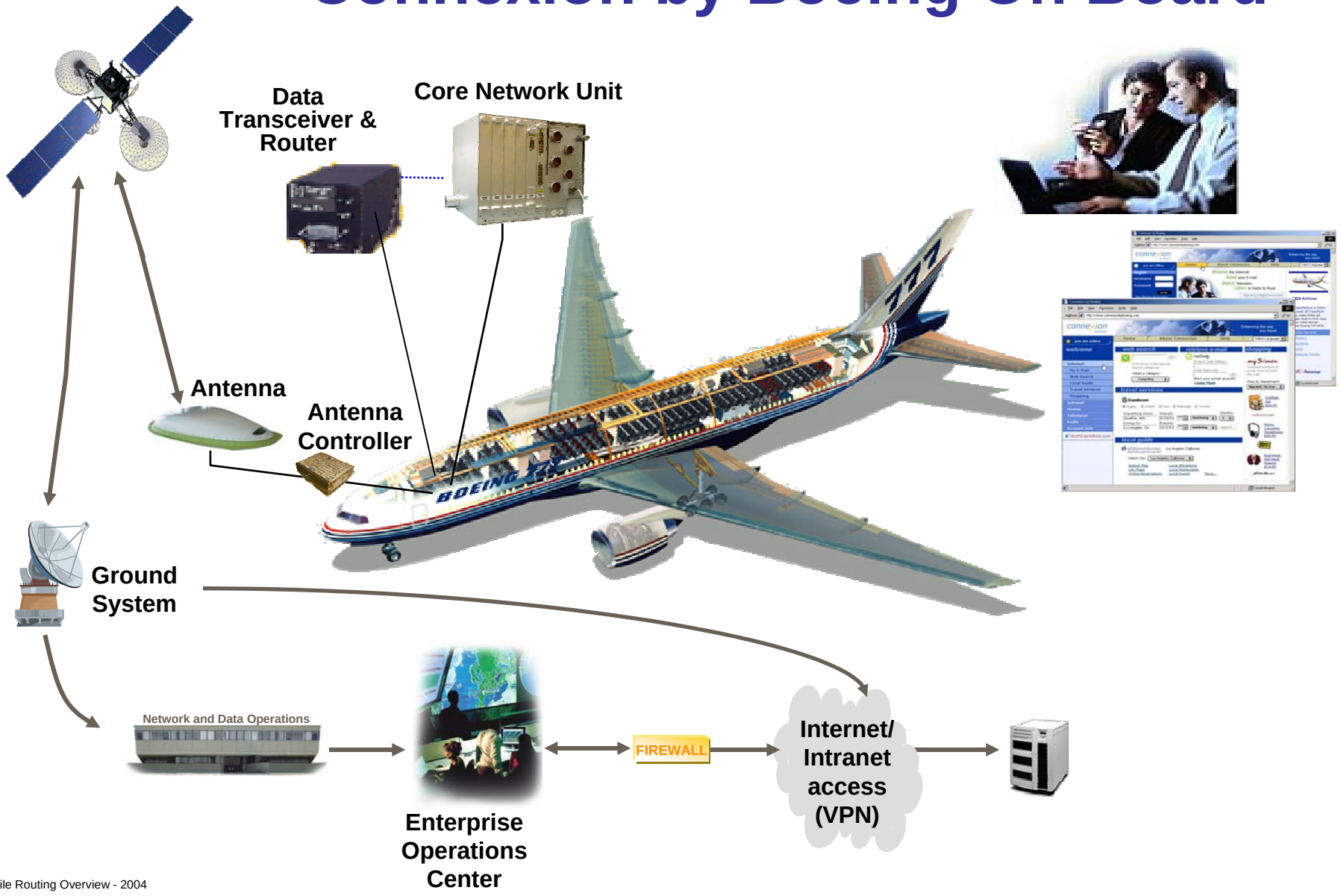
Passengers:

- **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**

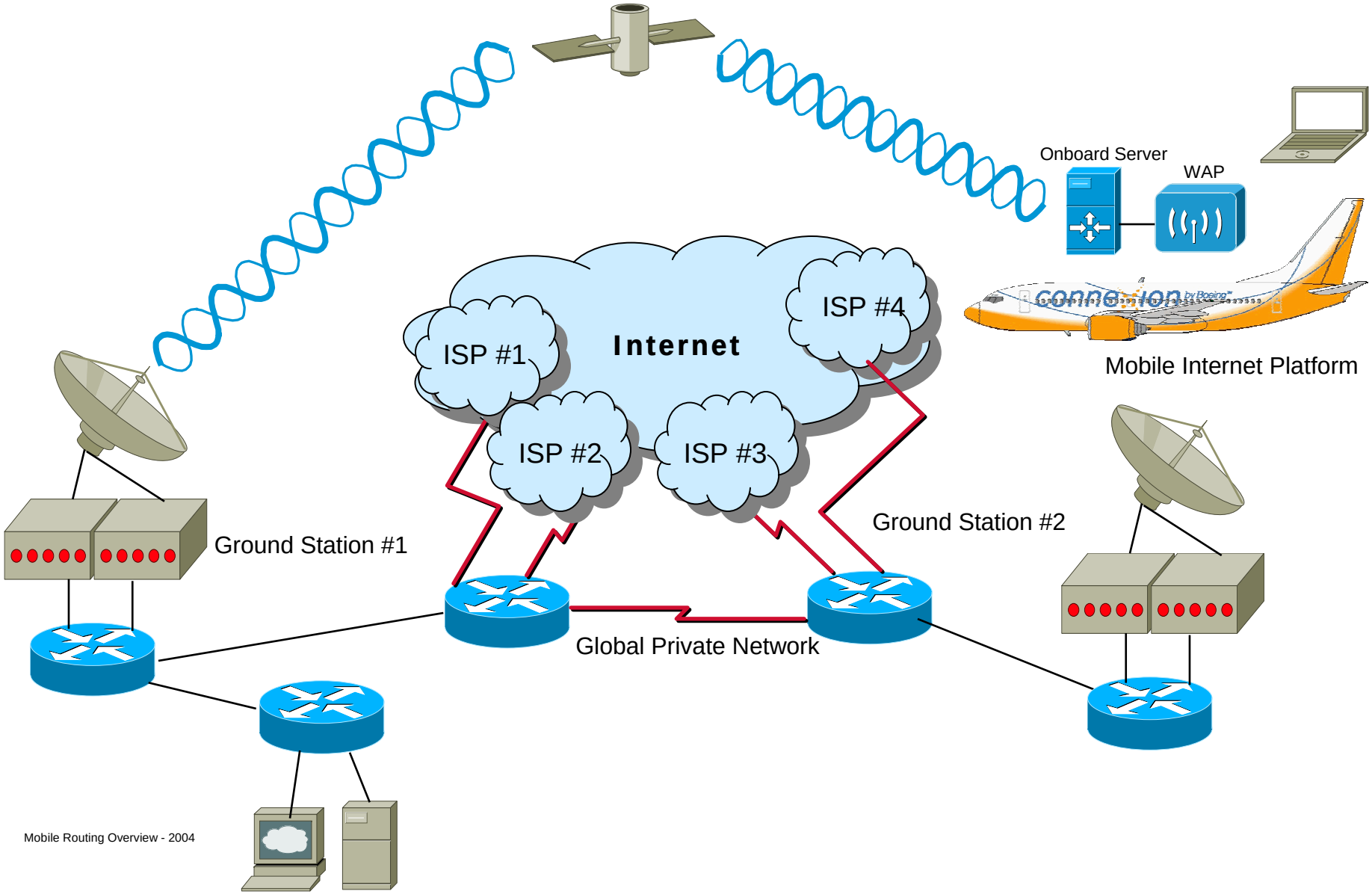
Airlines:

- **Simple cabin design**
- **Reliable and robust system**
- **Lightweight and power efficient**
- **Real-time crew information services**
- **Enhanced operational efficiencies**
- **Medical assistance to flight crews**

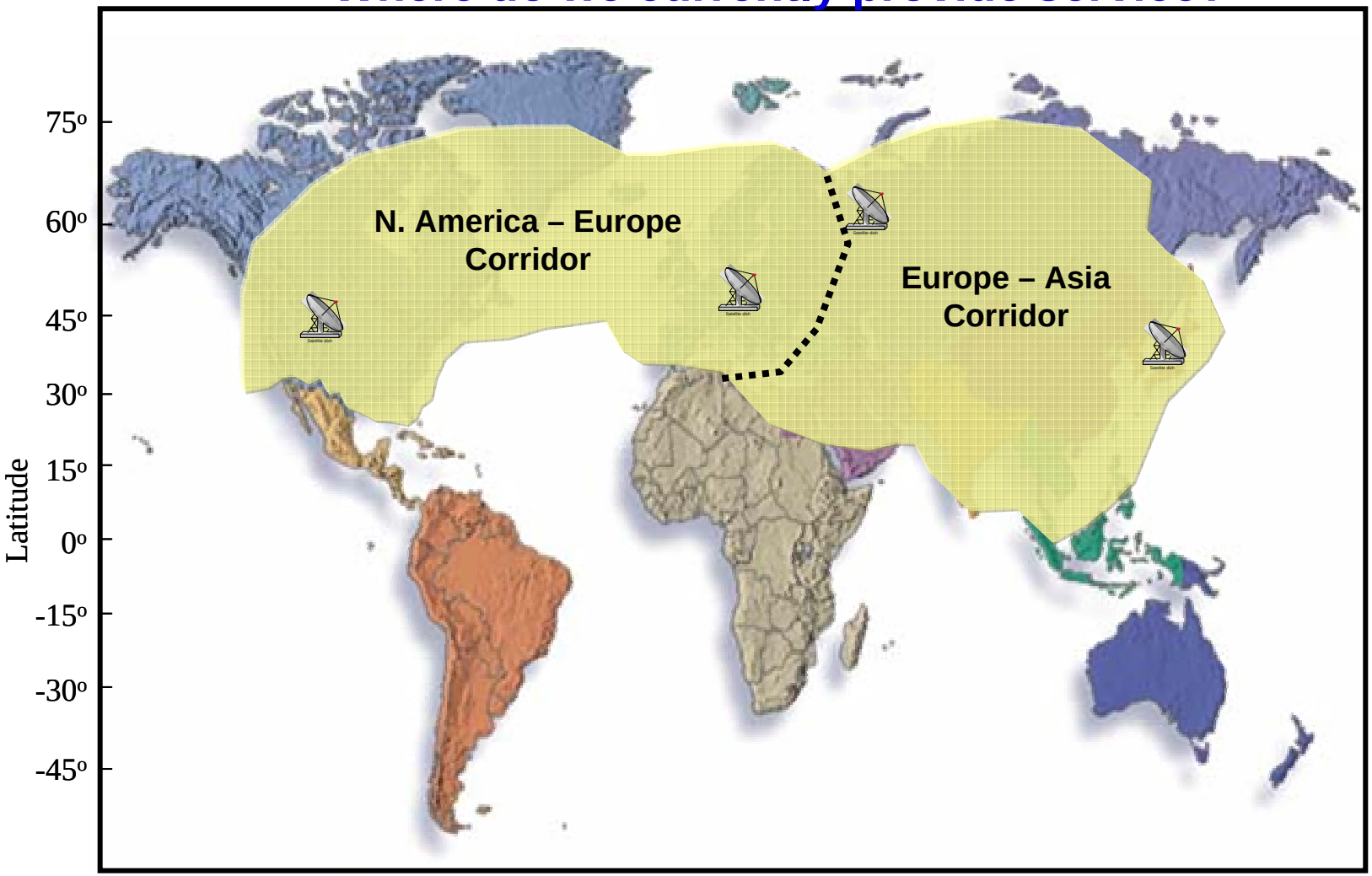
Connexion by Boeing On Board



Connexion Network Architecture



Where do we currently provide service?



90º maximum scan angle with 5º 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 (600 mph) fast
  - Hardware
    - Deploying hardware on commercial aircraft
    - We can't just put a commercial router on a plane
      - Needs to meet FAA Requirements and Regulations
  - 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.
- Tunneling traffic from a home router adds large latencies when platforms are globally mobile and not always near the home router.
- Example: Latency with tunneled mobile IP – aircraft homed in US currently over east-Asia to European website
  - 300ms - Aircraft -> geo-synchronous satellite -> (ground) East Asia
  - 130ms – East Asia -> North America
  - 70ms - Across North America
  - 80ms - North America (home agent) to Europe

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  - 580ms (1-Way) Total
- Takes almost 2 seconds to complete a 3-way TCP 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
  - Without backhauling or using traditional IP Mobility solutions involving Home/Foreign Agents
- 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 homed in US currently over east-Asia to European website:
  - 300ms - Aircraft -> geo-synchronous satellite -> ground Europe
  - 30ms - across Europe

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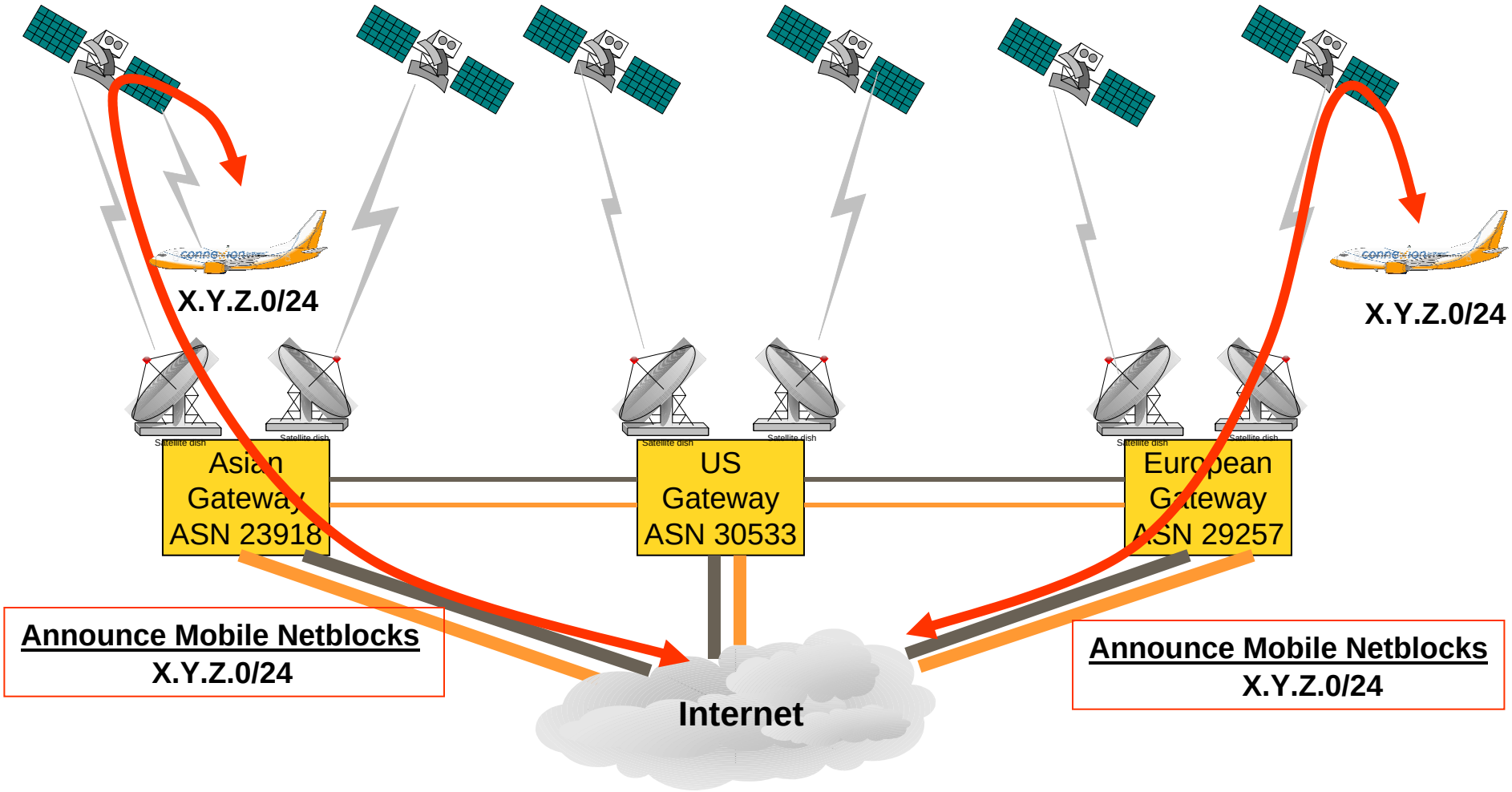
  - 330ms (1-Way) Total
- Takes 1 second to complete a 3-way TCP handshake
- 50% improvement over original 2 sec latency

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 prefix 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 several/all mobile platforms
  - Advertising the larger aggregate provides:
    - A routing path to our direct providers that do support the /24 announcements
    - A routing path to our mobile platforms during route transition period if there is no /24 deployed

Challenges using BGP for Mobility - 2

- BGP convergence vs. handoff time between ground stations
  - Testing has shown the time required to achieve 2-way communications on a new satellite transponder is complementary to the time it takes BGP routes to converge on global Internet providers
- Provider concerns
  - Prefix churn
    - Route changes happen only a few times a day
    - During testing, our prefixes did not turn up on the RIPE 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 be 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 5 flaps within a short period of time.
  - We always announce a stable aggregate (/19) “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.

Proposed Dynamic Prefix Management

- Dynamic Prefix Management
  - Our system allows for mobile platforms to “lease” address blocks for the duration of a “flight”.
    - Similar to DHCP for hosts
  - Mobile platforms request address space when joining the network and continue to use address space until the “flight” ends
  - When usage completes, address space is placed in a “free” pool for reuse
- Regionalization of address space
  - Certain “flights” are served by a single ground station, address space can be assigned from a larger aggregate tied to that ground station
    - This can prevent the need to announce specific block for each flight

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 in our current network infrastructure


Questions and Comments
Thank you
http://www.connexionbyboeing.com