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September 1, 2011

VIA ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: Permitted Oral *Ex Parte* Presentation
GN Docket No. 11-117, PS Docket No. 07-114 and WC Docket No. 05-196

Dear Ms. Dortch:

On August 30, 2011, Dr. David Whelan, Vice President of Strategic Innovation, Phantom Works and Chief Scientist, Boeing Defense, Space and Security, The Boeing Company ("Boeing") met with David Furth, Deputy Chief of the Public Safety and Homeland Security Bureau ("PSHSB") and Tom Beers, Chief of the Policy Division, PSHSB. Also participating in the meeting from the PSHSB and the Office of Engineering Technology ("OET") were Henning Schulzrinne, David Siehl, Tim May, Patrick Donovan, and James Miller. Other participants on behalf of Boeing were James Lassa, Michael Rizzo, Barry Martin, Frank Weaver, Alan Rinker, Bart Ferrell, Jeff Bennett, Joe Cramer and Kathleen Wong.

During the meeting Boeing representatives presented information regarding the Boeing Timing & Location ("BTL") technology. The Boeing representatives explained that the BTL technology is a commercially feasible, new capability that can improve E911 location performance in the near term. The issues discussed included the coverage capabilities and implementation opportunities for the BTL technology and how the BTL technology can help wireless carriers comply with the Commission's location accuracy requirements. Following the presentation, Boeing demonstrated the capabilities of a prototype BTL receiver. A copy of the



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materials presented by Boeing at this meeting is attached and has been provided to the meeting participants.

Please contact the undersigned if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read 'Kathleen H. Wong', with a long, sweeping flourish extending to the right.

Kathleen H. Wong
Senior Counsel

Attachment



Boeing Timing & Location

Presented To:

**Federal Communications Commission Public Safety and
Homeland Security Bureau**

August 30, 2011

Outline

Topic	Presenter	Time
Introductions	All	2:00
Introduction to Boeing Timing & Location and Boeing GPS Heritage	Bart Ferrell	2:05
Boeing Timing & Location Background	Dr. David Whelan	2:10
Boeing's Timing & Location Technology Overview	Mike Rizzo	2:20
Boeing's Timing & Location Technology – Applicability to E911	Barry Martin	2:50
Open Discussion	All	3:00 – 3:30

Boeing's Global Navigation Satellite System Business Spans 37 Years

- 1974 – Original GPS satellite contract awarded
- 1993 – GPS achieves initial operational capability with satellites and ground segment built by Boeing
- 1995 – GPS achieves full operational capability with Boeing satellites
- 1996 – GPS IIF contract awarded
- 2003 – Initial investments in Iridium based navigation
- 2007 – High Integrity GPS Enabling Technology contract awarded
- 2008 – High Integrity GPS Technology Concept Demonstration contract awarded
- 2010 – Boeing turns GPS Orbital Control Segment over to the Air Force
- 2011 – Boeing delivers 31st GPS satellite
 - Boeing Timing and Location business secured by long term agreement with Iridium
 - DOT Positive Train Location contract awarded
- 2012 – Boeing Timing and Location business goes operational

Our goal is to continue to provide the world's best global navigation satellite systems

Boeing Timing & Location (BTL)

- Ubiquitous coverage
 - Improves yield for all E911 calls
 - Consistent performance in rural Areas with no additional infrastructure
 - Minimizes county exclusions due to rough terrain or low tower density
- High power and rapid motion
 - Improved penetration in challenging environments
- New femtocell / cellular handset and retrofit SIM card implementations
 - To speed capability and time to compliance



A new capability that can improve E911 location performance and public safety in the near term

Boeing's Enhancement of Iridium: A "Transit-like" Navigation Augmentation of GPS

Iridium Background

- Primary purpose: global, micro-aperture communication
- User base: military, civil, and commercial
- Over 478,000 subscribers as of 2nd qtr 2011
- Constellation size: 66 satellites
- Altitude: low earth orbit (LEO)
- Built-in comms & datalink global backbone
- Boeing is engineering and operations subcontractor to Iridium
- "Iridium NEXT" preliminary design review this year. 1st launch Q1 2015

Physical Attributes for Enhanced Navigation

- Spatial diversity
 - 1-3 satellites in view
 - LEO high doppler/rapid geometry change
- Higher power, similar frequency relative to GPS

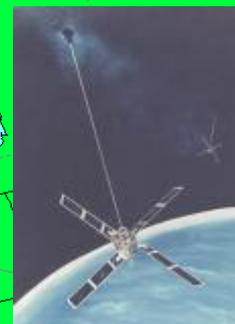


Leveraging Iridium's Global Reach for Enhanced Navigation

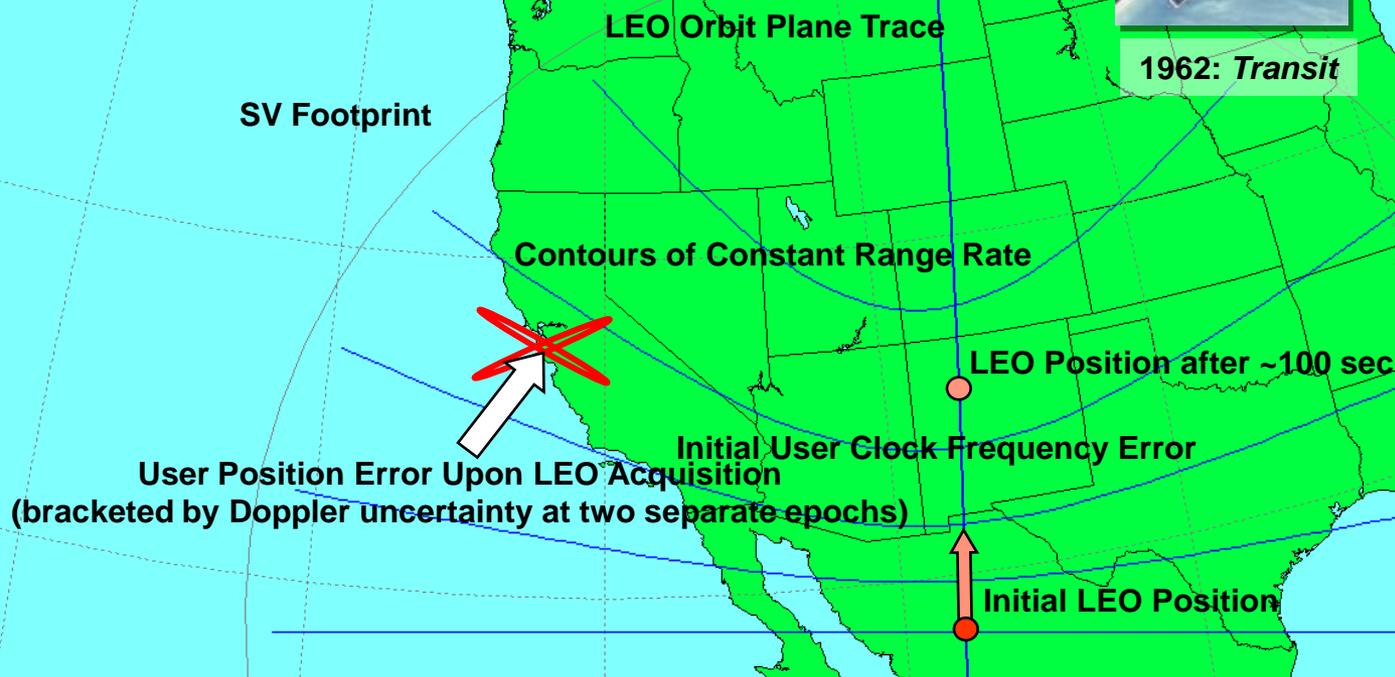
BTL Geo-location Builds on *Transit* Heritage

Moore's Law Enables Performance Unachievable in the 1960s

- U.S. Transit Navigation Satellites provided 500 m Navigation Error
- Performance limited in part by onboard clock error
- Iridium + Ground Reference Network creates **Effectively-Perfect Clock**

1962: *Transit*

2011: BTL

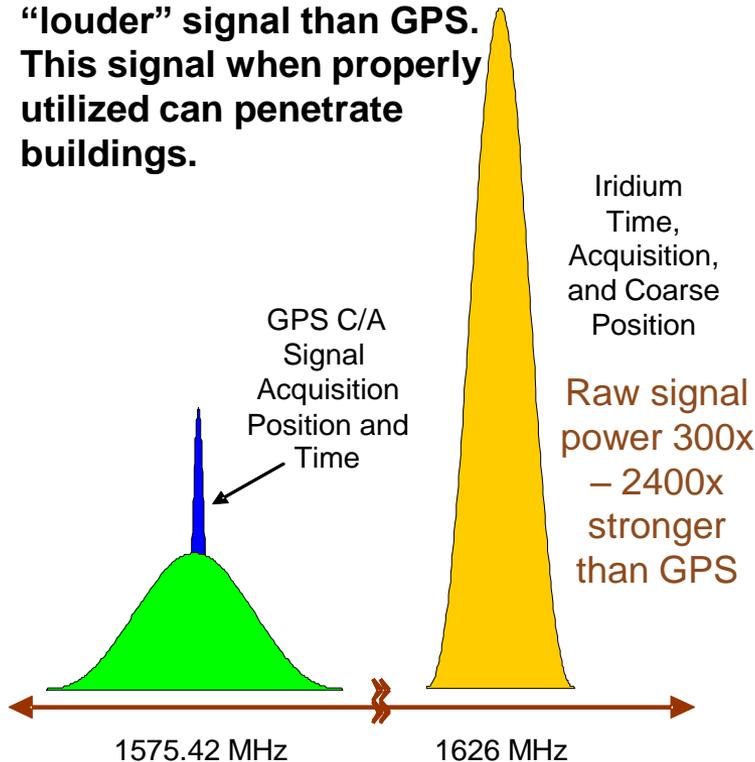


BTL leverages both Transit and GPS Heritage: Low Earth Orbit Provides Rapid Angle Motion and Spatial Diversity for a Geometry Rich Solution

Boeing Timing & Location Technology Overview

How it works in one slide

1. Iridium Provides a much “louder” signal than GPS. This signal when properly utilized can penetrate buildings.



2. The oscillator in a cell phone costs < 1\$. The oscillator in an Iridium satellite costs ~ \$10k

Boeing's Timing & Location technology is a broadcast data message that moves that quality oscillator, through buildings, into the phone



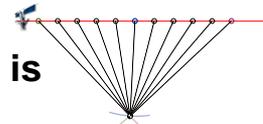
3. To leverage the time and frequency transfer of (2) data is needed by the phone: GPS data bits & satellite location delivered by cell network or in *BTL* broadcast



4. Precise time global broadcast improves GPS indoor performance and TTFF

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5. Broadcast ALSO enables Iridium-only geo-location deep indoors where GPS is not available



A Global Augmentation Broadcast Capability with a Simple Implementation into chipsets and handsets

Boeing Timing & Location Modes

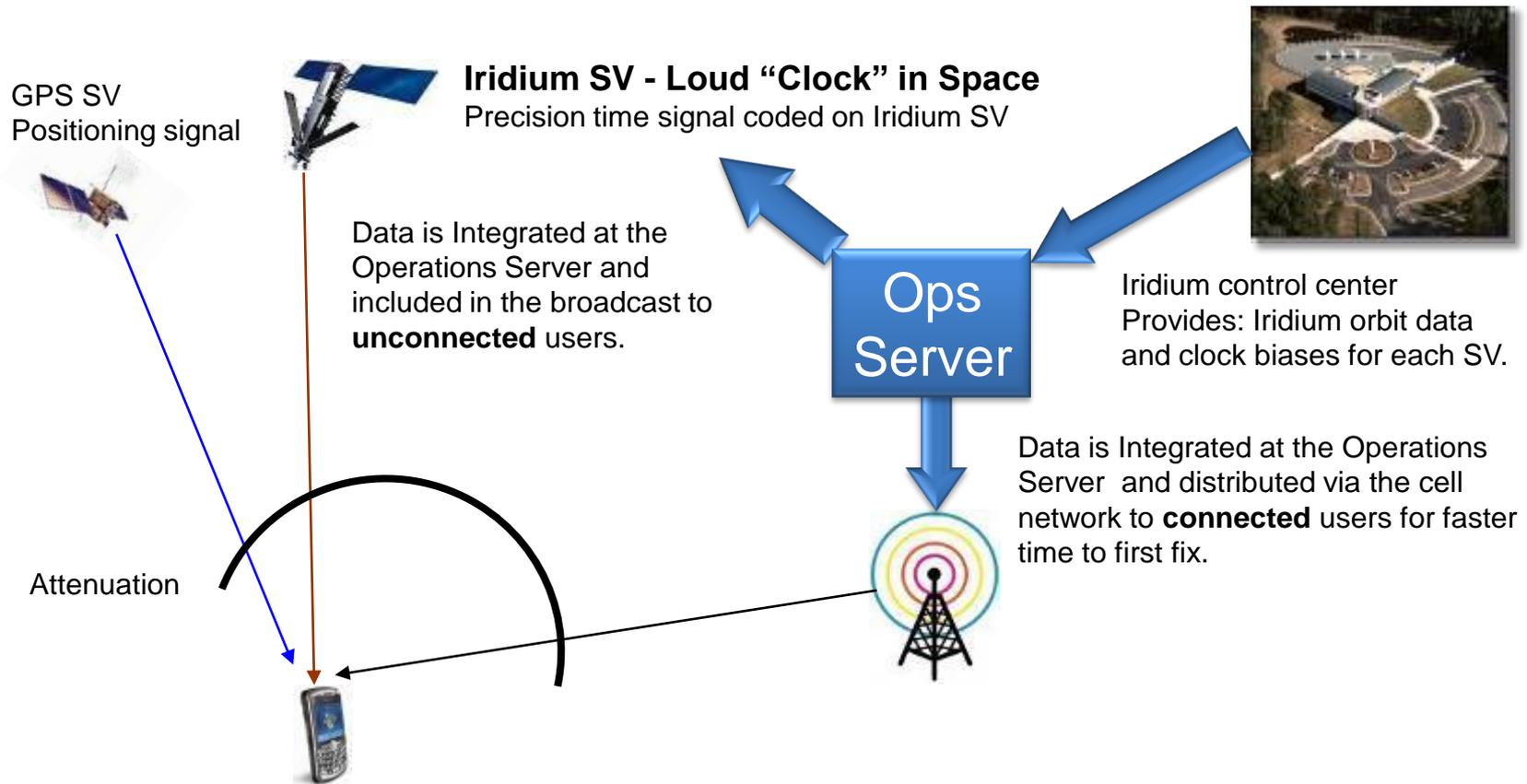
- **Precise time & frequency aiding for increased GNSS signal sensitivity & quicker time to first fix**
- **Hybrid Iridium/GNSS satellite ranging**
 - Augment with Iridium SVs when insufficient GNSS SVs in view
- **Deep indoor positioning**



Iridium-Only Ranging (IOR) Capability

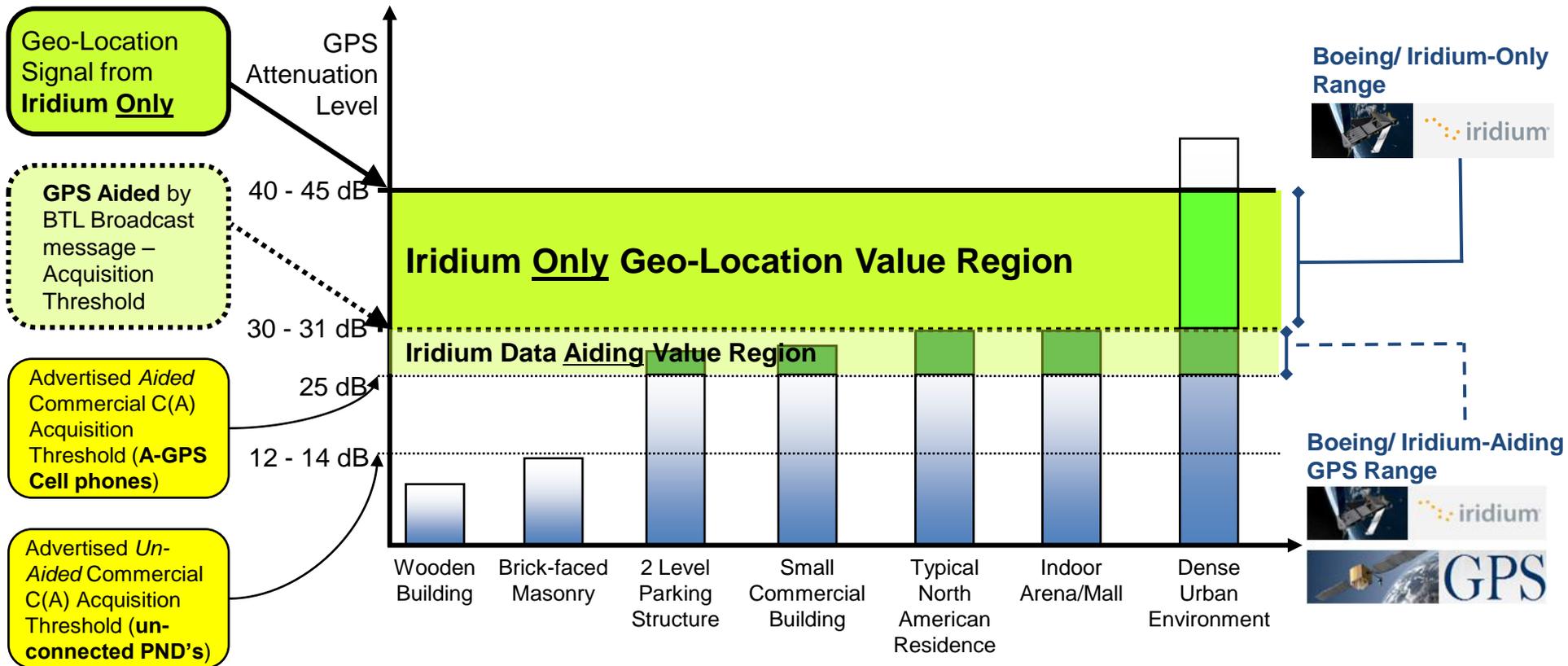


Boeing Timing & Location Positioning Under Occlusion – Operational Architecture



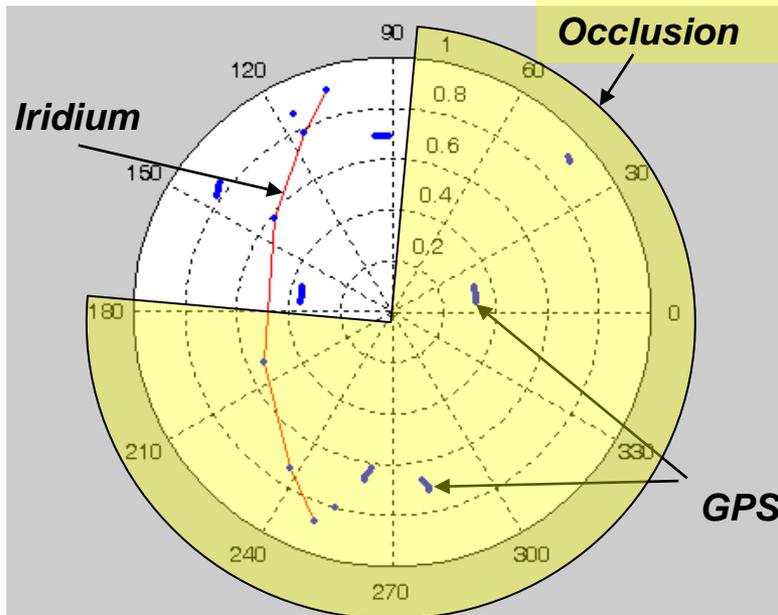
Handset receives precise clock signal and uses it to aid GNSS acquisition and perform geo-location using Iridium alone if GNSS signal not available

Boeing Timing & Location Provides Superior Dual Mode Positioning (Aid GPS or Stand-Alone)



Boeing's Location Technology Aiding Enhances Positioning in Typical GPS Operating Environments and Adds Robust Iridium-Only Geo-Location in Dense Urban Environments

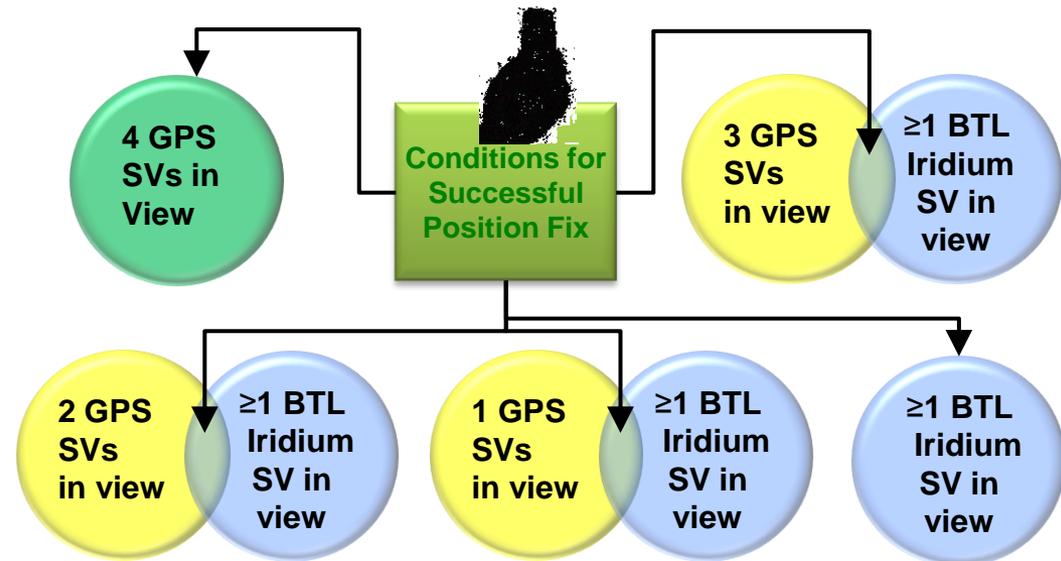
Iridium LEO Orbits Effect in Urban Canyons



Plot shows visibility change of an Iridium SV over about 10 minutes vs. several 40 minute GPS tracks

➤ At least one Iridium SV always in view

- Iridium SVs have rapid geometry change
 - The Iridium Orbit Period is 100 min
 - GPS Orbit Period is 12 hours
- If GPS conditions are not favorable (< 4 sats), at least one Iridium *BTL* signal is likely to be in view to provide the additional signal(s) required to obtain a position fix



BTL Rapid Motion Helps Ensure Visibility of Iridium SVs in Urban Canyons

Typical Current Performance in Iridium-Only Indoor Tests

Test conditions and results

- Typically at least 2 SVs are in view ~ 70% of the time between latitudes 30-60deg
- Initialization error: ‘random’ magnitude and direction represents inaccurate initial state from cell tower
- Shows how quickly true position converges from ~2Km error (to **< 150m on first measurement**)
- 30-100m 2D Location Accuracy
- < 2uSec Timing Accuracy
- < 2 parts per billion Frequency Accuracy

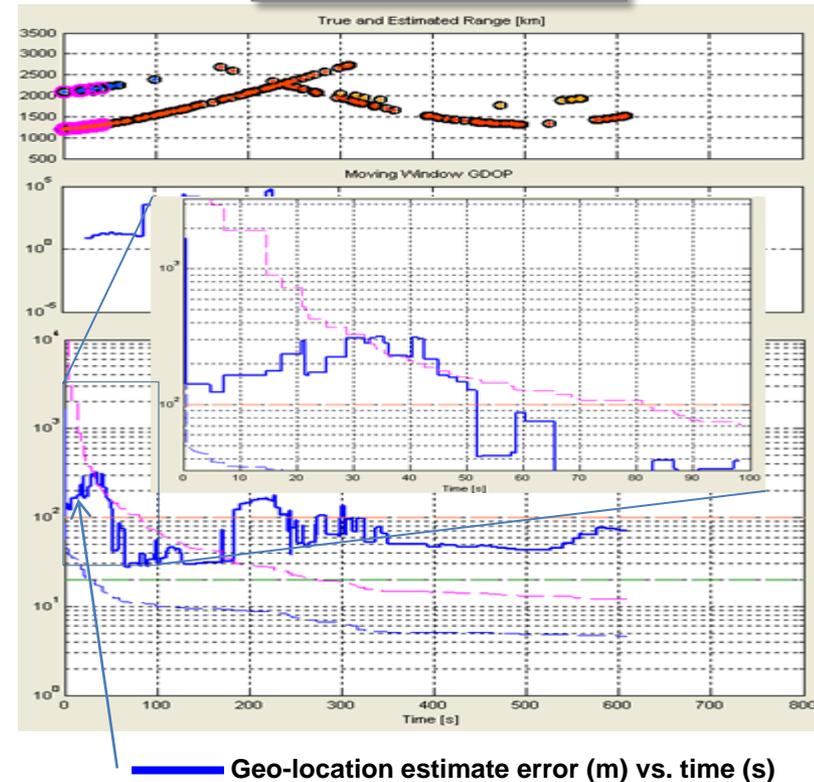
Other test locations

- 7 story bldg, internal conference room
- 17 floor bldg, all floors
- Shipping container
- Alaska, all floors of 7 story hotel in Anchorage, in Seward: auto, airplane, boat, shipping container, cave, under 5 ft of snow
- Inside moving rail car in NW CONUS
- In walk-out basement of 3 story house in Virginia

Accuracy improves with system maturity



Indoor mall data



2012 *Boeing Timing & Location Performance* Applicable to Femtocells

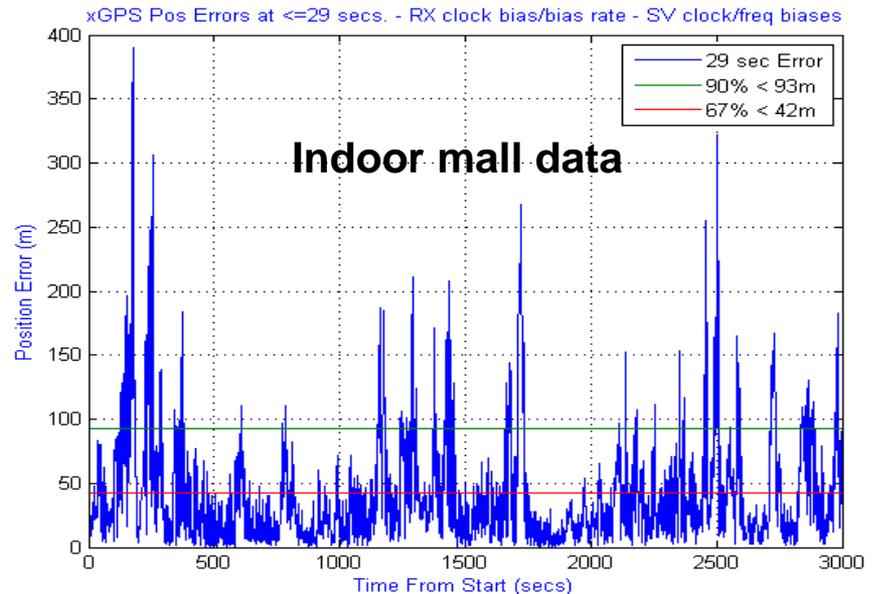
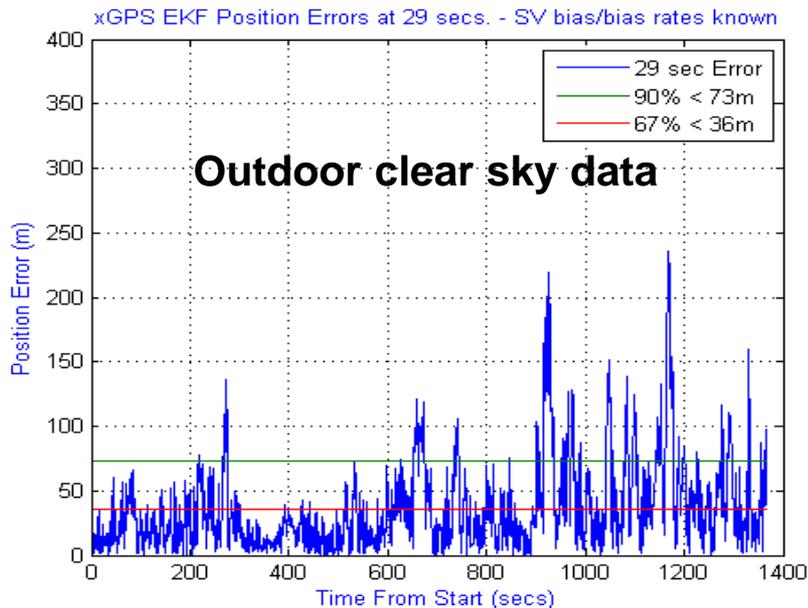
Application	Roll Out	Initialization	Time to validate address:
Femtocell	2012	Address	2 min

- Accuracy of BTL Indoor performance validates Femtocell location
- Validated Femtocell location used for E911 location

2013 BTL Iridium-Only Geo-location Performance

Accuracy [m]	Outdoor		Indoor	
	@ 29 sec	@ 120 sec	@ 29 sec	@ 120 sec
67% of Calls	50 m*	10 m*	100 m*	20 m*
90% of Calls	100 m*	20 m*	150 m*	40 m*

* Includes allocation for other error sources including signal multi-path



Business Roadmap

CY2011				CY2012				CY2013	
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
<i>BTL Signal-In-Space Broadcast Available For Service</i>					★				
<i>Femtocell Product and Service Available</i>							★		
<i>E911 SIM Card Product and Service Available</i>								★	
<i>Cellular Multi-Sensor Product / Service Available</i>								★	

FCC E911 Changes and Further Notice

- **Second Report & Order (FCC 10-176A1)**
 - The Commission Established a PSAP or **County-Level** Geographic Area for Location **Accuracy** Compliance (Outdoors Only)
 - **Phased in Time-to-Compliance** over 8 years,
 - Provided County **Exclusions** of up to 15%
 - Reduced % **Calls** from 95% to 90% (2 sigma accuracy)

- **Further Notice (FCC 10-177A1)**
 - The Commission seeks “**new prospective location technologies**”
 - Technologies which can provide improved location information in **more challenging environments**:
 - Rural Areas = heavy forestation, mountainous terrain, or sparsely located wireless towers
 - Urban Canyons
 - Indoors
 - **Confidence & uncertainty** data
 - **Roaming** issues
 - Providing automatic location information on **VoIP devices** or emerging network devices such as **Femtocells**

Boeing Timing & Location (BTL)

Applicability to Second R&O

- *BTL* test results exceed handset-based **accuracy** requirements
- *BTL* can improve carriers **time to compliance** with:
 - Ubiquitous coverage & consistent performance (Yield) +...
 - Retrofit SIM Card
- *BTL* can provide emergency call locations with **minimal county exclusions** because:
 - **Ubiquitous coverage**
 - High power, rapid motion signal emanating from space provides better availability in rough terrain/forestation
 - Consistent Performance = **High Yield = Greater % calls compliant**
 - **No Additional Infrastructure by Carriers**

**A new capability that can improve E911 location performance
and public safety in the near term**

Boeing Timing & Location (BTL)

Applicability to Further Notice

- *BTL* Can Locate Emergency Callers in **Challenging Environments in the near term**
 - Ubiquitous coverage in **rural areas** – heavy forestation, mountainous terrain, or sparsely located wireless towers
 - **Urban canyons**
 - **Indoors** – ~25% of all 911 calls are wireless and indoors
- *BTL* can provide confidence and uncertainty data
- *BTL* is not affected by roaming
- *BTL* can provide a validated (verified MSAG), accurate location indoors for VoIP phones and Emerging Network Devices (Femtocells, Wi-Fi Access Points, Routers)
- *BTL* is commercially feasible
 - Plan for roll out across the entire U.S. in 2012
 - No additional infrastructure required for rural GSM Carriers

