

On-Orbit Servicing for Commercial Geosynchronous Spacecraft

**

The Need
The Technology
The Time For Teamwork

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Kay Sears
President - Intelsat General



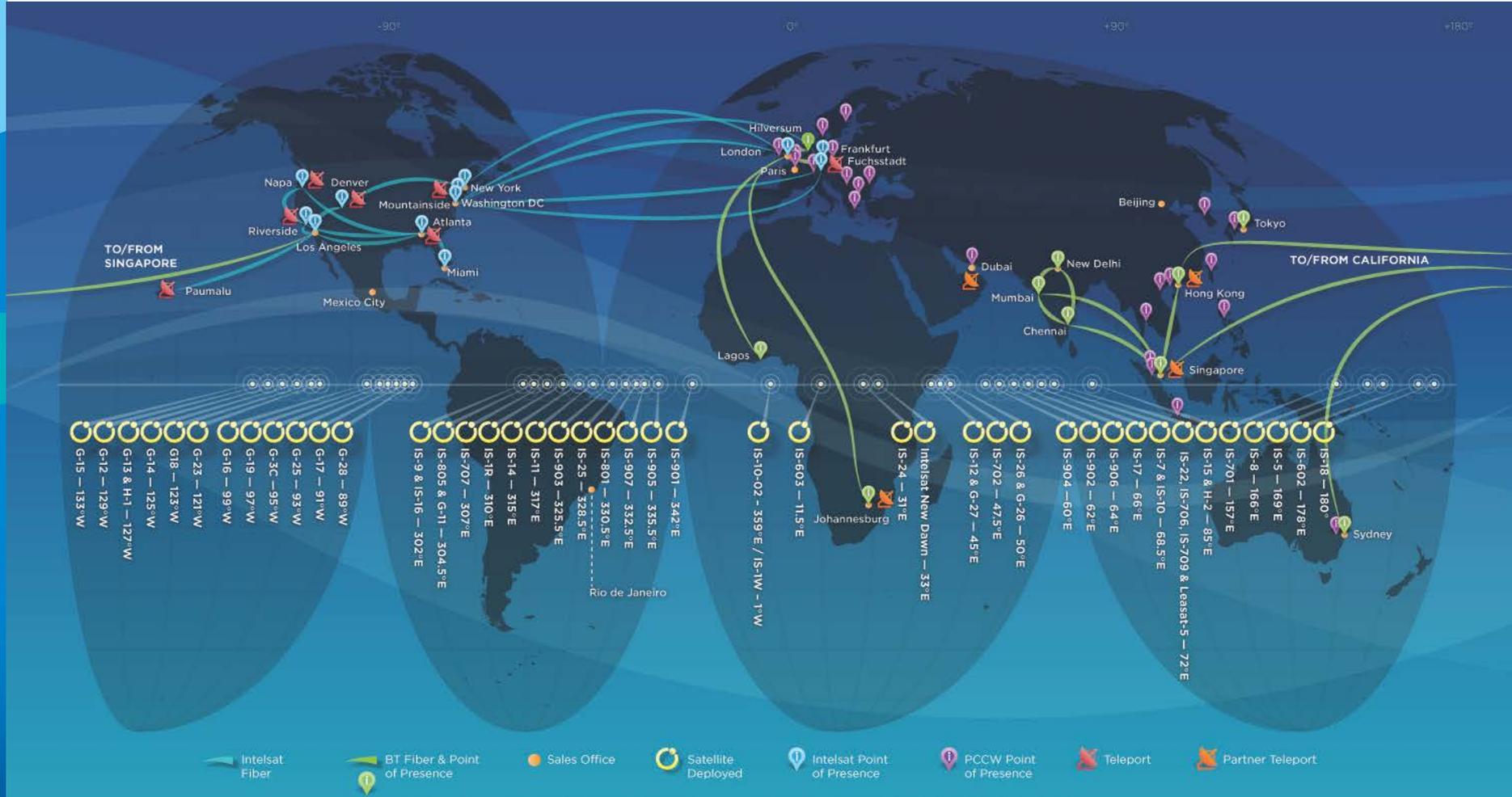
**THE SECOND INTERNATIONAL WORKSHOP
ON ON-ORBIT SATELLITE SERVICING**
May 30 — May 31 ■ NASA's Goddard Space Flight Center ■ Greenbelt, Md.



603 ReBoost Demonstrated Anomaly Recovery In Space



Intelsat: Global Communication Infrastructure



- Global fleet of 52 geostationary satellites
- IntelsatONESM : 48,000 km of fiber, IP/MPLS Cisco technology, global peering

Satellite Operations Experience

- Currently 72 satellites operated
 - 52 Intelsat, 20 Third Party



Astrium E3000

Boeing 376

Boeing 381

Boeing 393

Boeing 393+

Boeing 601

Boeing 601HP

Boeing 702

Boeing 601MEO

IAI Amos 1

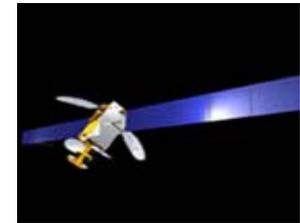
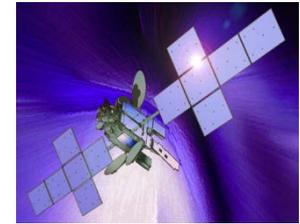
LM 7000

OSC Star 2

SSL 1300 Omega

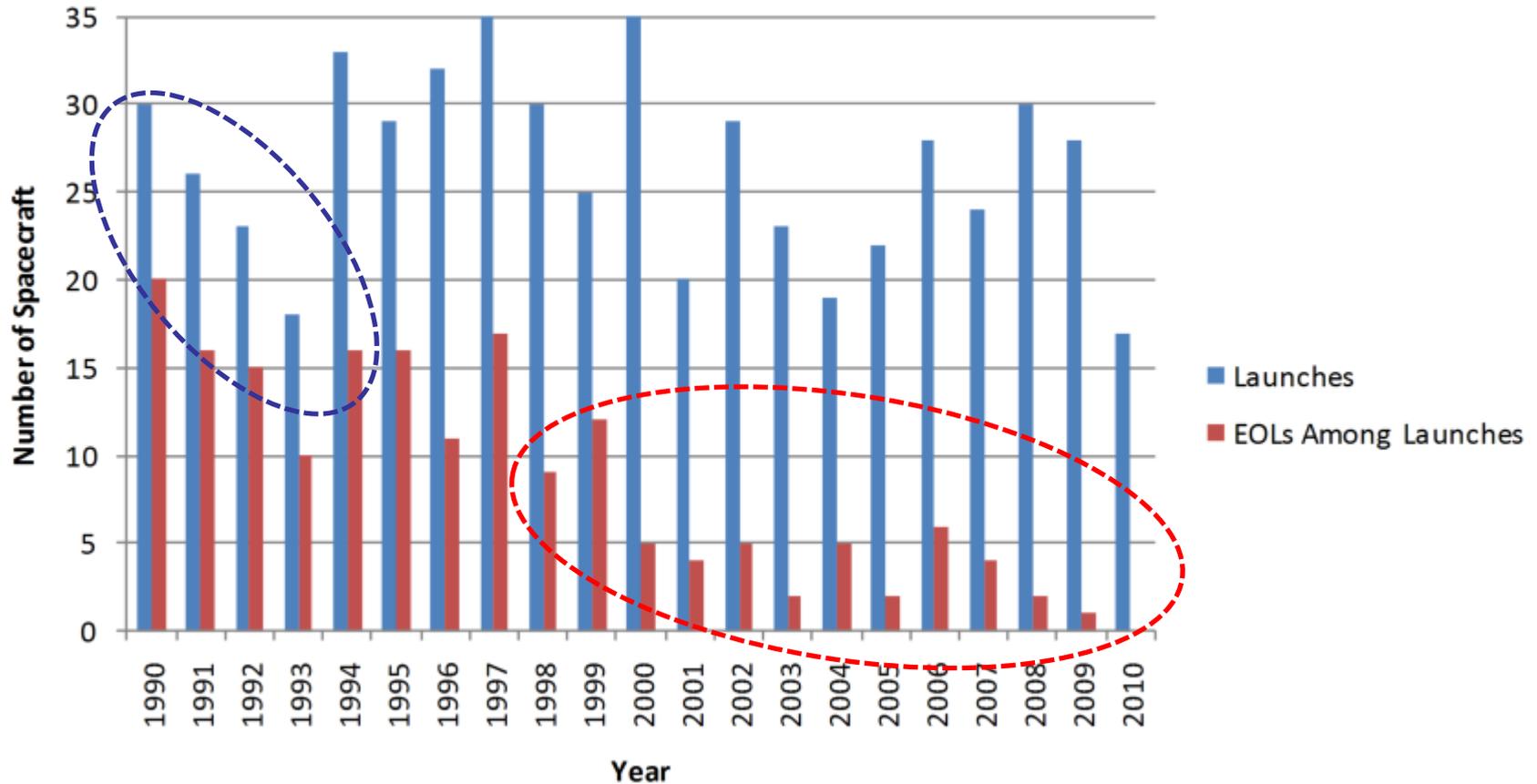
SSL FS1300

Thales Spacebus 3000B

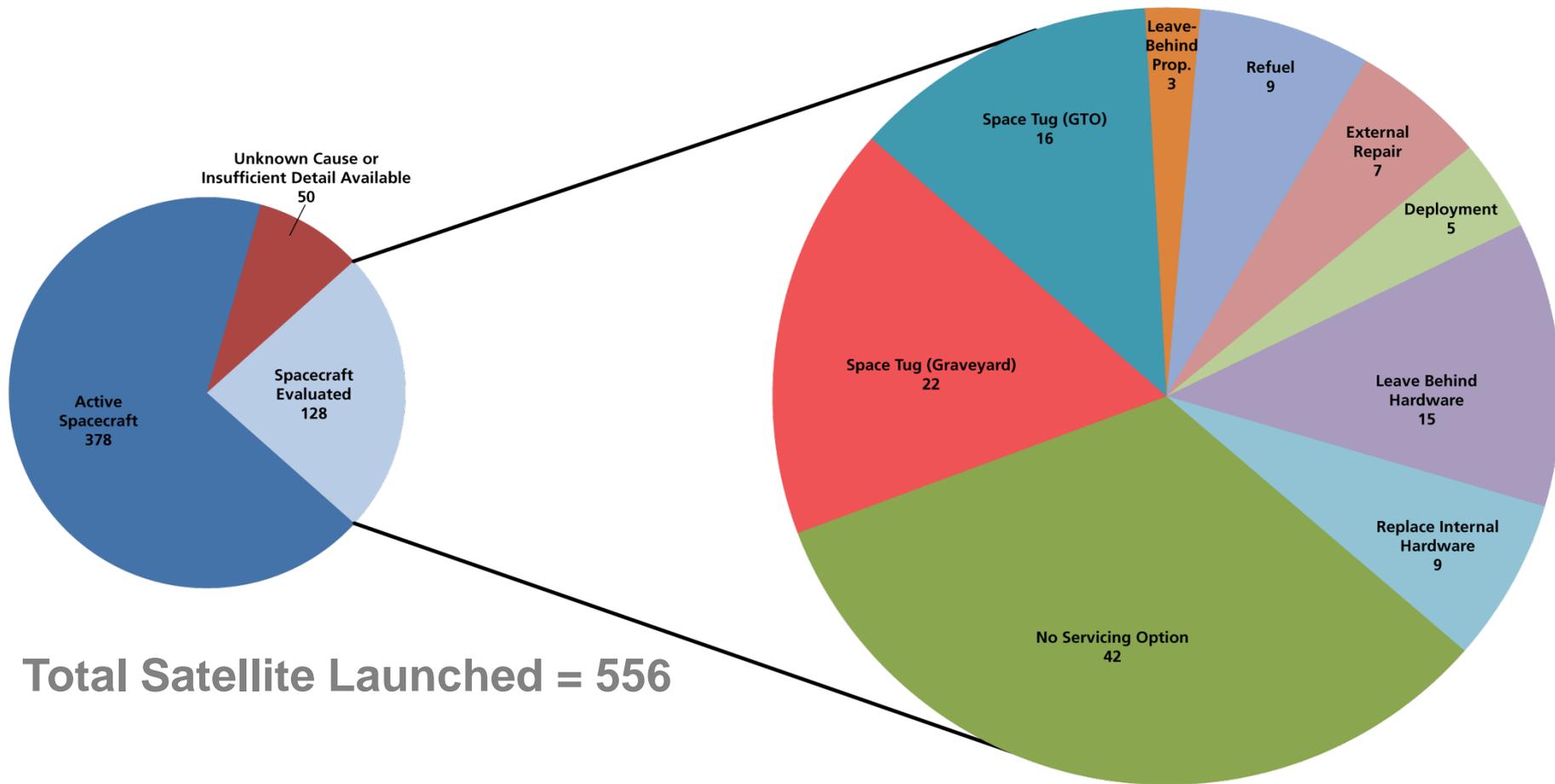


Launch and EOL Dates – All GEO Satellites

Launches and EOLs by Launch Date



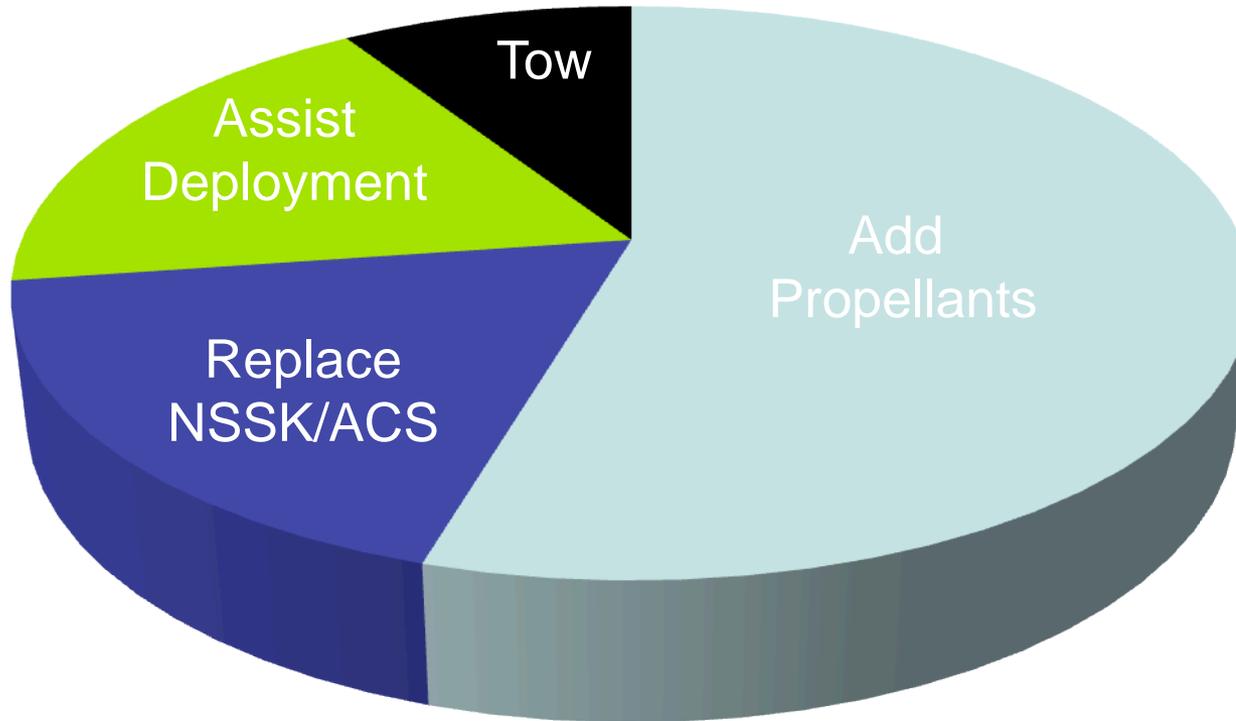
Spacecraft by Servicing Category



Total Satellite Launched = 556

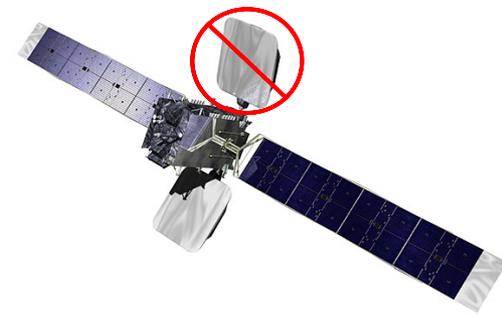
Of 128 evaluated, 67% are servicing candidates and 4% are “early” service candidates

Ten Years of Industry “Serviceable” Anomalies



- Adding propellant would be a possible solution for majority of recent “serviceable” anomalies

Case Study – Intelsat New Dawn



- Spacecraft launched on Ariane 22 April 2011
- C-band antenna failed to deploy following execution of pin releases
- “Shake and bake” failed to induce deployment
- Failure investigation suggests snagging on billowed antenna sun shield
- Nature of failure suggests C-band antenna could be coaxed open using robotic servicer
- Resulted in loss of C-band revenue, loss of spacecraft life, insurance risk escalation, significant expense by satellite manufacturer

Early In-Orbit Servicing Offers Great Value



Wishlist

for On-Orbit Servicing Capabilities

- **Life Extension Services for S/C with Revenue-Generating Payloads**
 - Compromised ACS → tug, towing
 - Propellant shortfall or EOL → refueling
- **On-Board Robotic Tooling – Including CONOPs to Bring Up New**
 - Free jammed deployables (e.g., solar arrays, antennas)
 - Move out-of-place thermal blankets, cables,..
 - Grasp/Move dead sats / debris to ensure safety of flight
- **Imaging capabilities to inspect exterior of spacecraft**
- **Heritage/Proven Process and Hardware – Retired Risks**
 - Rendezvous, docking, tug operations
 - Robotic hardware and procedures proven on ground and on orbit (including refueling)
- **Minimal impact to primary mission of client**
 - Reliable servicing vehicles with acceptable attitude stability (maintain client traffic)
 - Available in a timely manner at reasonable cost
 - Policy, legal, regulatory, insurance issues understood and resolved



Business Case Considerations

Life Extension / Refueling

- Health of payload
- Revenue generation of asset (before and after)
- Capital deferment
- Customer off-load scenario's
- Timing / Schedule
- Risk

In-orbit Servicing

- Type of anomaly and serviceability (% of success)
- Potential revenue loss
- Timing / Schedule
- Customer off-load scenario's
- Insurance considerations
- Risk

EOL Life Extension/Refueling is attractive Life Extension plus in-orbit servicing is home run

We Have Just Scratched the Surface

- It is highly likely that dependable on-orbit servicing capabilities will evolve the space industry into directions that today we cannot even fathom
- Disruptive technologies need to be leveraged, not shunned



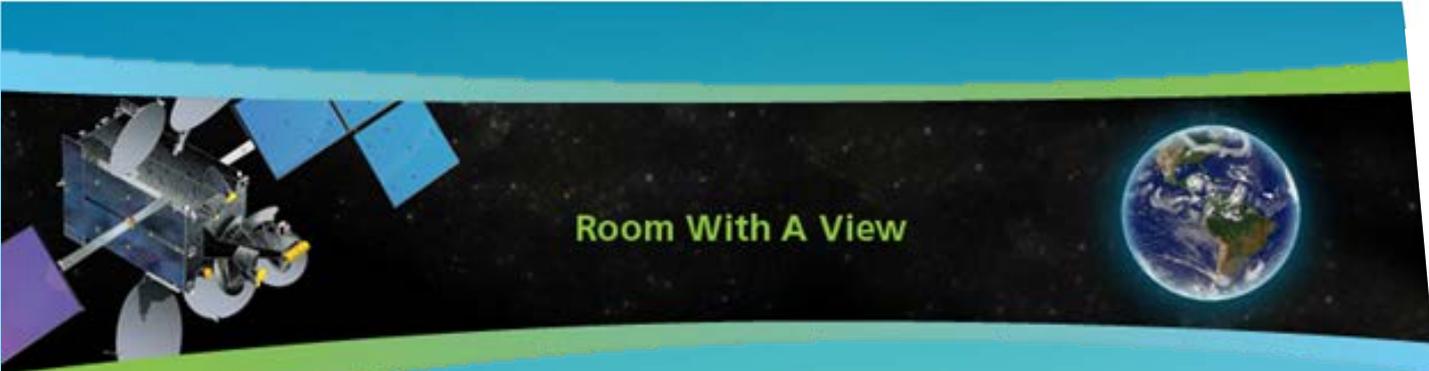
"A lot of times, people don't know what they want – until you show it to them."
Steve Jobs – Business Week, May 25 1998

- Launch with less fuel, more payload
- Build satellites that are more easily “serviced”; reduce redundancy SWAP
- Customized tools for custom jobs
- Changes to insurance rates
- Changes by ITU / FCC



Closing Perspectives

- On-orbit servicing can provide solutions for a number of on-orbit issues
- With the largest number of Geo spacecraft and the greatest quantity of launches, Intelsat has a vested interest in the success of this technology
- Both refueling and towing offer life extension advantages in different situations → on-orbit history suggests combining this with robotic services produces a strong business case for operators
- Without the commitment of major satellite owner-operators and the advocacy of the USG, risks associated with commercial in-orbit servicing may not be realized fully
- Public/Private partnerships encouraged by the US National Space Policy are a cooperative way forward



Room With A View

Thank You

Kay Sears
kay.sears@intelsatgeneral.com
(301) 571-7670