SPACE DATA ASSOCIATION

www.space-data.org

User Group Meeting
Industry Session

10 March 2014

Morning Agenda
SDA Members Only (14:00-16:00)

- **Welcome and Logistics**
- **Overview of Past Year**
- **SDA Future Plans**
- **Case Study: Star One**
- **Current Activities**
  - SDC Rehost to Amazon Cloud
  - RFI Enhancements
  - Carrier ID (CID)
  - FDS Topics
- **SDA & JSpOC Complementary Services**
- **Space Insurance**
- **Q&A**

What is the Space Data Association?

- The Space Data Association (SDA) is a not-for-profit association formed by and for satellite operators to provide reliable and efficient data-sharing critical to the safety and integrity of the space environment and the RF spectrum.
- The SDA was founded by **Inmarsat**, **Intelsat** and **SES** — three of the leading global satellite communications companies. These three companies, plus **Eutelsat**, now form the Executive Board of the SDA.

"Safety of Flight"

Definition: The condition where satellites are positioned and operated in a manner that preserves their long-term operational viability and the preservation of the orbital regime(s) involved

SDA Charter

- Seek and facilitate improvements in the safety and integrity of satellite operations through wider and improved coordination between satellite operators

- Seek and facilitate improved management of the shared resources of the Space Environment and the RF Spectrum

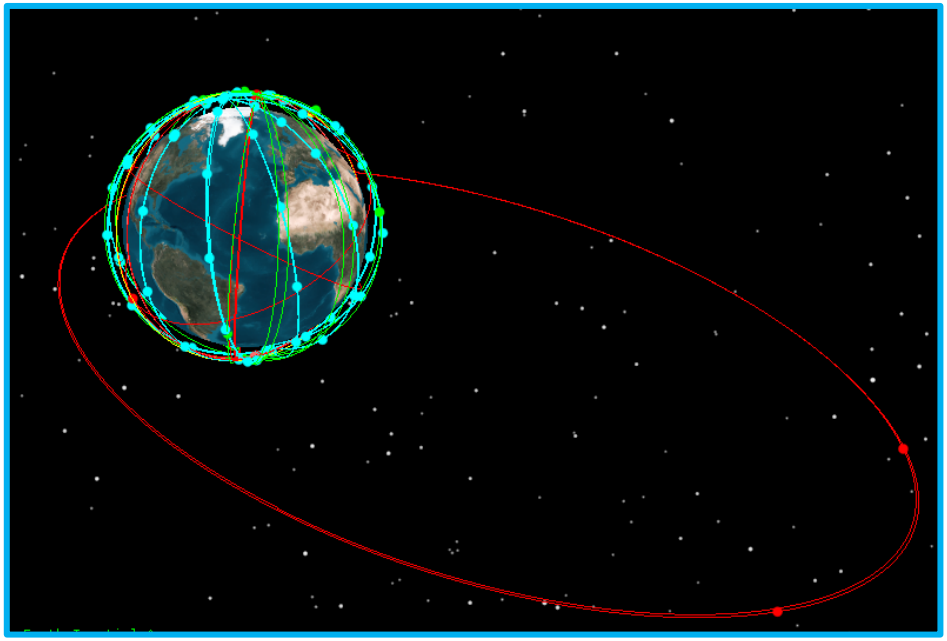
SDA Current Participants

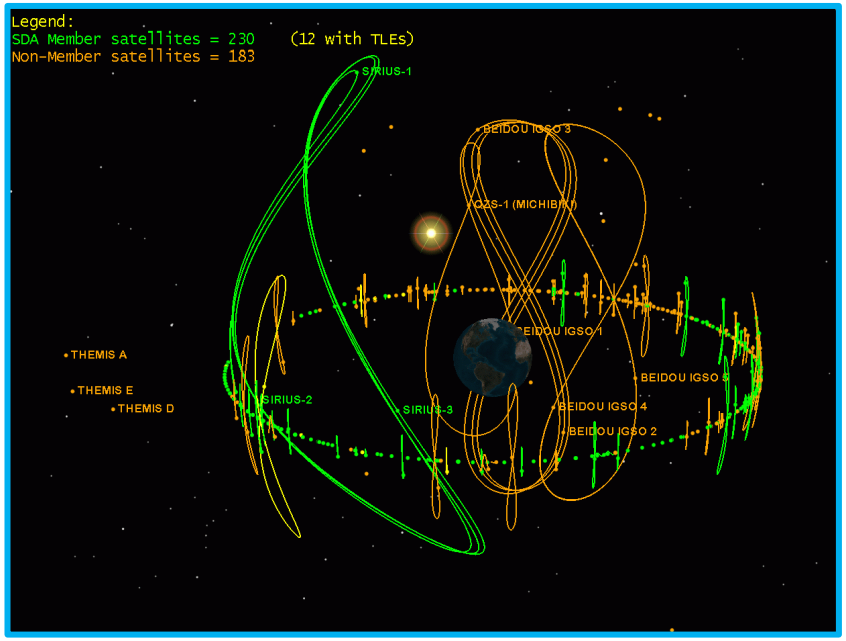
Multi-national, open to all space operators, in all orbital regimes

- 24 contributing operators
- 3 civil satellite operators

Space Data Center
Current Participation

- 3 civil satellite operators
- 23 participating operators
- 118 LEO/MEO satellites from 7 operators
- 241 GEO satellites from 18 operators





Space Data Association Membership

- **Executive Directors**
  - Eutelsat (Mark Rawlins), Inmarsat (John Mackey), Intelsat (Ron Busch) and SES (Stewart Sanders)
- **Standard Member Director**
  - Astrium (Philip Wadey)
  - StarOne (Erika Antonio De Souza Rossetto)
- **Including FOC participants**
  - 241 GEO satellites from 18 operators
  - 118 LEO/MEO satellites from 7 operators
  - Approx. 57% of GEO satellites processed in SDC through operator data

Space Data Association
System and Process Support

- **SDA Technical Advisers**
  - SDC Oversight (Paul Welsh, AGI)
  - SDC Operations Manager (T.S. Kelso, Ph.D, AGI/CSSI)
  - SDC Program Manager (Dan Oltrogge, AGI/CSSI)
- **SDA Ltd. Administration**
  - Corporate & Membership Administration Services (Ian Jarritt, ManSat, IoM)
- **Legal/Strategy/Government Policy**
  - Andrew D'Uva (SDA), Myland Pride (IGC), William Blunt (SES), Denise Olmsted (Intelsat), Paul Welsh (AGI)
- **Flight Dynamics**
  - Dean Hope (Inmarsat), Joe Chan (Intelsat), Pascal Wauthier (SES), David Zamora (Eutelsat)
- **RF Interference**
  - Steve Smith (SES), Ron Busch (Intelsat), Chris Ashton (Inmarsat), Mark Rawlins (Eutelsat), Patty Harrison (Intelsat)

This list is not exhaustive and the SDA requires the active support of its members. Many are involved in multiple activities so please feel free to volunteer to help.

SDA Users Meeting: SDA General Forum

SDA FUTURE PLANS

RON BUSCH

Space Data Association Objectives for 2014

- **SDA**
  - Grow Membership
  - Develop Government and Industry Relationships
  - Develop Space Insurance Relationships
  - Secure Access to Additional Data Sources

- **SDC**
  - Reduce Operating Costs and Improve Service
  - Implement Data Sharing for RFI Mitigation
  - Carrier ID Database

SDA Future Consideration

- **Space Weather**
  - Improved data distribution & alerts
  - Controlled sharing of proprietary data
  - Improved modeling with feedback
- **Carrier ID Database**
  - Supports RFI initiative of other industry bodies (sIRG, EUI)
- **Space insurance**
  - Secure preferred terms for SDA members based on better management of risk

SDA Future Challenges

- **Data Sources**
  - SDA/SDC built on user data, including ‘future knowledge’
  - Full catalogue requires additional data:
    - Increase participation >>> 100% of satellite operators
    - Access other data sources to fill gaps and verify existing
  - Increasing tracking capabilities/data is key
- **Funding**
  - SDA is funded solely by participants
  - Funding levels limit future developments
  - External funding could affect independence
  - Fee-paying ‘added value’ service models considered

SPACE DATA ASSOCIATION

How Star One keeps its fleet safe

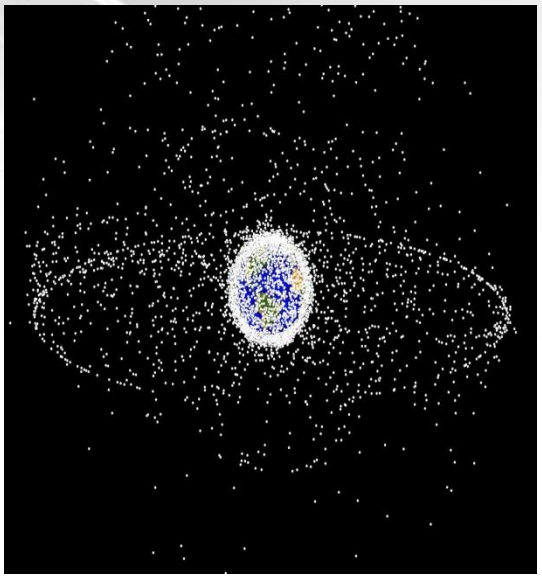
Erika Rossetto

March, 10 2014

SDA User's conference

Star One
an Embratel company

Introduction

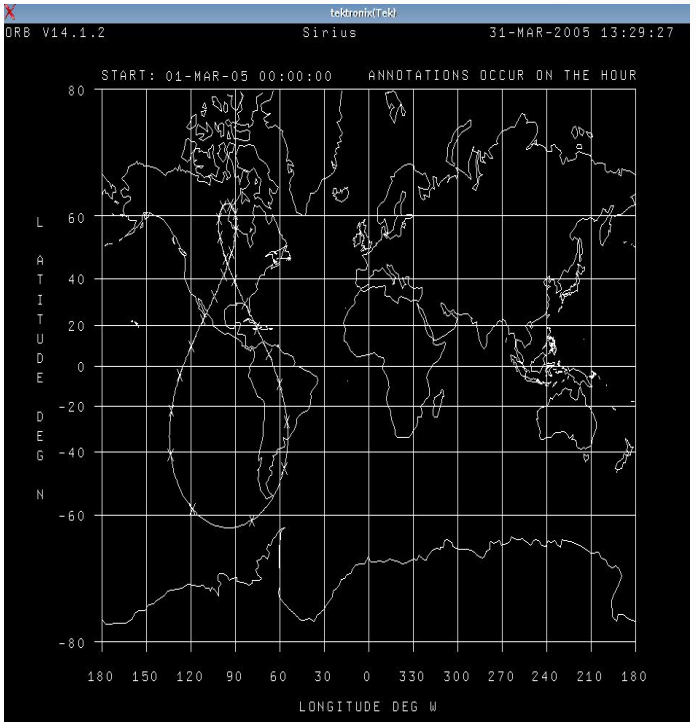


Space debris should be a concern for all satellite operators

Customers ask about space surveillance

Beginning to worry

- **In 2003, Telstar 402R failed in orbit and passed by several satellites with risk of collision, including Brasilsat B4 (in 92°W at that time).**
  - In 2000 Star One started to receive ephemeris from 2 Sirius satellites.



Watching systematically

- **In 2006, Star One joined SOCRATES (Satellite Orbital Conjunction Reports Assessing Threatening Encounters in Space). It was a service from the Center for Space Standards & Innovation (CSSI), which provided reports twice a day, notifying satellite operators about close approaches with their satellites. Later, SOCRATES was incorporated into the Space Data Center (SDC), maintained by the Space Data Association (SDA).**

First Mitigation Maneuver	
2006, June 23rd	SOCRATES predicted an approximation of 3.5 km between B4 and Telstar 402R for Jun 30th
June 29th	Star One executed a Mitigation maneuver
Jun 30th	Separation distance increased to 10.5 km

Joining SDA

- In 2011 Star One decided to join SDA in order to keep the systematic space surveillance;

- Initial challenges: ephemeris format, automatic upload, data quality and analysis;

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How SDA Helps Us

- **Frequent Conjunction reports**

GOES 13 (29155|2006-018A)	15.5895	5.8777	-8.4787	17.7461	2013-09-28 05:17:17	2013-09-28 00:00:00.000	35751.3508	18.6941	50000.0000
STAR ONE C3 (38991|2012-062A)	-15.5948	-5.8732	8.4722	17.7475		2013-09-28 09:55:51.351	7.392446E-007		

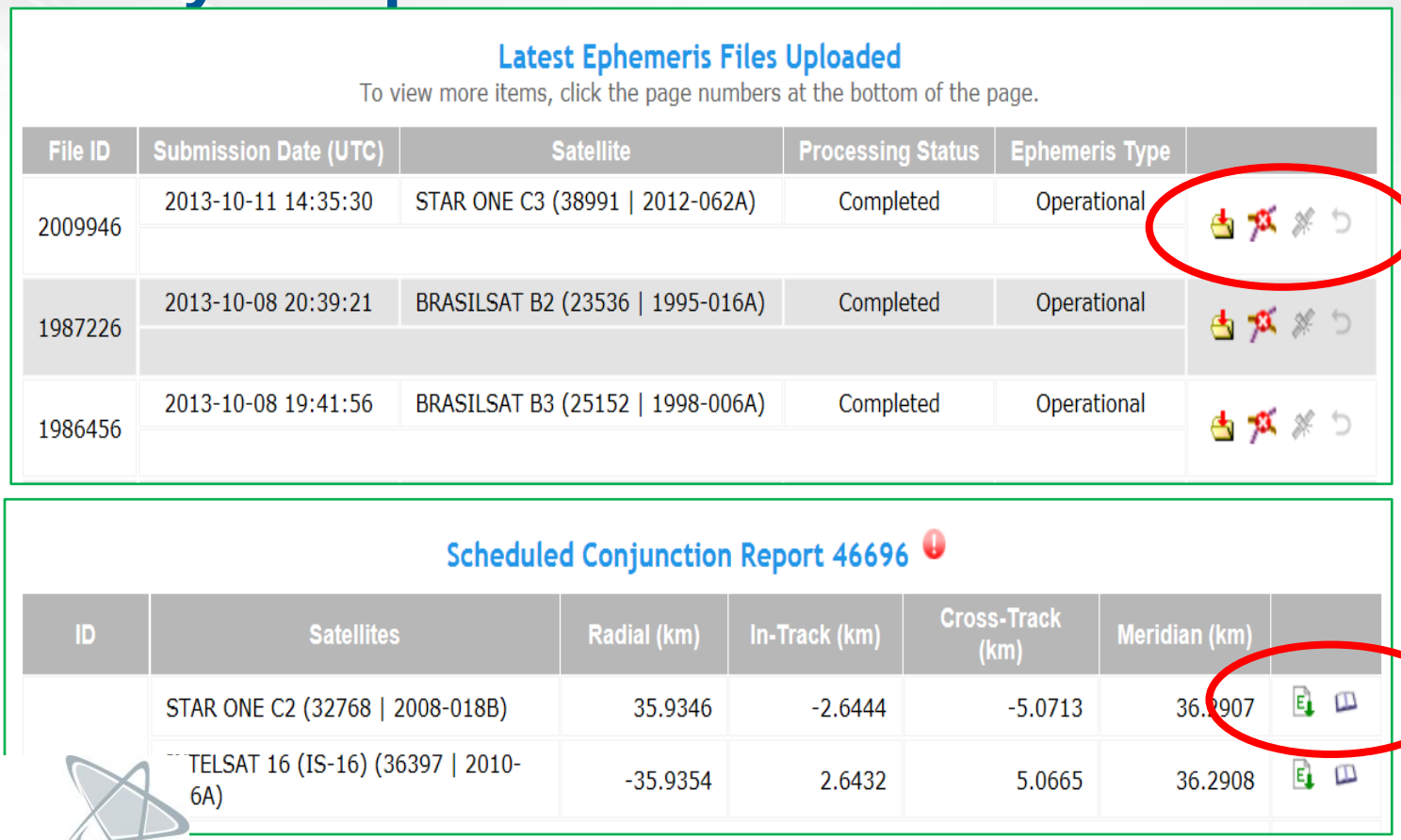
Satellite Name	Data Type	Last Upload	Name	Contact Phone	Contact E-mail
GOES 13 (29155|2006-018A)	Ephemeris	2013-09-25 20:18:07	Casey Thomas Kevin Work Steven Hadesty	+1-301-817-4239 +1-301-817-4024 +1-301-817-4042	casey.thomas@noaa.gov Kevin.Work@NOAA.gov Steven.Hadesty@noaa.gov
STAR ONE C3 (38991|2012-062A)	Ephemeris	2013-09-26 18:12:41	Erika Rossetto Evandro Paiva Giovanni Ferreira Henrique Almeida Mauricio Bottino MECCEL STARONE Reinaldo Silva Wallace Ferreira	552121219373 +552121217003 552121214450 552121212736 +552121212990 +552121212703	ccse@starone.com.br epaiva@starone.com.br ganni@starone.com.br riqueal@starone.com.br botino@starone.com.br meccel@starone.com.br reisilv@starone.com.br walfer@embratel.com.br

Contact Information

Satellites	Cross-Track (km)	In-Track (km)	Radial (km)	Meridian (km)	Time of Closest Approach(UTC)	Start Date (UTC) End Date (UTC)	Duration (sec) Probability	Minimal Range (km)	Screening Threshold (m)
STAR ONE C3 (38991|2012-062A)	-1.2741	-16.2123	11.8303	11.8987	2013-09-28 01:59:52	2013-09-28 01:58:12.080	201.7964	20.1101	50000.0000
LES 6 (03431|1968-081D)	-1.1256	16.2187	-11.8365	11.8899		2013-09-28 02:01:33.877	6.388048E-007		

How SDA Helps Us

- **Analysis options**



Latest Ephemeris Files Uploaded

To view more items, click the page numbers at the bottom of the page.

File ID	Submission Date (UTC)	Satellite	Processing Status	Ephemeris Type	
2009946	2013-10-11 14:35:30	STAR ONE C3 (38991 | 2012-062A)	Completed	Operational	
1987226	2013-10-08 20:39:21	BRASILSAT B2 (23536 | 1995-016A)	Completed	Operational	
1986456	2013-10-08 19:41:56	BRASILSAT B3 (25152 | 1998-006A)	Completed	Operational	

Scheduled Conjunction Report 46696

ID	Satellites	Radial (km)	In-Track (km)	Cross-Track (km)	Meridian (km)	
	STAR ONE C2 (32768 | 2008-018B)	35.9346	-2.6444	-5.0713	36.2907	
	TELSAT 16 (IS-16) (36397 | 2010-6A)	-35.9354	2.6432	5.0665	36.2908	

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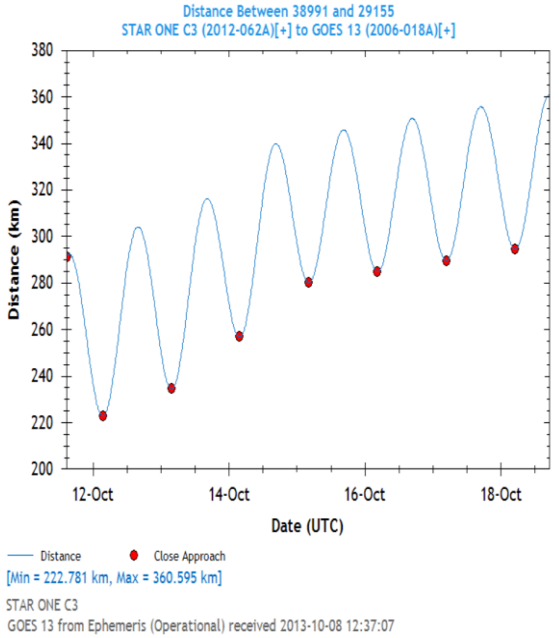
How SDA Helps Us

- **Neighborhood Watch list, very helpful for colocated satellite**

Primary Satellite	Neighbor Satellite
BRASILSAT B2 (23536|1995-016A)	TELSTAR 14R (37602|2011-021A)
STAR ONE C3 (38991|2012-062A)	GOES 13 (29155|2006-018A)

neighborhood watch



Approved for public release

How SDA Helps Us

- **JSpOC analysis also used to improve conjunction analysis**

Below are the latest CSM analysis results for STARONE (as of 2013 Oct 09 @ 13:18 UTC):

- 1 new CSM(s) downloaded
- 1 CSM(s) analyzed
- 0 CSM(s) skipped because they were more than 24 hours old

JSpOC Unique ID 101328235350

Creation Date: 2013-10-09 09:45:54 UTC (3.5 hours ago)

Upload Time: 2013-10-09 12:01:37 UTC (1.3 hours ago)

Conjunction for 38991/STAR ONE C3 [+] and 23741/GALAXY 3R [-]		
CSM min range at TCA (2013-10-21 18:29:42.202 UTC) = 8.979 km		
Ephemeris vs. CSM/TLE Comparison		
Primary	CSM Range at TCA: 119.345 km	TLE Range at TCA: 98.275 km
Primary ephemeris epoch: 2013-10-07 00:00:00.000 UTC (2.55 days old)		
CSM vs. TLE Comparisons		
Primary Range at TCA: 21.789 km	Secondary Range at TCA: 2.960 km	
CSM Conjunction Comparisons		
CSM vs. CSM	TCA: 2013-10-21 18:29:42.202 UTC, 8.979 km	
Ephemeris vs. CSM	TCA: 2013-10-21 18:29:38.098 UTC, 115.356 km	
Ephemeris vs. TLE	TCA: 2013-10-21 18:29:37.747 UTC, 116.497 km	
Ephemeris vs. Ephemeris	N/A	
Complete AGI Viewer Scenario		
Notes: • *Valid ephemeris for primary* • *No ephemeris available for secondary*		

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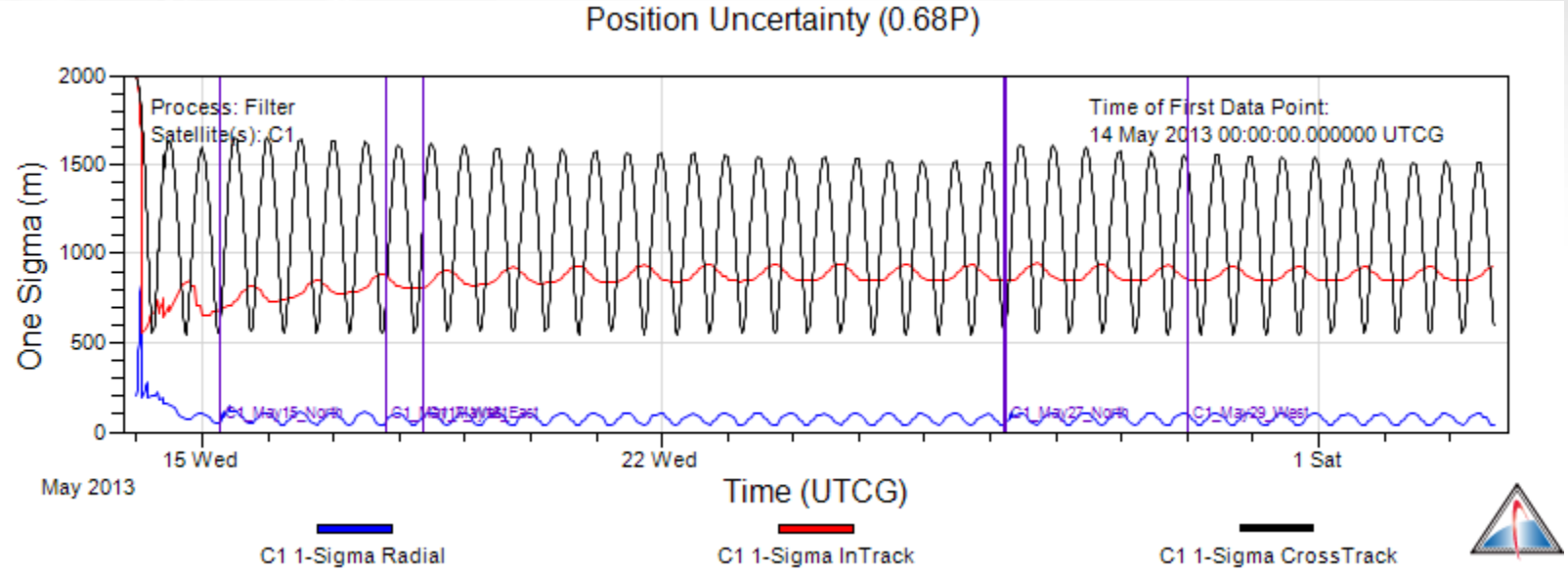
How SDA Helps Us

- **Orbit Determination Evaluation**



After our first OD evaluation we detected a systematic error in our system.

How SDA Helps Us

- **Launch support**

Satellites	Cross-Track (km)	In-Track (km)	Radial (km)	Meridian (km)	Time of Closest Approach(UTC)	Start Date (UTC) End Date (UTC)	Duration (sec) Probability	Minimal Range (km)	Screening Threshold (m)
Star One C3 Launch (77760|2012-314L)	1.352	0.1988	-3.0914	3.3742	2012-11-11 23:49:20	2012-11-11 23:48:47	67.6514	3.3800	50000.0000
KIZUNA (32500|2008-007A)	-1.3585	-0.1516	3.0913	3.3766		2012-11-11 23:49:54	1.159214E-006		

Satellite Name	Data Type	Last Upload	Name	Contact Phone	Contact E-mail
Star One C3 Launch (77760|2012-314L)	Ephemeris	2012-11-09 23:47:39	Erika Rossetto Evandro Paiva Giovanni Ferreira Henrique Almeida Mauricio Bottino MECCEL STARONE Reinaldo Silva Wallace Ferreira	552121214436 552121219373 +552121217003 552121214450 552121212736 +552121212990 +552121212703 552121219109	ccse@starone.com.br erisouz@starone.com.br epaiva@starone.com.br ganni@starone.com.br riqueal@starone.com.br botino@starone.com.br meccel@starone.com.br reisilv@starone.com.br wallfer@starone.com.br
KIZUNA (32500|2008-007A)	TLE	2012-11-09 16:19:47			

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Conclusion

- Star One relies on SDA and considers it as the best space surveillance system;
- Over last years SDA has been very helpful for our operations.
- We strongly recommend any operator to join SDA.

Thank you!

Questions?

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SDA Users Meeting: SDA General Forum

STATUS OF SDC AND THE SDC PLUGIN

DAN OLTROGGE

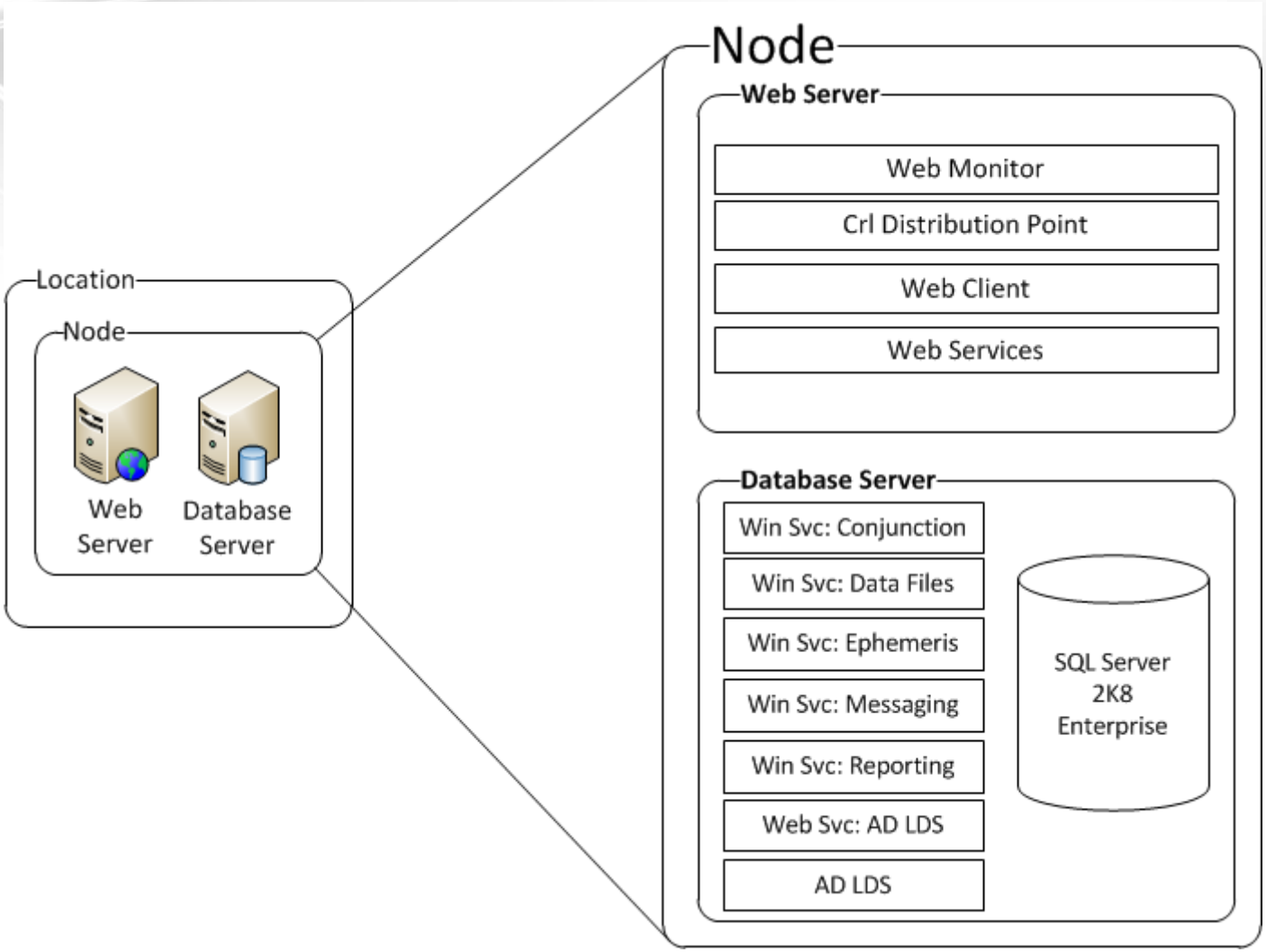
Space Data Center (SDC)

- **The SDC is the processing system of the SDA**

- **SDC – Three Key Mission Areas:**
  - Collision avoidance monitoring (Conjunction Assessment)/ Manuever Planning Validation / Flight Safety
  - Radio Frequency Interference mitigation / Geolocation support
  - Contact information (operations center) for SDA Member objects

- **SDC reliable and secure operation:**
  - Tertiary, geographically separated redundancy
  - High level data security and encryption
  - Best practice Information Assurance (IA) based on standards for high level computing systems

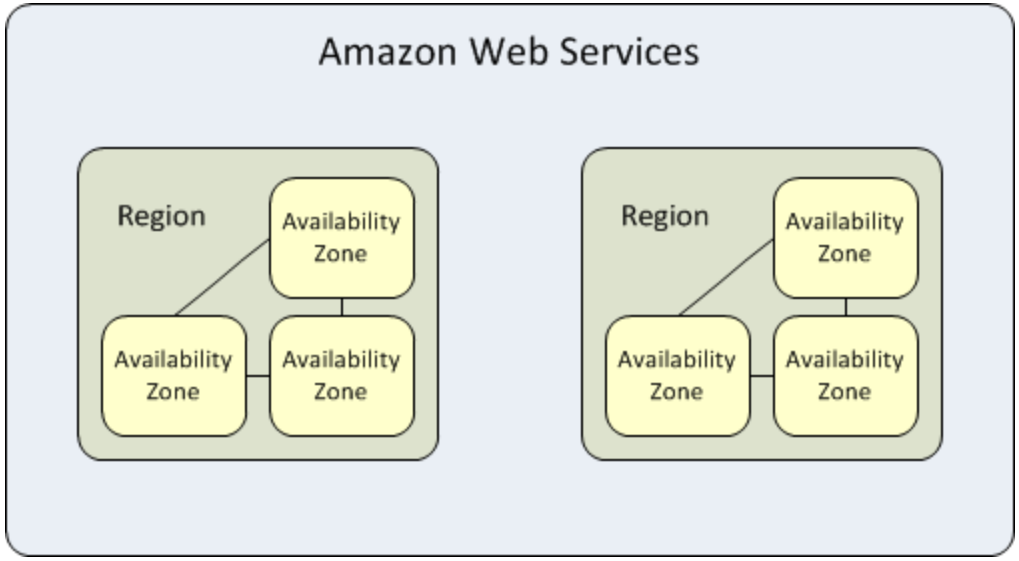
SDC Node Composition



SDC Demo: Home Page…

SDC Transition to Amazon Cloud

- **Substantial hosting provider cost reduction**
- **March/July 2014 – SDC switchover to Amazon**
- **Multi-region (continent), dual-AZ topology**
  - Amazon AWS regions are separate geographic areas
  - Each region has multiple, isolated locations known as *Availability Zones,* connected by low-latency links.



FGUA

- **Fundamental re-tooling of the SDC user permissions regime**
- **Enable users to authorize other user's access to first user's data under controlled circumstances**
- **Incorporate flexibility to allow a variety of rules, workflows, permission time intervals, etc.**
- **Permissions specified at the granular level**
  - by user, by satellite, by discipline
  - Sunset expirations of granted permissions

SDC Plugin

- **SDC Plugin provides easy access to user-friendly, tailored analysis of SDA member data**
  - Augments SDC rich repository of SOAP and REST web services for automated machine-to-machine interface
  - Allows SDC users to obtain any/all SDC data they are authorized to access
    - SDC ephemerides and maneuvers populated by operators
    - SDC RF parameters and RFI alerts to be populated as well.
    - Automatically ingests JSpOC CSMs and performs 9-way comparisons of conjunctions and two 3-way positional compares
- **SDC Plugin released January 2013**
  - ***Free*** to SDA members; requires business-level STK-Pro license

SPACE DATA
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RFI FUNCTIONS FOR SDC

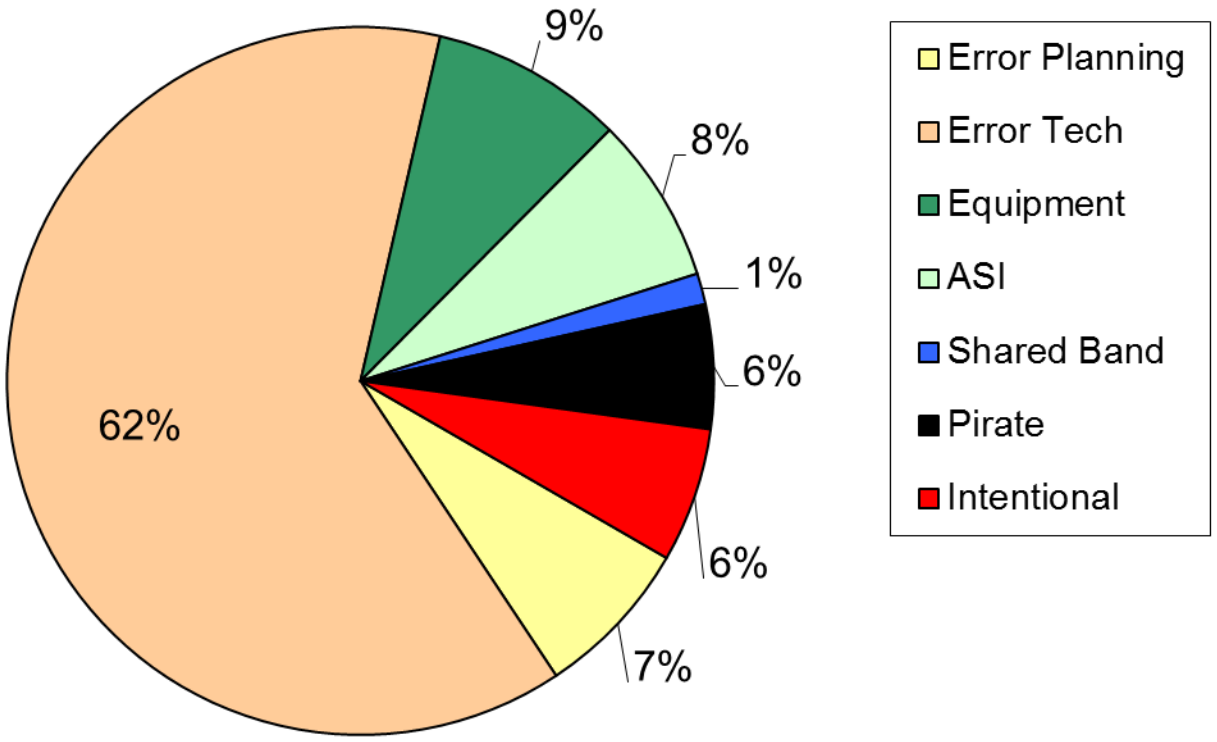
MARK RAWLINS

SDC/RFI – Introduction

- **Why share data or automate RFI functions?**
  - RF interference is the single most important operational problem affecting customer services on geostationary satellites
  - ~85-90% of customer issues are due to RFI
  - RFI only affects a small amount of capacity (1-2%?) but has a cost and service impact if not resolved
  - Investigation often needs data on other satellites
  - Investigating RFI is time consuming – we are always seeking methods and processes to improve response

Causes of Interference

Source: Eutelsat



SDC/RFI – Current RFI Ops Issues

- **Overview of the current RFI process**
  - Operators need contact details for other operators
    - No existing industry-wide database with reliable contact info
  - Operators need help and information
    - RFI Alert function, to seek assistance – exists today with sIRG email distribution – but need enhanced functions
    - To get information on other operator's payload, have to know who to contact
  - In-house knowledge, not documented
    - Tremendous experience, but not captured, not shared internally, let alone with other operators
  - Cooperation with other satellite operators
    - Geolocalisation using other operator satellites information exchanged "manually".

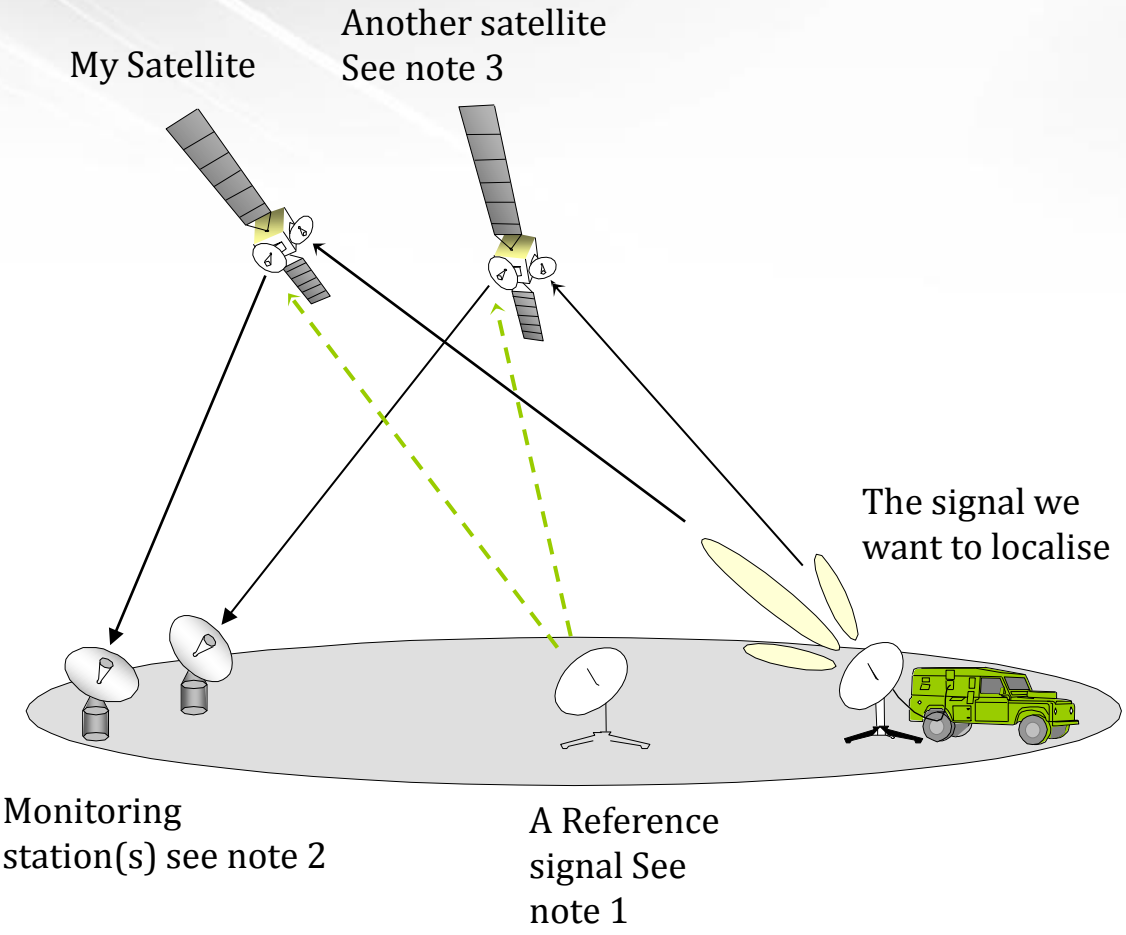
SDC/RFI – Geolocalisation Support

Why do I think that this is good for my operations?

What am I looking for?:

1. **Reduced time to solution**
2. **Less manpower for the same result**
3. **Higher precision**

The Geolocalisation Scenario



1. **A reference signal that shares the same RF hardware on the satellite and is located in the uplink are of both satellites**
2. **The monitoring station(s) need to be able to receive the signals from both areas. These may be in different places.**
3. **The other satellite needs to operate at the same frequency and a similar coverage area.**

If the other satellite does not belong to us we need to know the following:

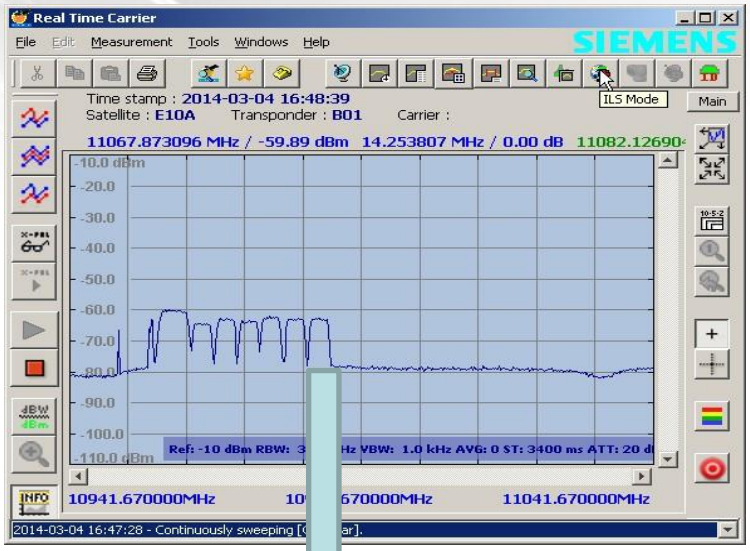
- **The cross strapping**
- **The coverage areas**
- **The frequency conversion**
- **The frequency bands**
- **The ephemeris data**

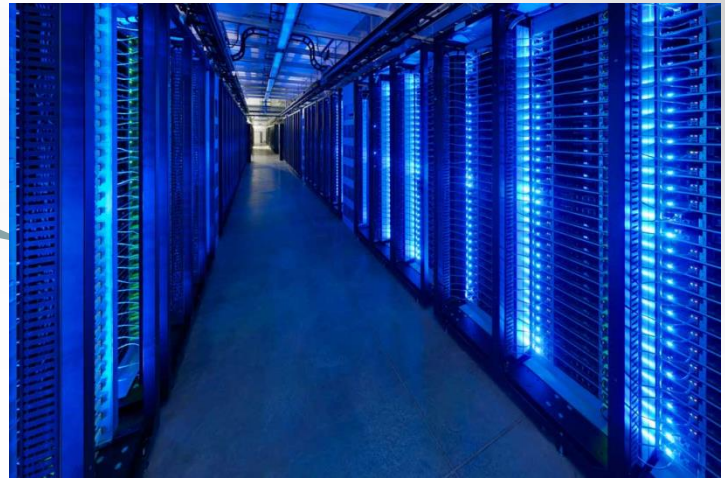
We go from this scenario…

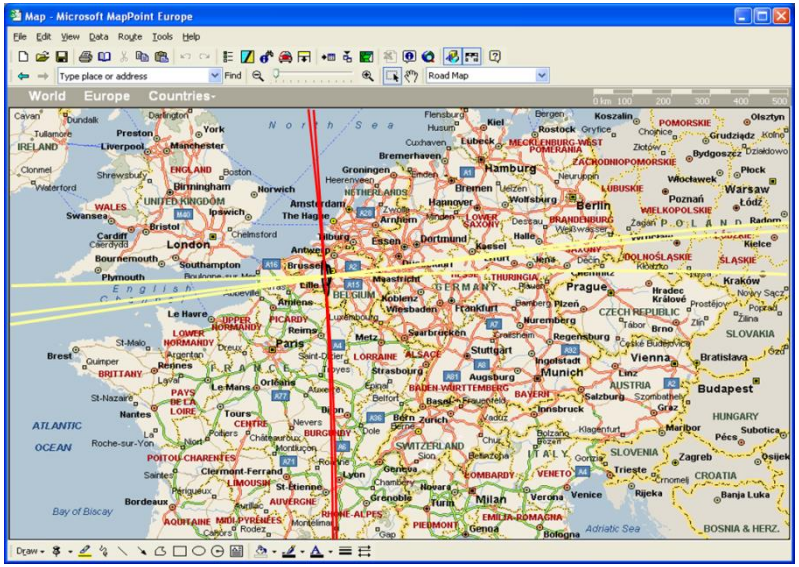
"Hi Patty, I have a nasty interference on my satellite at 180 East, do you have anything there that covers Fiji at 14.450GHz?"

"Hello Andreas, sorry we have nothing at that position, you'll have to try Russ" By the way do you know what time it is here?

To this….







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Data Secure, but available

The SDC provides this:

- Access to the specific data needed to geolocalise
- Available 24/7
- Legally binding conditions for data use

Summary

- ✓ One stop shop for the information – all the data needed for geolocalisation in one place.
- ✓ Always on – don’t need to wait to get the data in an informal manner
- ✓ Higher precision – Operator provided ephemeris up to date and verified
- ✓ A secure environment for sharing data
- ✓ Machine to machine data exchange.

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SDA Users Meeting

RFI FUNCTIONS FOR SDC

Patty Harrison

SDC/RFI – Introduction

- **Interactive functions to actively help operations**
  - RF data for interference geolocalisation
  - Fly-by RFI predicts for LEOP and drifting satellites
- **Reference functions**
  - Contacts database/Phonebook
  - RF Interference Alerts
  - RF Interference case study database
  - Carrier ID database
- **Why should SDC provide these functions?**
  - It already contains precise ephemeris data for geolocalisation

SDC/RFI – Interactive Functions

- **RF Data and Geolocalisation**
  - Members provide current RF payload (transponder) frequencies, polarizations, connectivity, satellite antenna patterns, reference carriers (data needs to be updated regularly to ensure accuracy)
  - SDC will use payload data to find best ‘pairing’ of primary and adjacent satellites to match geolocalisation requests from members
  - SDC will provide a ‘dataset’ of the required parameters to feed into the member’s geolocalisation system
  - **Benefit:** SDC computes optimum pairing of satellites for selection by the member; provides data formatted for the geolocalisation system; data immediately available for geolocalisation
- **Drifting satellites and LEOP (Fly-by)**
  - CA predicts fly-bys; TT&C frequencies predict RFI
  - **Benefit:** Analysis and Automatic alerts for potential fly-by RFI

SDC/RFI – Reference Functions

- **Contacts (Phonebook)**
  - SDC has a phonebook database. Members can enter their own contacts (e.g. 24x7 center, technical managers, support staff, etc.)
  - **Benefit:** Member-maintained, single reliable contacts database
- **RFI Alert (seeking information and assistance)**
  - Structured Alert message can be issued to selectable distribution
  - Data and messages can be saved and searched
  - Feedback provided to the distribution when event is solved
  - **Benefit:** Focused distribution; message tracking; feedback
- **RFI Database (historical information, case studies)**
  - Stores RFI Alerts, case studies, white papers, etc.
  - Assign tags, keywords, to aid searching
  - **Benefit:** Members can search RFI events, find useful information

SDC/RFI – Data From Members

- **RF Payload Data:** Data describing transponders and connectivity (not customer carrier data):
  Frequencies, polarizations, connectivity, beam antenna pattern data, reference carrier freq/pol/location/bw
- **Drift and LEOP:** TT&C data for satellites:
  Beacon, command and telemetry frequencies, cmd eirp
- **Contacts:** For RF Payload teams:
  Name, email, phone, role (24x7, mgmt, ops center, etc.)
- **RFI Alert:** Information describing an event, or information you need:
  Affected s/c, transponder, connectivity, freq, RFI characteristics, attach plots as needed, comments
- **RFI Database:** Similar data as for ‘RFI Alert”, for historical reference:
  Info describing an event, investigation performed, resolution, techniques, test equip, poor vendor equip list

SPACE DATA ASSOCIATION

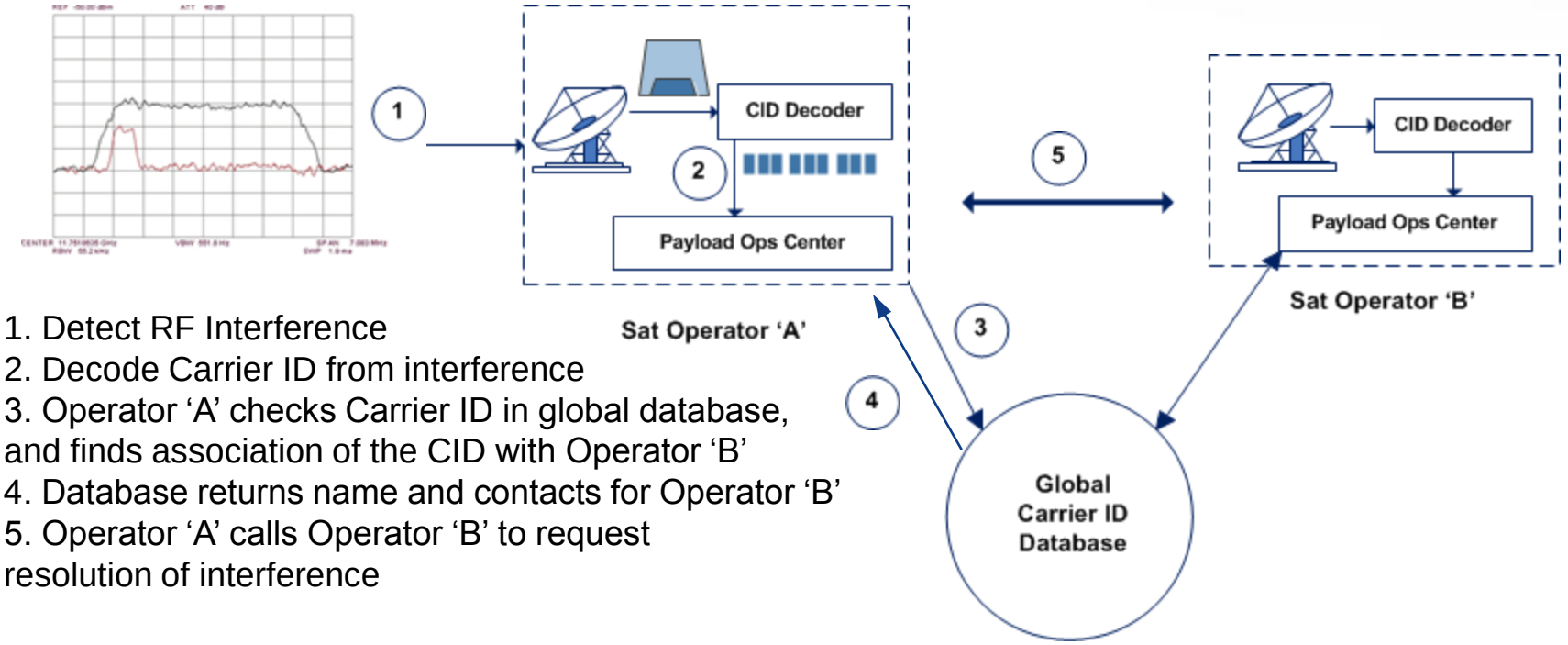
SDA Users Meeting

CARRIER ID DATABASE

Steve Smith

What is Satellite Operator CIDB ?

- **The Satellite Operator Carrier ID** dataBase **(CIDB)** is a centralized data repository for all satellite operators to use at no charge to store & search for Unique Carrier IDs
  - Associates Carrier IDs w/satellite operators
  - Facilitates rapid RFI mitigation for cooperating operators



1. Detect RF Interference
2. Decode Carrier ID from interference
3. Operator 'A' checks Carrier ID in global database, and finds association of the CID with Operator 'B'
4. Database returns name and contacts for Operator 'B'
5. Operator 'A' calls Operator 'B' to request resolution of interference

Satellite Operator CIDB Status

- SDA Board approved hosting of CIDB
- High level CIDB requirements are drafted
- CIDB mock-up developed by AGI and demonstrated to satellite operators at Oct 2013 sIRG Conference in Brazil
- The SDA has a requirements team overseeing RFI/CID functional development, and will work with sIRG CID WG

Satellite Operator CIDB Schedule

Industry timeline (WBU-ISOG Resolutions):

- **2014 – World Cup (June)**
  - Encouraging use of CID for broadcast video
  - Allow operators to demo processes and CIDB database
- **2015 – (demonstration and initial deployment)**
  - Uplink customers deploy DVB-CID-ready equipment
  - Operators implement CID detection and decoding
  - Operators finalize CIDB & processes
- **2015 – 2017 (Implementation of CID continues)**
  - Phase out interim CID-NIT format
  - 31 Dec 2017: DVB-CID globally operational

FCC Ruling (as of February 2014)

- **1 June 2016 – SNG uplinks to use DVB-CID**

Carrier ID Tour at Sat 2014…

To get more information

- **Come and join the CID Tour!**
  - Being conducted at Sat2014 conference at the following times…
  - Can email press@satirg.org for more information

Here is the full schedule for the CID Tour at Satellite 2014. Each tour will begin at the L Street Bridge

Tuesday 11th

2pm – CID Tour

4:15 pm – CID Tour

5pm – Integrasys Workshop

Wednesday 12th

10am – CID Tour

2.30pm – CID Tour

4:30pm – CID Tour

Thursday 13th

9:30 – 4:30 pm -Interference prevention summit

No tour on this day

For further information, please contact press@satirg.org

To book a place on the tour, please fill in the form below.

SPACE DATA ASSOCIATION

SDA Users Meeting: General Forum

FLIGHT DYNAMICS TOPICS FOR SDC
JOE CHAN

Current SDA Conjunction Monitoring Process

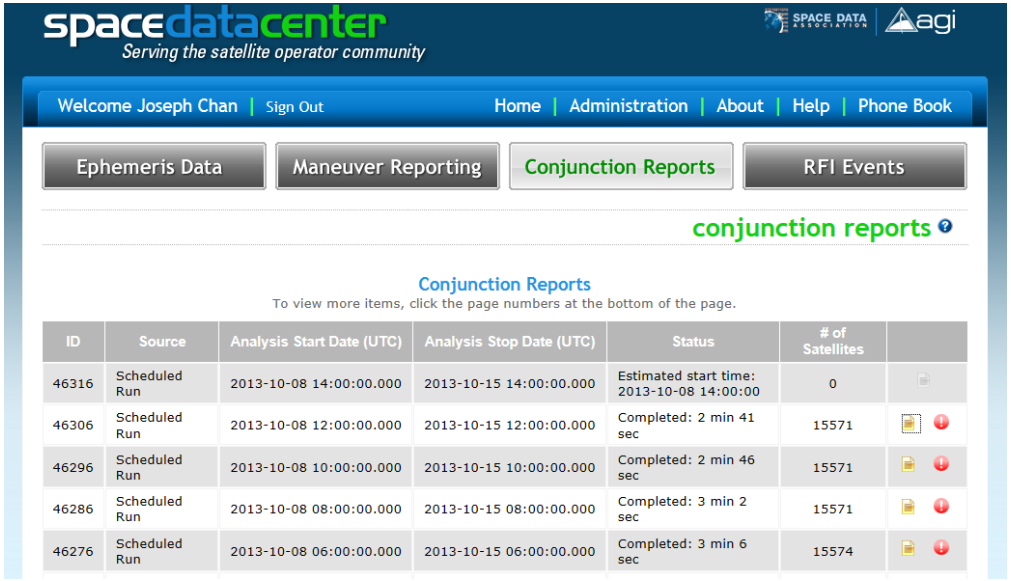
- **Space Data Association**
  - Cooperated with other satellite owners/operators orbit ephemeris including maneuver effects
  - TLE to supplement drifters and non-cooperated satellites
  - Conjunction alerts currently based on miss-distances only
  - Monitoring to 7 day time span

- **Monitoring strategy**
  - Single Tier system for member satellites
    - Actionable alerts
    - Efficient responses and coordination
    - Reduce (eliminate) false alarms
  - Two Tier system with non-cooperative satellites and drifters
    - Alerts based on TLE and validation via JSpOC Form-1 process with member ephemeris data

Current Services Provided by SDA (1/3)

- **Conjunction Assessment (CA) to analyze and warn of close approaches between a member's satellite and other space objects**
  - On-station, LEOP and Satellite Relocation

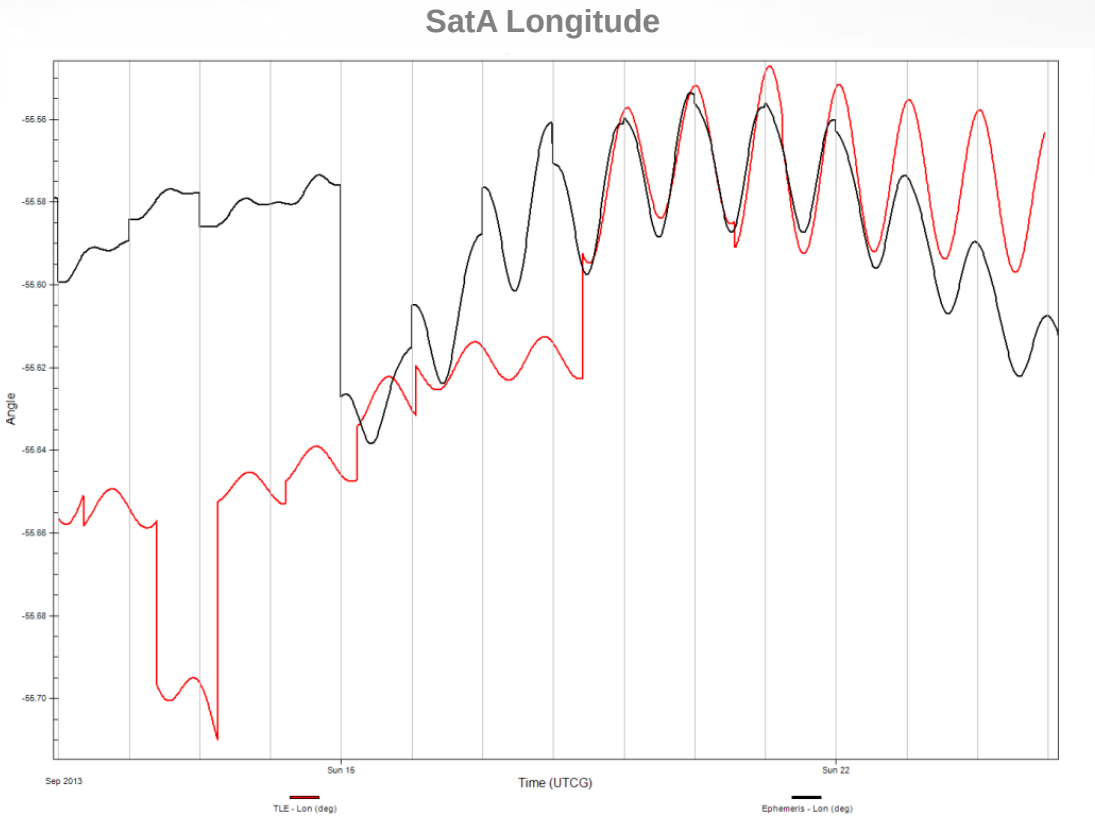
Neighborhood watch program to monitor collocating satellites with different members and within the same operator



ID	Source	Analysis Start Date (UTC)	Analysis Stop Date (UTC)	Status	# of Satellites
46316	Scheduled Run	2013-10-08 14:00:00.000	2013-10-15 14:00:00.000	Estimated start time: 2013-10-08 14:00:00	0
46306	Scheduled Run	2013-10-08 12:00:00.000	2013-10-15 12:00:00.000	Completed: 2 min 41 sec	15571
46296	Scheduled Run	2013-10-08 10:00:00.000	2013-10-15 10:00:00.000	Completed: 2 min 46 sec	15571
46286	Scheduled Run	2013-10-08 08:00:00.000	2013-10-15 08:00:00.000	Completed: 3 min 2 sec	15571
46276	Scheduled Run	2013-10-08 06:00:00.000	2013-10-15 06:00:00.000	Completed: 3 min 6 sec	15574

Current Services Provided by SDA (2/3)

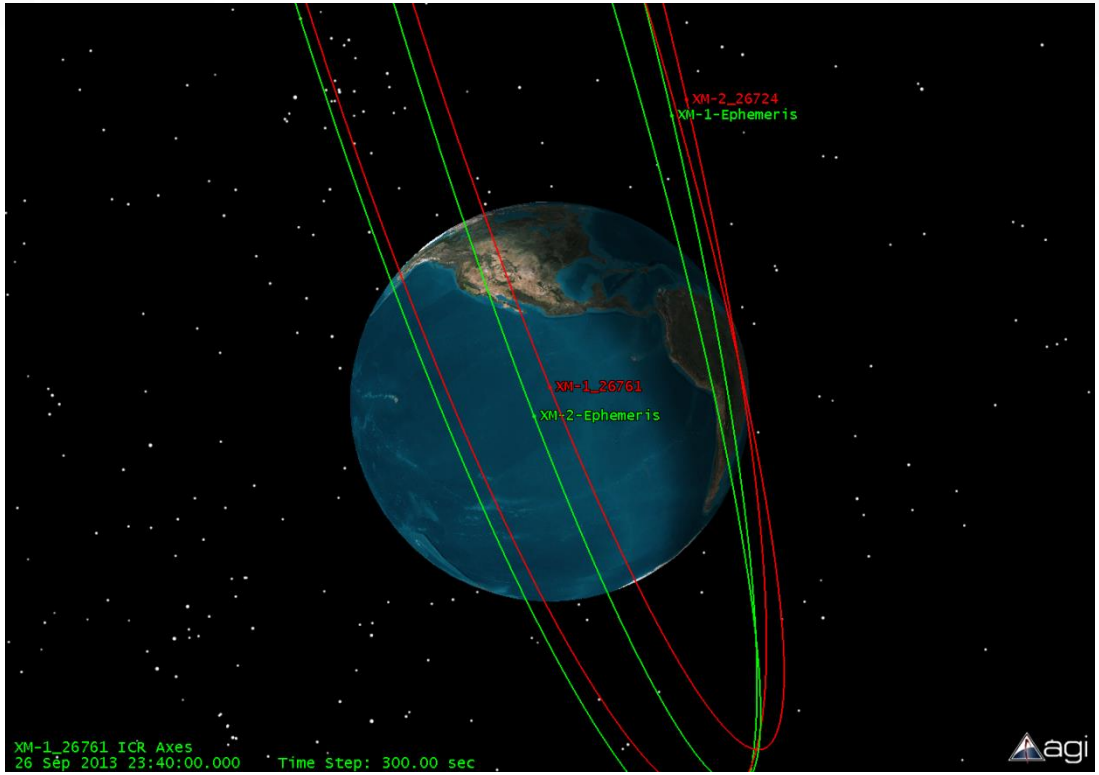
- **Sanity sensor calibration by comparing OwnersOperator (O/O) ephemeris with the Two-Line-Elements (TLE)**



Current Services Provided by SDA (3/3)

- **Cross-Tag detection and provide alerts to JSpOC**

Recently provided to JSpOC and was corrected



Value Added Services

- **Plug-in to interface with Conjunction Summary Message (CSM) for members to provide added value conjunction a**

JSpOC Unique ID xxxxxxx

Creation Date: 2013-08-14 10:24:41 UTC (2.5 hours ago)

Upload Time: 2013-08-14 12:43:11 UTC (0.2 hours ago)

Conjunction for SatA and SatB	
CSM Conjunction Comparisons	
CSM vs. CSM	TCA: 2013-08-24 16:54:09.485 UTC, 9.991 km
Ephemeris vs. CSM	TCA: 2013-08-24 10:26:54.584 UTC, 43.677 km
Ephemeris vs. TLE	TCA: 2013-08-24 18:00:13.493 UTC, 7.927 km
Ephemeris vs. Ephemeris	TCA: 2013-08-24 09:17:23.031 UTC, 62.633 km

Current State of Conjunction Monitoring

- **Space Data Association (SDA)**
  - Member orbit ephemeris including maneuver effects
  - TLE to supplement drifters and non-cooperated satellites
  - Conjunction alerts currently based on miss-distances only
  - Single Tier system for member satellites
  - Two Tier system with non-cooperative and drifters
- **JSpOC Support**
  - Conjunction monitoring using special perturbation (SP) data
  - Conjunction alerts based on miss-distances only
  - Automatic email to operators and via. online CSMs
  - Two Tier System with SP data and validated via Operator Ephemeris data

Missed Close Conjunction (1/2)

- **The satellites**
  - XXXX Active satellites
  - YYYY Non-active Rocket Body

Creation Date: 2013-10-23 09:24:34 UTC (3.4 hours ago)

Upload Time: 2013-10-23 11:47:47 UTC (1.0 hours ago)

Conjunction for XXXX and YYYY	
CSM vs. CSM	TCA: 2013-10-26 08:31:43.139 UTC, **7.567** km
Ephemeris vs. CSM	TCA: 2013-10-26 08:32:08.832 UTC, **3.343** km
Ephemeris vs. TLE	TCA: 2013-10-26 08:32:08.802 UTC, **3.425** km

Missed Close Conjunction (2/2)

- **The satellites**
  - SatA: Active satellite with low thrust engines and maneuvers loaded onboard
  - SatB: Decommissioned non-active satellites (drifter)

Screening	SatA	SatB	Separations (km)	Notes
SDA	Ephemeris	TLE	14.0	Bad SatB TLE
JSpOC	SP	SP	> 10	SatA SP did not include planned maneuvers
Request	Ephemeris	SP	0.6	SatA ephemeris included planned maneuvers
Request	Ephemeris	SP	3.9	Cancelled loaded maneuvers
JSpOC	SP	SP	3.3	Additional Tasking (~ 12 hours) and cancelled loaded maneuvers

Multiple Tiers monitoring is not efficient nor sufficient

SPACE DATA ASSOCIATION

SDA Users Meeting: SDA General Forum

SDA & JSPOC COMPLEMENTARY SERVICES

ANDREW D'UVA, DAN OLTROGGE

SDA or JSpOC ?
That's The Wrong Question …

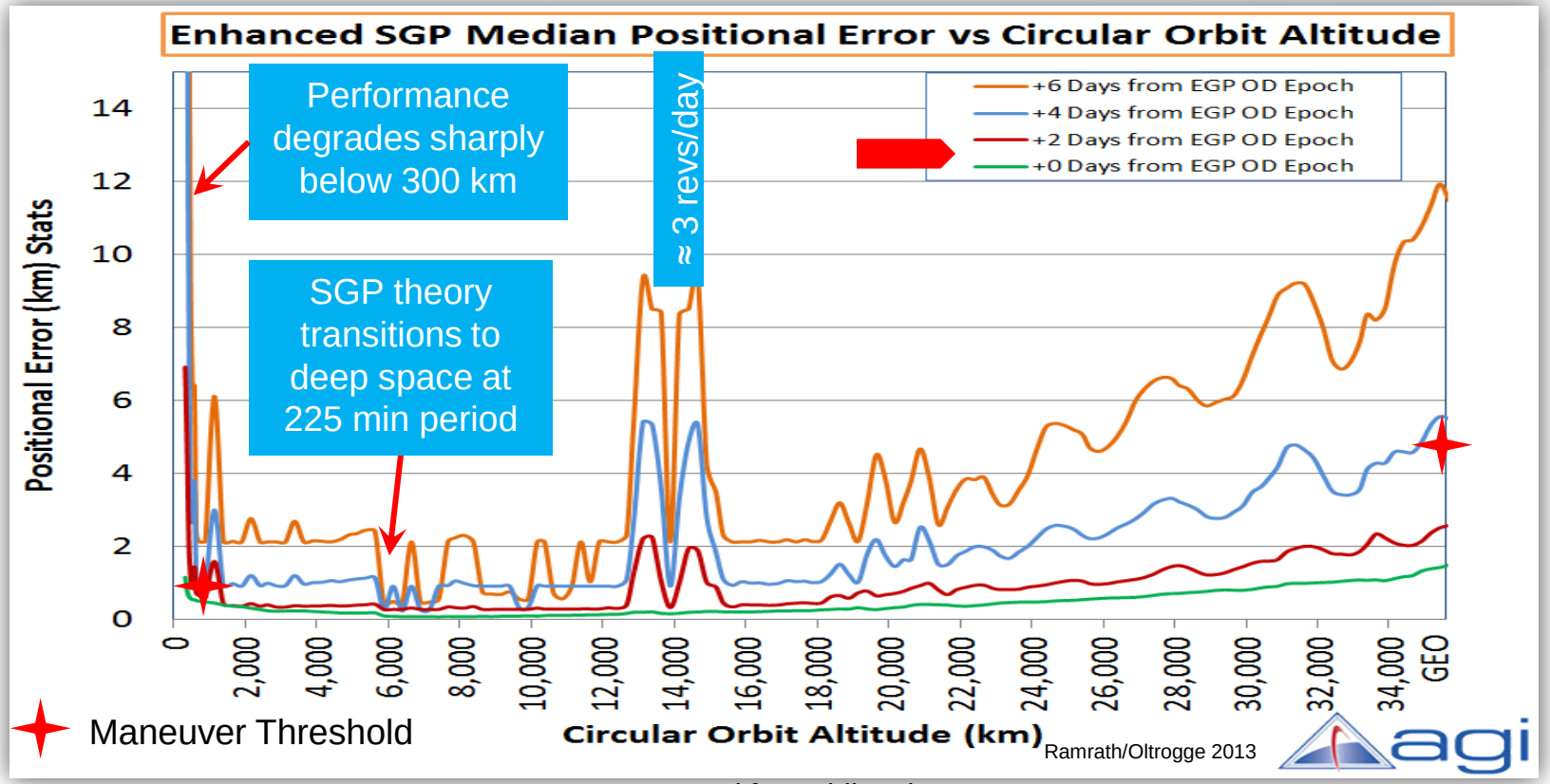
- **Myths:**
  - JSpOC CA services cover all risks, so participating in SDA is not necessary for operators already working with JSpOC
  - SDA's services cover all risks, so participating in JSpOC's CA services has no utility either
  - TLEs on space-track.org are useless for CA processing by SDA
- **Reality:**
  - As of now, neither JSpOC nor SDA are using (or are able to access and use) all of the best orbital data for CA
  - Participating in *both* SDA and JSpOC CA processes prudent
    - Even U.S. government does so: NASA, NOAA
  - Not to mention geolocation… where accurate ephemeris really matters

SDA AND JSpOC – The Right Answer for Responsible Operators

- **Lots of technical data and historical evidence available, but the bottom line is:**
  - CSMs are not ‘actionable’ per the JSpOC; simply a ‘heads up’ for all to start analysis
  - JSpOC does not process all owner-operator advance maneuver data and measured ephemeris contributed by operators, but has access to some debris and object data SDA lacks
    - JSpOC has access to some data that SDA does not
    - SDA has access to some data JSpOC does not
    - SDA working to ensure that everybody’s limited resources in this area are used to best effect
  - SDA CA warnings and tools also aid analysis
    - SDA provides unparalleled SDA/JSpOC comparisons to minimize Flight Dynamics Staff (FDS) workload

SDA AND JSpOC – The Right Answer for Responsible Operators

- JSpOC new "Enhanced General Perturbations" TLEs
- The SGP orbit theory of TLEs sufficient accuracy for SSA
  - At 1-day maneuver decision point:
    - EGP TLE median positional accuracy ≈ ***1km at GEO and ≈ 500m at LEO***

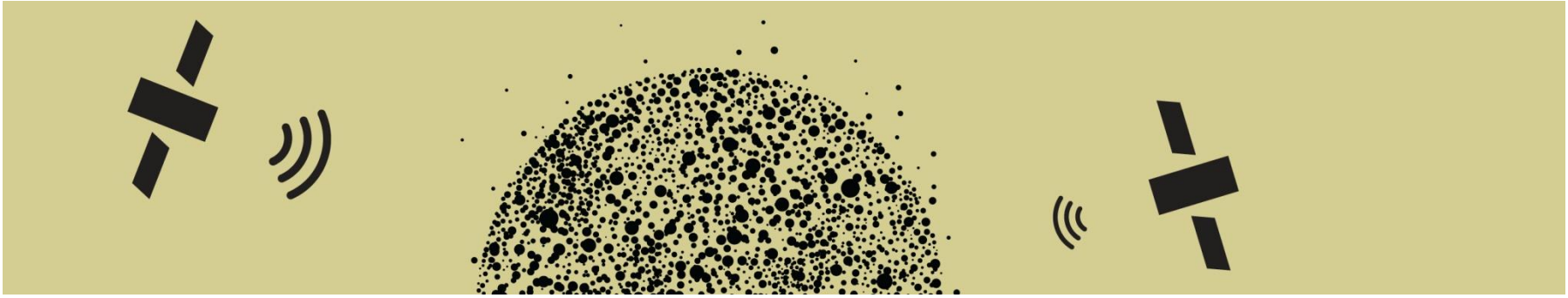


SDA AND JSpOC – The Right Answer for Responsible Operators

- **Impact of Maneuvers**
  - JSpOC technology has difficulty detecting and reflecting maneuvers (fitting orbits, up to seven day lag) – owner/operators have best data on their actions
  - SDA excels at operator-vs-operator analysis
  - Supporting operators is SDA's only priority
- **So why use JSpOC at all?**
  - Unparalleled 'non-cooperative tracking' sensor network (Space Surveillance Network)
  - It helps to build a common picture to the benefit of all
  - SDA will keep looking for ways to work with JSpOC ; it's responsible and prudent to start now
  - It's "free" (i.e., U.S. taxpayer funded)

WHY SPACE INSURANCE MATTERS

CHRIS KUNSTADTER • XL INSURANCE • MARCH 2014



XL Group plc is…

- A publicly traded company *(NYSE stock symbol: XL)*
- Total assets of $45.7 billion *(as of 31 December 2013)*
- Shareholders' equity of $11.4 billion *(as of 31 December 2013)*
- Ratings: S&P: A+ (strong) / stable, A.M. Best: A (excellent) / stable
- 60 offices in 25 countries
- Through its subsidiaries, a global provider of:
  - Insurance and reinsurance
  - Specialized commercial risk management solutions
- *XL Aerospace is a leading provider of insurance and risk management services to the aerospace, telecommunications, and related industries worldwide*
  - XL has worked on numerous launch vehicle and satellite failure review boards and industry working groups
  - XL has unique capabilities in space

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What Is Space Insurance?

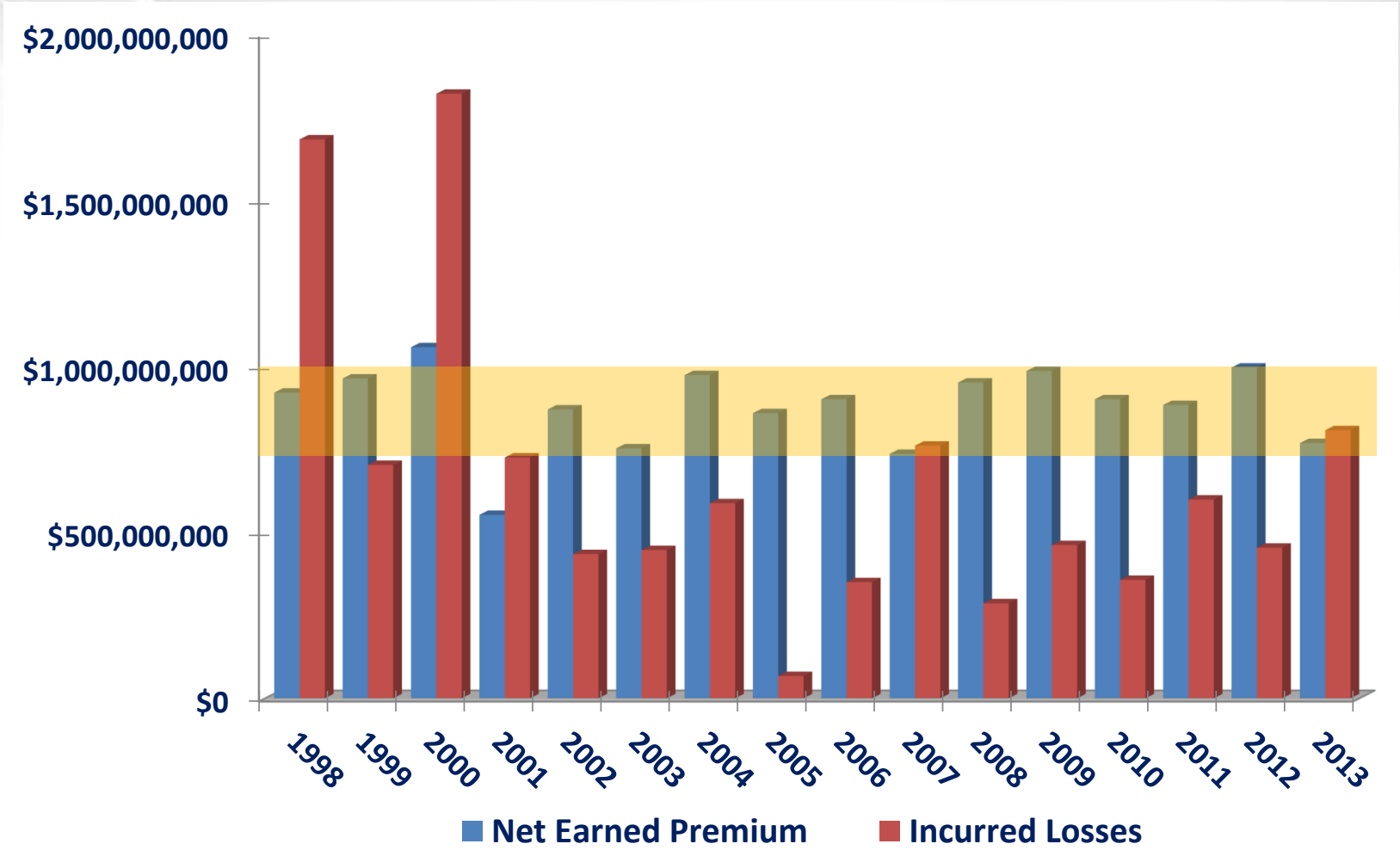
- **Coverage for first-party losses (*e.g.*, loss of asset, business interruption) for satellite operators and users, satellite manufacturers, and launch providers, during launch, initial operations, and on-orbit operations**
  - **Includes virtually all of the technical risk of the space segment, from launch onwards**
  - **Generally covers all risks, with few exclusions (*e.g.*, war, nuclear, terrorism)**
  - **Generally covers losses due to environmental hazards (*e.g.*, space debris, space weather)**
- **Small population of risks + high severity = volatility of results**
- **Overcapacity in space insurance**
- **Unique underwriting challenges**

What Keeps Us Up At Night

SPACE DATA ASSOCIATION

- **Operations**
  - Environment – debris, solar activity, interference
  - External threats – intentional and unintentional
  - On-orbit servicing – prox ops
  - Hosted payloads – liability, cross-impact
  - Commercial human spaceflight
  - Cyber – unbounded risk
- **Systems**
  - Technology insertion
  - Test and analysis
  - Counterfeiting
  - Workforce
- **Commercial**
  - Global economy – shifting alliances
  - Market weakness – volatility
  - Capital allocation
  - Emerging risks

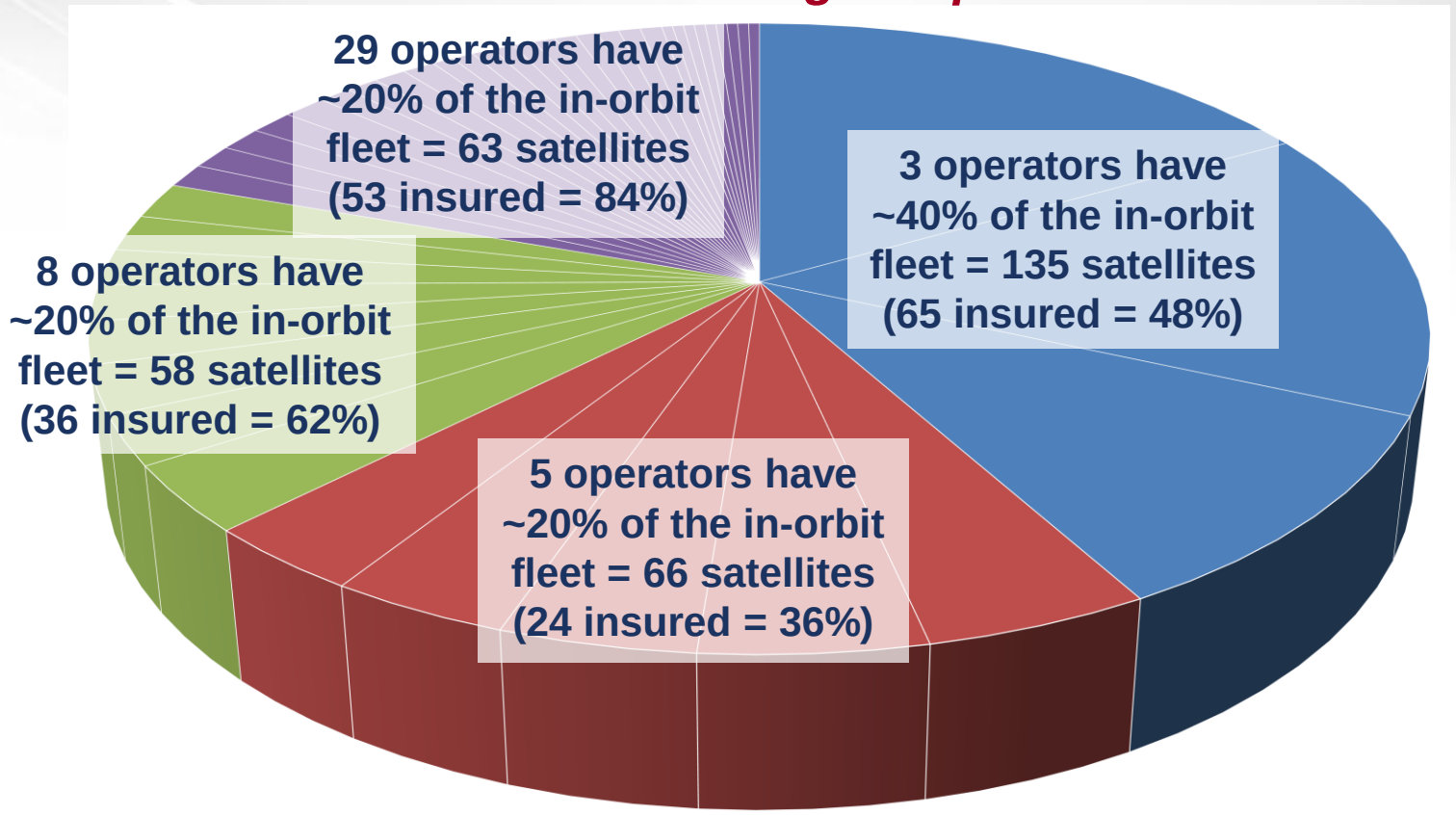
Market Annual Premium and Claims



Commercial GEO Satellites In Orbit

By operator, insured and uninsured

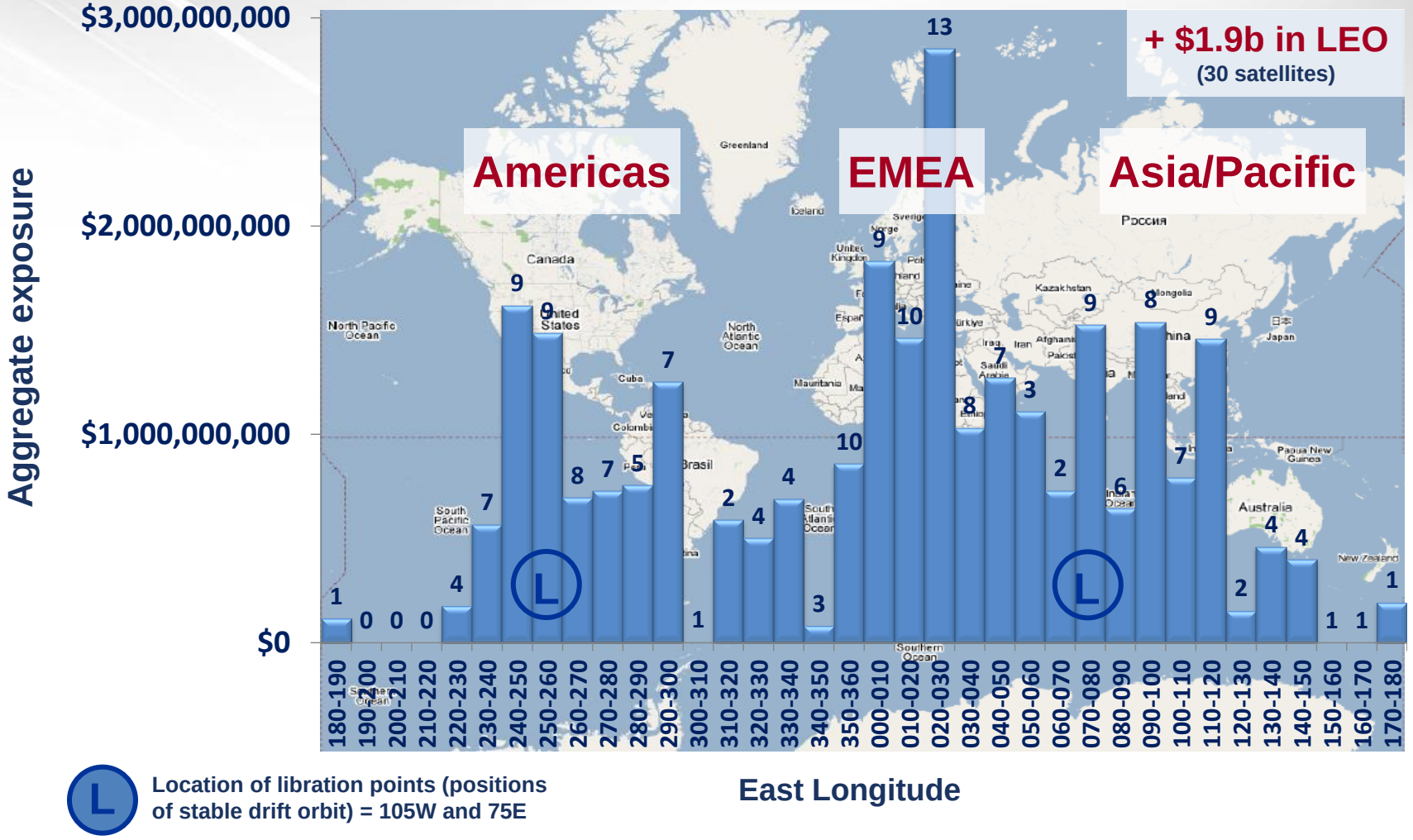
322 satellites among 45 operators



6 of 45 operators buy little or no in-orbit insurance
(13% of operators, 31% of in-orbit fleet)

Insured GEO Satellites by Orbital Slot

In 10° longitude increments

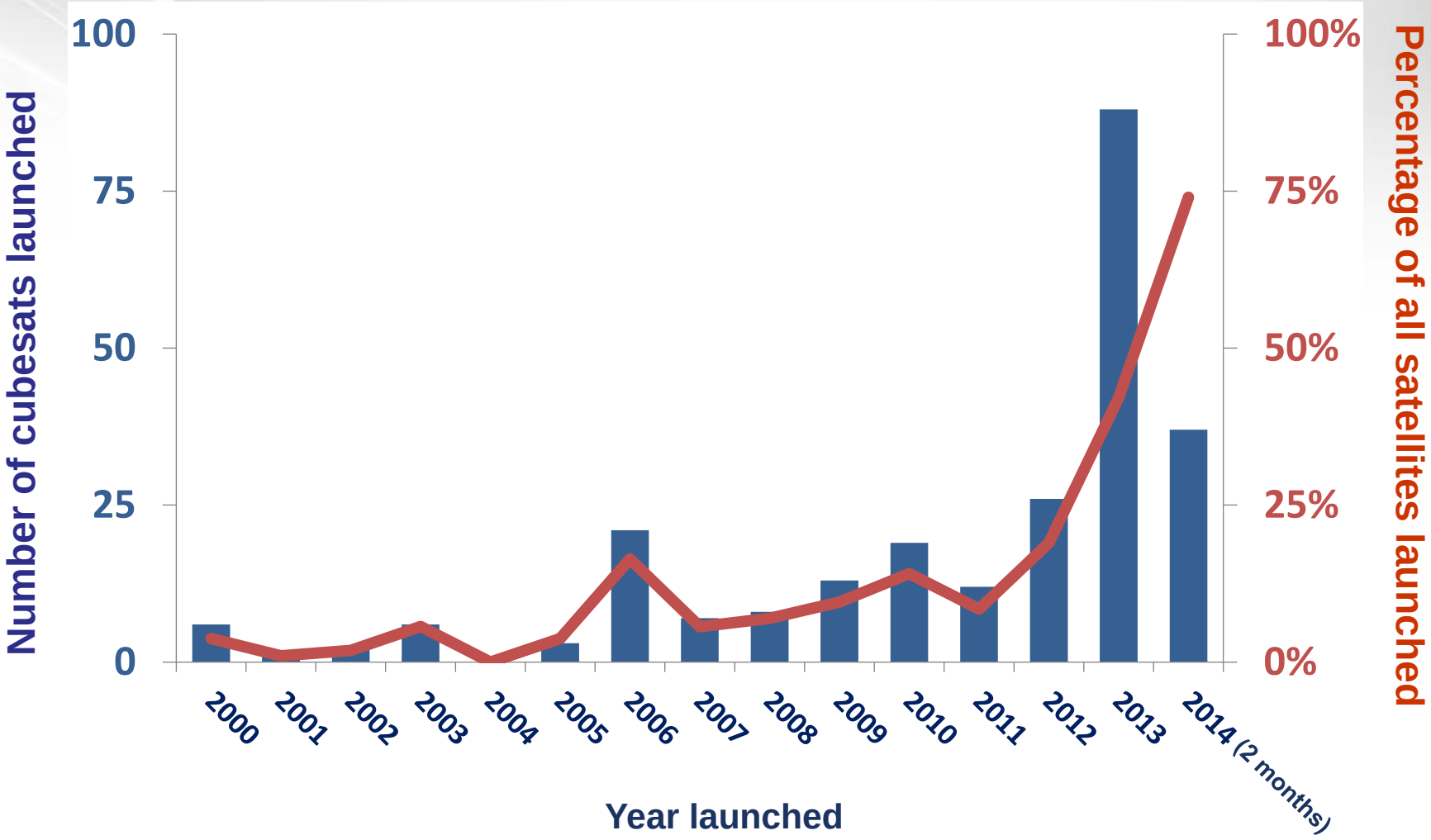


L Location of libration points (positions of stable drift orbit) = 105W and 75E

Approved for public release

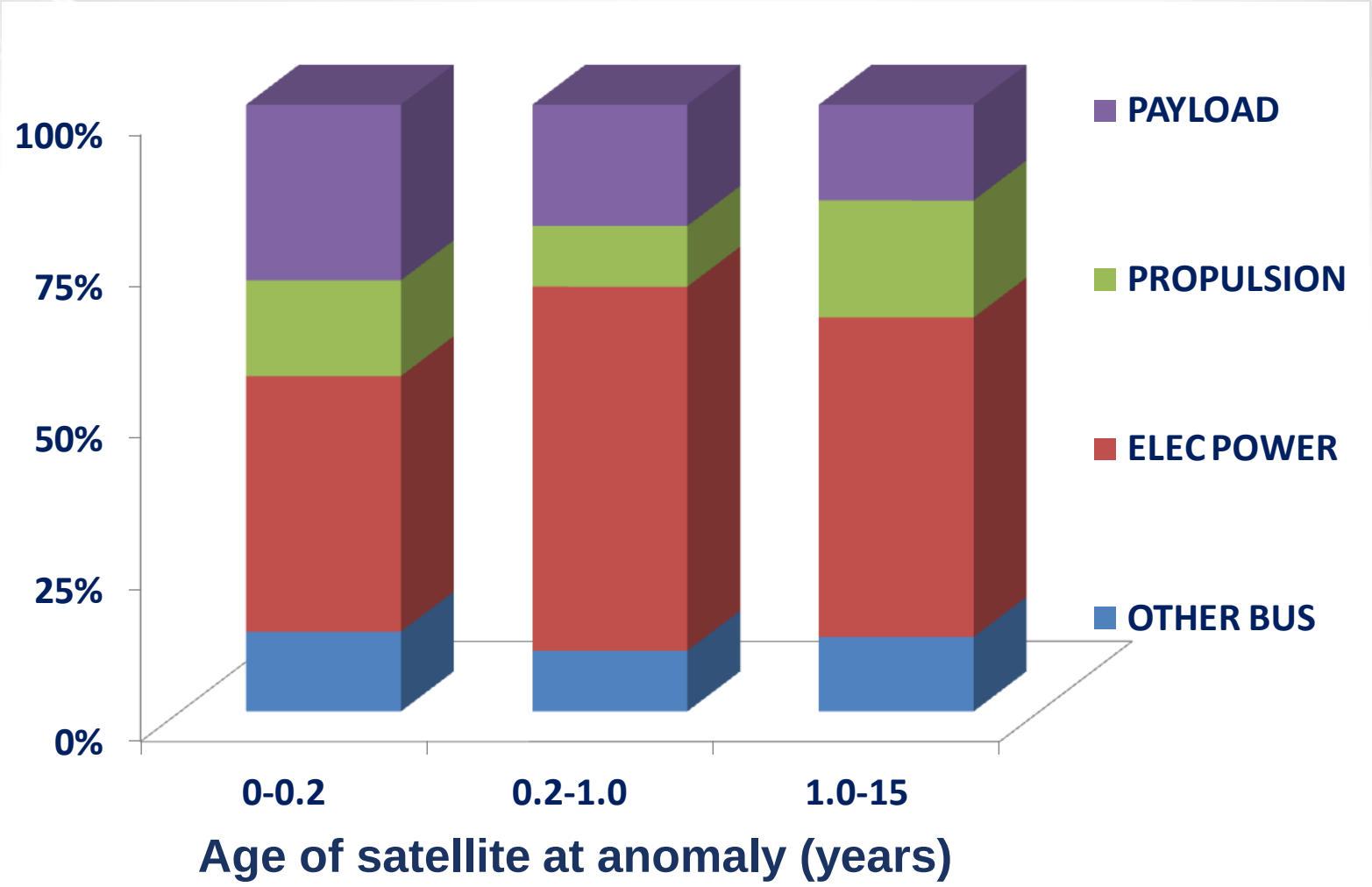
Cubesats Launched

Number and percentage of total



Satellite Loss Progression

Losses by subsystem based on age at anomaly



The Way Forward
SDA and the insurance community

- **Collisions in space are covered under space insurance policies***
  - **We want to ensure that all reasonable steps are being taken to avoid collisions**
- **EMI and RFI are *excluded* from space insurance policies***
  - **Typical exclusion language: *"This policy does not apply to loss, damage or failure caused by or resulting from…electromagnetic or radio frequency interference, except for physical damage to the Satellite directly resulting from such interference and from interference coming directly from the Satellite."***
- **Many (typically minor) satellite anomalies reported to space insurers are blamed on space debris**
  - **Solar array string losses**
  - **Attitude disturbances**

**** ceteris paribus***

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Conclusion

- Space insurance market has been profitable over the long-term, but margins are increasingly thin
- Emerging risks, introduction of new applications and technologies, and increasing hazards in the space environment will stress satellite operators, manufacturers, launch providers, end-users and insurers
- Competitive space insurance market demands even more diligent underwriting
- XL's industry involvement allows us to help shape strategy and policy
- XL encourages satellite operators to participate in SDA

Space for new ideas…

…new ideas for space

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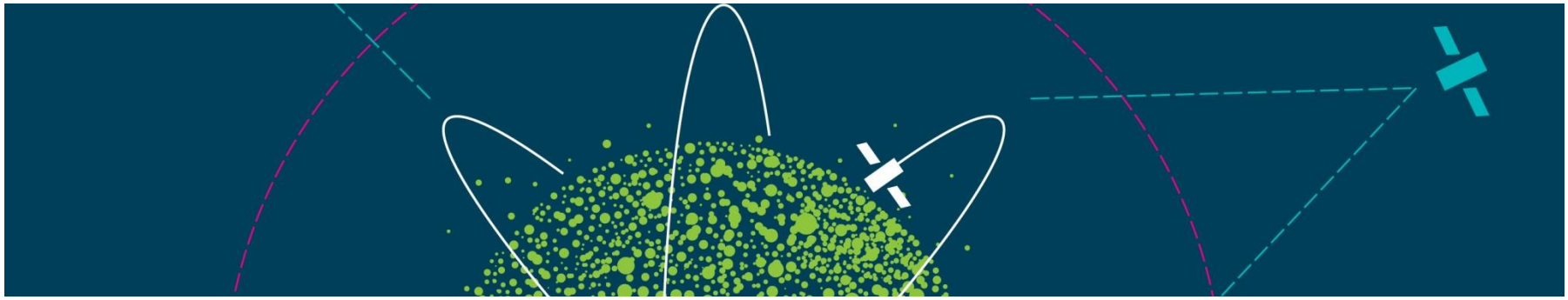

SDA Users Meeting: SDA General Forum

SUMMARY AND CLOSING REMARKS

RON BUSCH

Summary Comments

- SDA has shown that a user owned/managed operational solution is viable and can encourage membership precisely because of its independence.
- The legal framework protection of proprietary data has been critical in encouraging participation.
- SDA has already solved Conjunction Assessment and general processes – the wheel doesn't need to be reinvented – public money is better spent on additional tracking/data sources.
- Physical space and the RF spectrum need better operational management – the SDA is the best means of achieving this.

Q & A

Contacts – For Presentation Follow Up

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