



# PROJECT MANAGEMENT CENTER FOR EXCELLENCE

A.J. CLARK SCHOOL OF ENGINEERING  
Civil & Environmental Engineering Department



## BREAKING THE LEARNING/ DEVELOPMENT CURVE

*Jim Peterka, Boeing Satellite Systems  
2016 Project Management Symposium*



# 702SP

## Breaking the Development Cycle

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Program Manager  
Commercial Satellite Systems

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# Satellite 101

- High-value assets – typically \$100M+ per spacecraft
- Perform for 15+ years with no human intervention except for periodic Radio Frequency (RF) telemetry/command – everything else is autonomous
  - International application for telephony, high data-rate transmission over large regions – Connectivity, Information, Business Support
  - Continuous operation 24/7 with NO interruptions to customer business case
- Typically 6 years from start of development to delivery on orbit
  - *702SP accomplished this in 4 years*
- Typically 2 to 3 years from contract start to launch of a satellite
  - *702SP can do in <2 years and with >20 years propellant life while meeting power/payload objectives – two at a time!*



***Satellites are a critical asset to customer business***  
***Quality and Mission Assurance are #1***

# Spacecraft Subsystem Description

## “10” Major Subsystems

### Propulsion

Orbit raising, momentum & orbit control

- Xenon thrusters
- Positioning mechanisms
- Switches
- Controllers
- Valves
- Flow control
- Xenon tank
- Pressure sensors

### Attitude Control

Attitude determination and control

- Reaction Wheels
- Inertial Reference Units
- Star Trackers

\*BLUE denotes new developments/technologies

### Power

- Power generation (Solar Arrays)
- Energy storage (Batteries)
- Controllers
- Distribution
- Monitors
- Switches

### Avionics (Spacecraft Control Processors and Software)

- Attitude and orbit control
- Processing & control sequences
- Data storage & status
- Payload & platform control
- Command distribution
- Telemetry collection

### Payload

- Comm repeater
- Instruments

### Antenna

- Reflectors
- Pointing mechanisms
- Hemi antennas

### Telemetry and Command

- Transmitters
- Receivers
- Data bus

*Challenge is balancing performance, cost, risk and meeting the plan*

### Structure

- Hardware mounting
- Static and dynamic loads
- Release mechanisms

### Launch Vehicle Interface

- Power
- Separation status
- T&C

### Thermal

Temperature control and monitoring

- Heat pipes
- Blankets
- Heaters
- Temperature sensors

*Program Manager and Chief Engineer needed a strong team!*

***Maintain a symbiotic relationship amongst disparate technologies***

# Overview of our newest 702 satellite design

- **Evolution of 702 Product Line**

- Began as Feb 2011 IRAD study
- Built upon 702MP and 702HP flight heritage

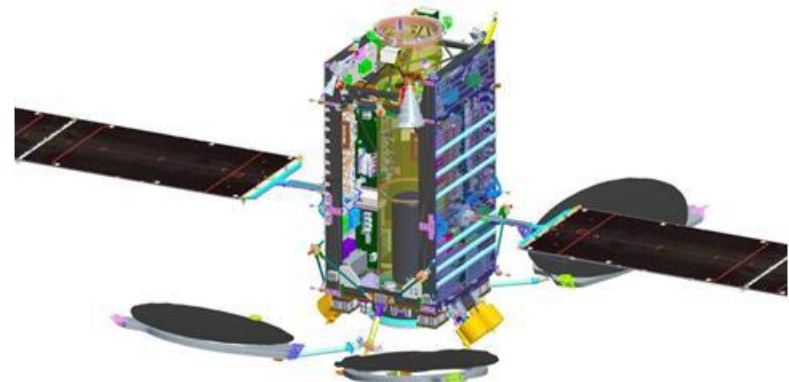
- **Change the value proposition for the customer**

- All-electric propulsion to reduce launch costs
- Provide increased payload telemetry points
- Reduce overall processing cycle time

- **Adaptable spacecraft architecture that allows a common bus to accommodate various payloads**

- **Dual-manifest on Falcon 9 with Industry Standard Separation Systems**

- Launch vehicle integration, spacecraft stacking, separation within Boeing experience

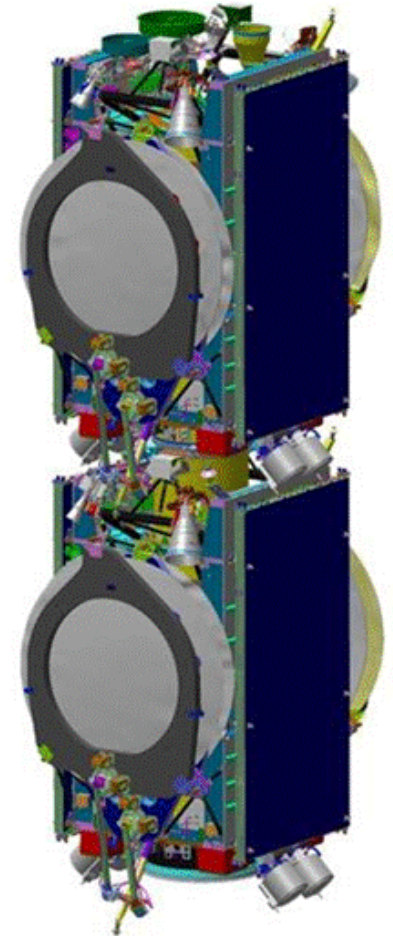


702SP Development and ABS / Satmex "4-Pack" Flight Schedule											
	2011		2012		2013		2014		2015		2016
Development	IRAD / Full Scale Model		Engineering Models		Testbed Validation						
Flight		Proposal	Requirements	Design Phase		Assembly	Integration and Test		Launch F1/F2	Integration / Test	Launch F3/F4

## Parallel Development and Flight Program

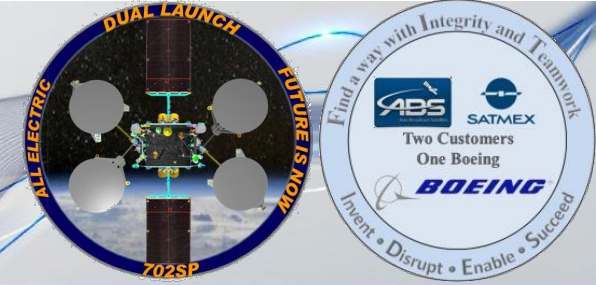
# Market Based Demand

- **What was the situation before change?**
  - Minimal orders won in this payload/power class (<7 kW)
  - Marketplace “stagnant” on liquid propellant technology and capability for new payload types and new rockets
- **What was the challenge?**
  - Reduced cost by >20%
  - Marketable within 1 year, developed within 2 years and deployed by 4<sup>th</sup> year
  - Product life cycle from contract sign to launch in <2 years
  - Able to build (at least) 6 per year on the various launchers
- **What was the situation after change?**
  - Any customer is able to receive economics of dual launch and all-electric propulsion design
  - Most competitors have now entered into the electric propulsion market



***Satellite industry calling for technology and capability refresh***

# Method and Approach



- **Strategize for Innovation**

- Apply “stretch goals (30% less cost, 50% increase in “production velocity,” >50% performance improvement, etc.)”
- Have the courage to create and introduce new product

- **Build on success – All-electric propulsion is evolutionary**

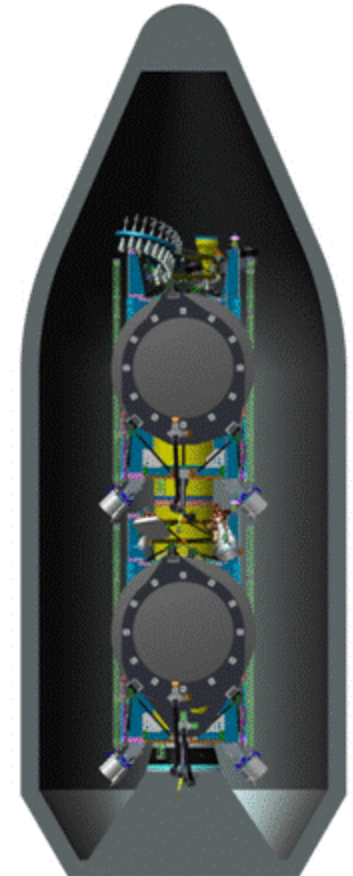
- Took the 702HP from c1999 and “threw off the bi-propellant” to go all Xenon Ion Propulsion (XIPS)

- **Assemble small team (20-25 people) of experienced + early career Hi-Po’s\* to work in a “crucible of innovation”**

- Challenge team outside of comfort zone
- Foster new ideas, drive innovation to get surprising results

- **Strong Executive support**

- “Steering Committee” to review cost/schedule/performance bogies
- Experts for internal non-advocate review, and a constant mission assurance presence



***The result – dual-stacked high-capacity satellites in one launch package***

*\*High-potential employees*

# Assessment of Program Performance

- **Good**
  - Met development cost goals
  - Retired risk of new technologies and processes per the plan
  - Sold 6 customers in 1<sup>st</sup> year of marketing
  - 1<sup>st</sup> pair launched on plan and performing well
- **Challenges**
  - Difficult to find willing partners to align to common build and launch schedule
  - Finding the “sweet spot” of performance, price-point and industry acceptance – delicate balance



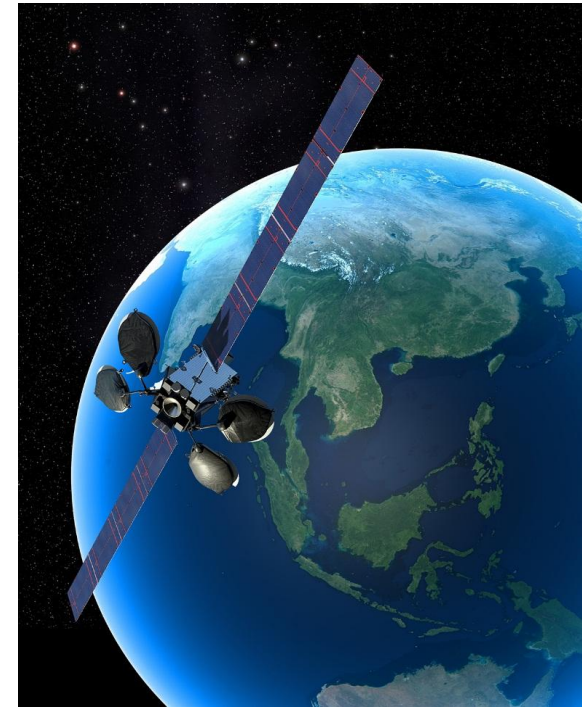
***Successful launch and deployment of two high-value assets in record time***

# Flawless Execution of a New Product Line

- **Four years to develop**
- **Three years from contract to launch**
- **Two satellites on orbit on a single launch**
- **One dedicated and motivated satellite team at Boeing**



1 March 2015



Present Day  
*Times 2!*

# Questions?

