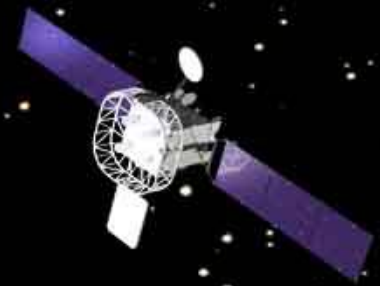
Communications Satellite Program Office (PMW-146)



Managing Requirements to Manage Scope in the Case of MUOS

25 October 2007

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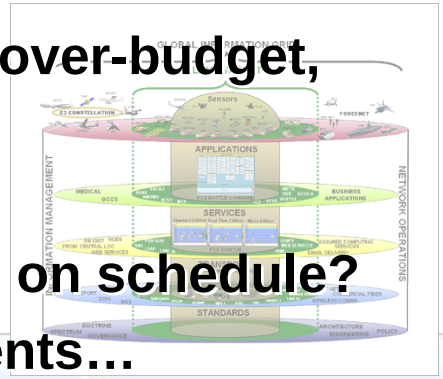
CLASSIFICATION (U)
Classified by: PMW-146

Agenda

- Our Goal for Today
- MUOS in a Nutshell
- Our Challenges
- Our Approach to Requirements Management
- Lessons Learned
- Challenges Ahead

Why We're Here

- **The history of DoD acquisition is littered with over-budget, late and failed projects**



- **Why do projects fail to stay within budget and on schedule?**

  Frequently, the answer is related to requirements…
  - **Requirements that are unachievable from the start**
  - **Poor management of changing and emerging requirements**
  - **Lack of contractor oversight by the acquisition program office**

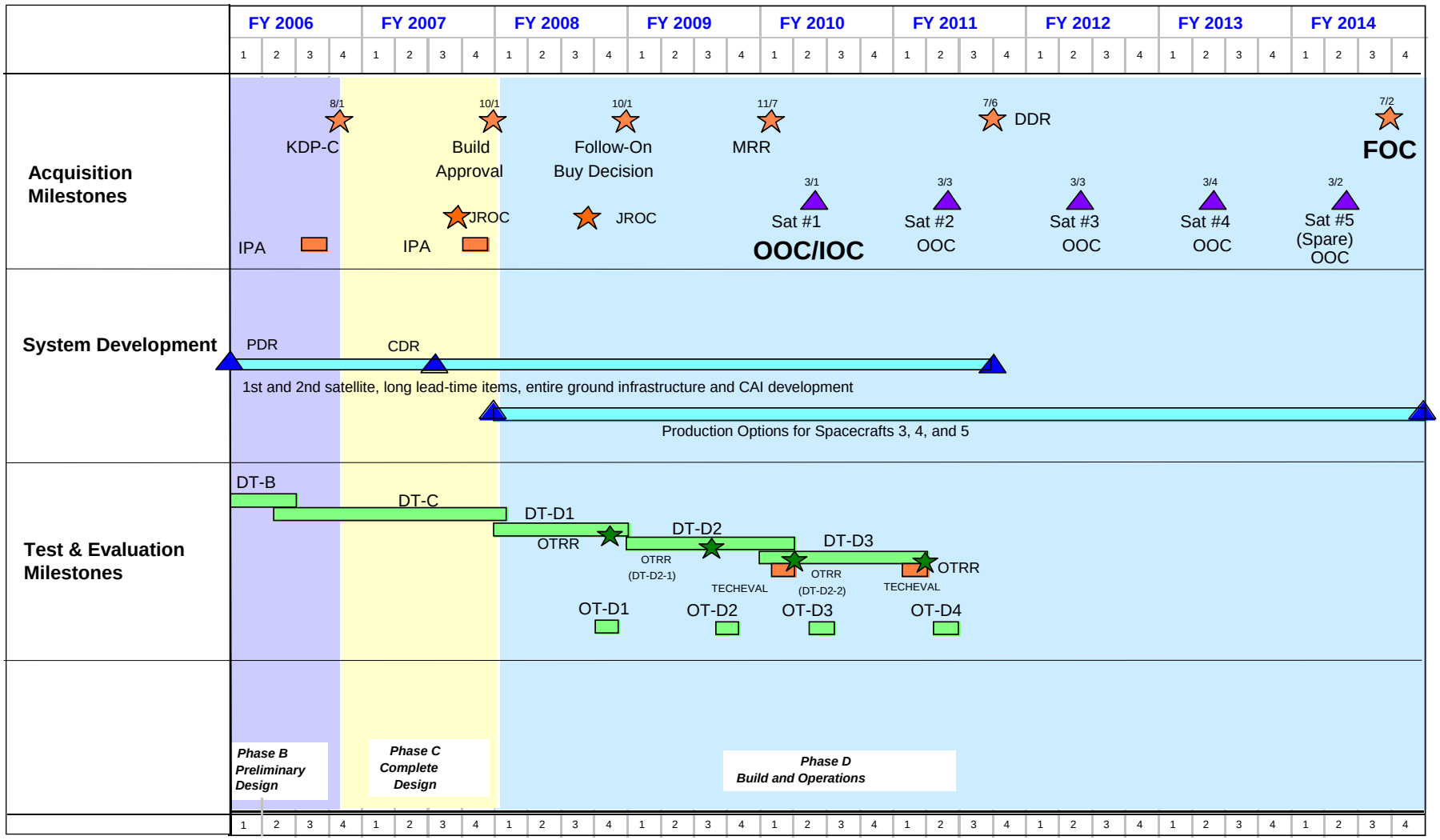
- **Today we will discuss what the MUOS program has done in an attempt to avoid these pitfalls, which we believe has helped the program stay, thus far, on budget and on schedule**

Mobile User Objective System

- A Major Space Defense Acquisition Program
- Tomorrow's Narrowband SATCOM constellation to replace current Ultra High Frequency (UHF) Follow-On (UFO) constellation
  - Will provide 10x legacy capacity and significantly improved availability
  - On Orbit Capability (OOC) in 2010
  - Full Operational Capability (FOC) in 2014
- Critical Design Phase initiated in Nov 05/completed May 07
  - Contract for MUOS Development awarded to Lockheed Martin Team, including Boeing Satellite Systems and General Dynamics
  - Development of MUOS satellites, ground systems, and user terminal waveform
- Key Decision Point (KDP) – C board completed Aug 06

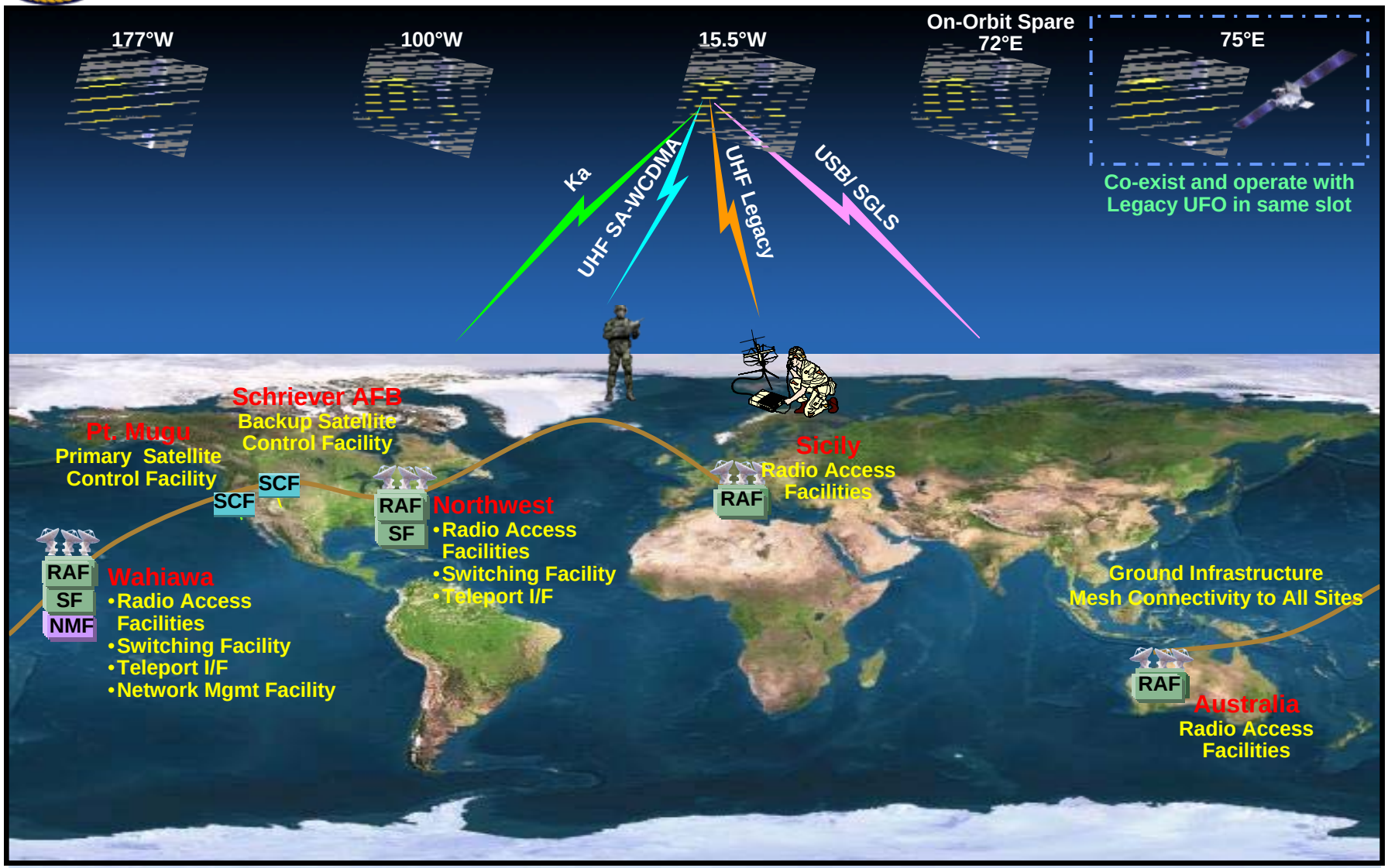
The MUOS program remains on budget and schedule through KDP-C and the critical design phase

MUOS Program Schedule



OOC: 2010 **FOC: 2014**

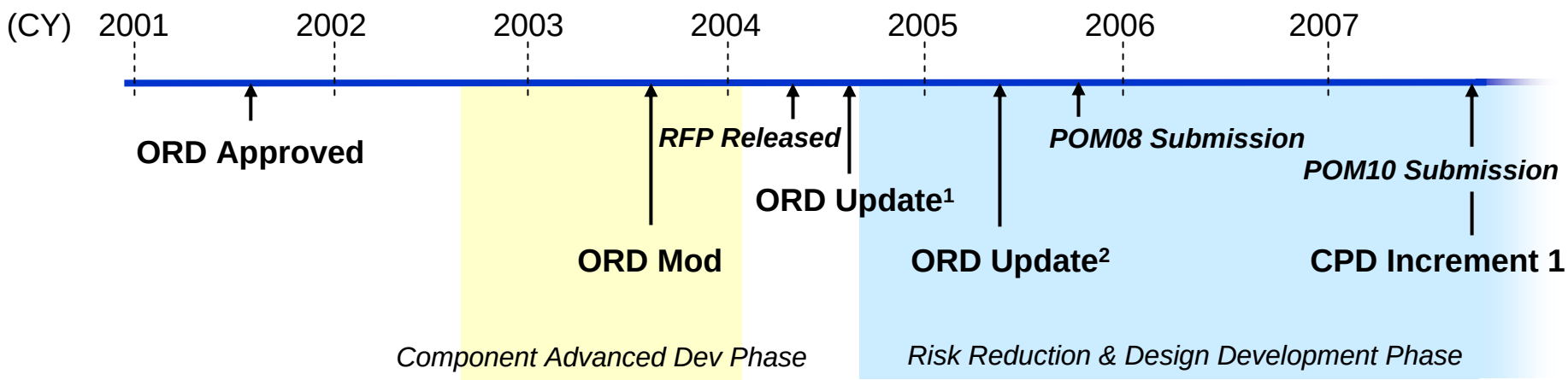
MUOS Architecture



Our Challenges

- Fixed Project Schedule and Budget
  - Aging legacy constellation drives 2010 need date for MUOS capabilities
  - Budget is always limited
- System-of-Systems
  - MUOS is not a stand-alone system
  - End-to-end capability dependent on user terminals (JTRS) and DoD Teleports
- Changing Requirements
  - MUOS ORD has been updated two times since release of contract RFP
- Shifting Strategic Directions
  - Introduction of the Net-Ready KPP
  - Evolution of the Global Information Grid (GIG)
  - Movement toward packet-switched technologies
- Large and Complex Project With a Distributed Team

MUOS Requirements Timeline



[1] MUOS was grandfathered from having to convert to a CDD; this update addressed only non-key performance parameter (KPP) requirements.

[2] This ORD update replaced the Interoperability KPP with the Net-Ready KPP.

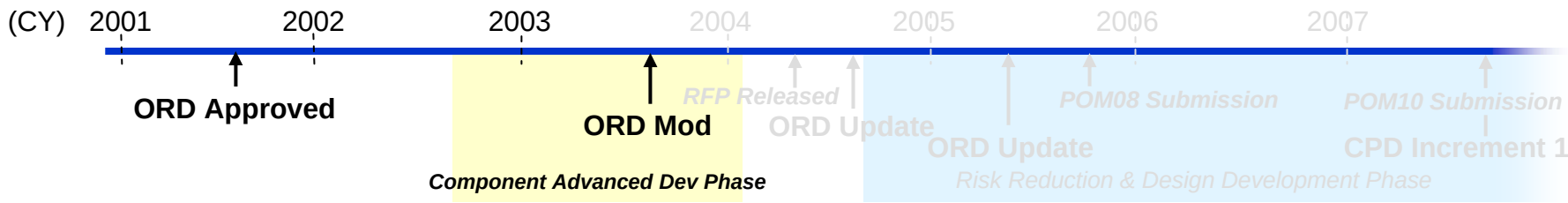
Our Approach to Requirements Mgmt

The Big Picture

- MUOS Program Management is committed to controlling scope
  - Managing requirements is key to controlling scope, but…
  - A degree of flexibility is critical
- Our Requirements Management goes well beyond simply maintaining documents and databases
  - Our team includes technical experts to manage the *content* of the requirements
  - We utilize and customize tools to provide the program office comprehensive insight and oversight of requirements
- Requirements are being managed throughout the program's entire life cycle

Our Approach

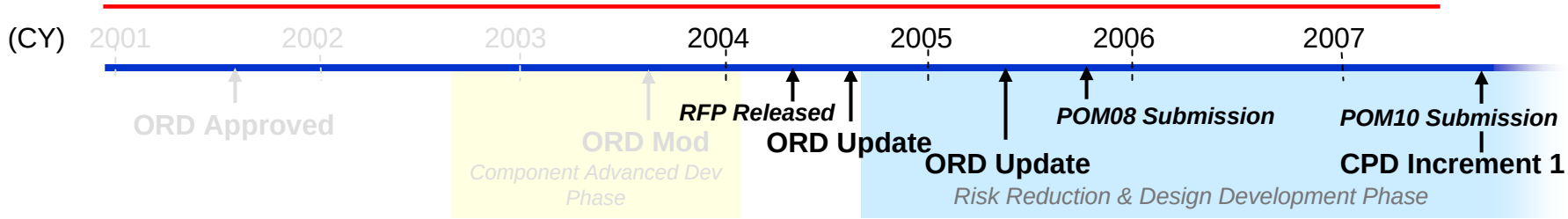
Unachievable Requirements…



- We participated in all early operational requirements meetings with warfighter representatives (COCOMS, services, OSD, etc.)
  - Raised issues with requirements that were deemed to push the limits of technology at the time, which influenced the initial operational requirements (ORD)
- CAD phase was an opportunity for us to further refine the requirements with 2 contractor teams
  - Provided insight into how the requirements were driving the architectures
- As potential architectures matured, we worked with the resource sponsor and user community to address requirements that were significantly impacting architecture designs and costs
  - Successfully reduced 2 requirements (1 a key performance parameter) as a result of both cost as an independent variable (CAIV) and technical feasibility studies

Our Approach

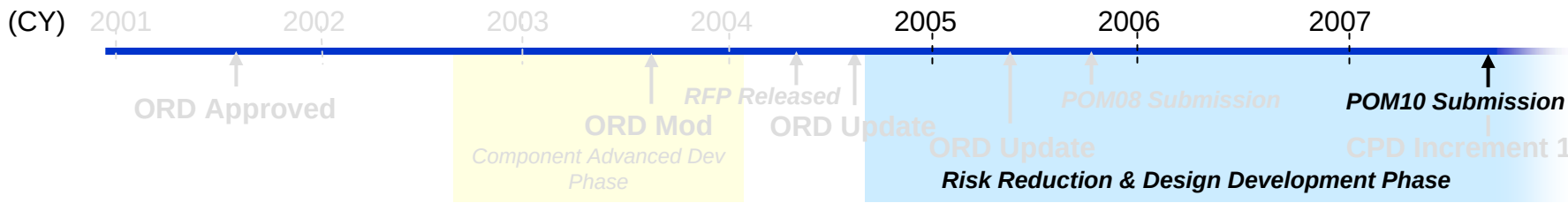
Changing and Emerging Requirements…



- MUOS has successfully managed 2 post-RFP ORD updates
  - Contractor performed impact assessment of new & changed requirements
  - Results allow us to make informed budget, schedule, performance and risk decisions and elevate issues
    - We are allocating requirements to 2 Increments
      - Current capability is documented in the MUOS CPD Increment 1
      - Remaining requirements, when funded and contracted, will go into CPD Increment 2
    - Requesting funds through resource sponsor via POM inputs
- We track applicable policies and DoD directives and work closely with NSA…
  - incorporating derived requirements, when possible
  - raising issues, as necessary

Our Approach

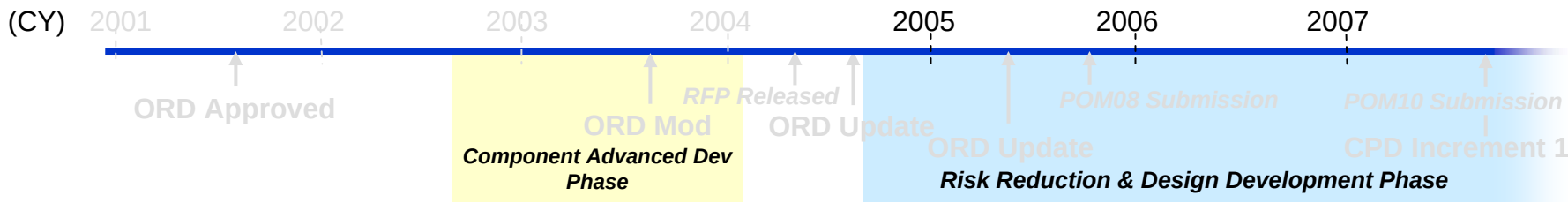
Changing and Emerging Requirements…



- We acknowledge we are part of a system-of-systems
  - We work hard to remain aware of JTRS and Teleport architecture development and changes and address issues as early as possible
    - Established the MUOS Acquisition Council
    - Active Interface Control Working Groups
  - We stay ahead of Net-Centric directives to minimize impacts while making smart decisions – i.e., evolving with our environment within our constraints
    - Example is early decision to change to an entirely packet-switched architecture
- Moving ahead, we continue to communicate with the user community on emerging requirements
  - Conducted meeting with warfighter reps to understand their priorities, which will influence POM10 submission and future allocation of funds

Our Approach

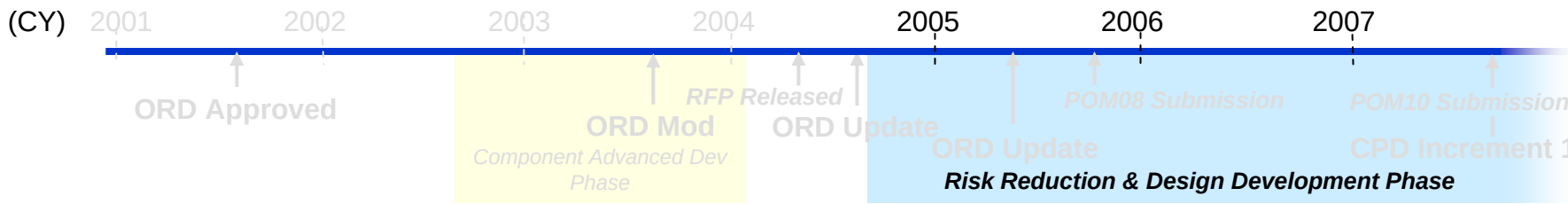
Contractor oversight by the program office…



- We translated the operational requirements into more detailed and testable requirements via the contract performance specification
  - Frequently requested clarifications of the requirements by participating in every ORD meeting, email, phone calls, etc.
  - Involved subject matter experts across the program office team
- We have a very productive relationship with STRATCOM's MUOS representative, ensuring we consider the user's perspective
  - He frequently participates in IPT meetings and attends design conferences
- We continually foster frank and open communications with the contractor
  - Contractor not only requests clarification of requirements, but also…
  - Contractor has proposed refinements to requirements to allow improved design and/or cost savings

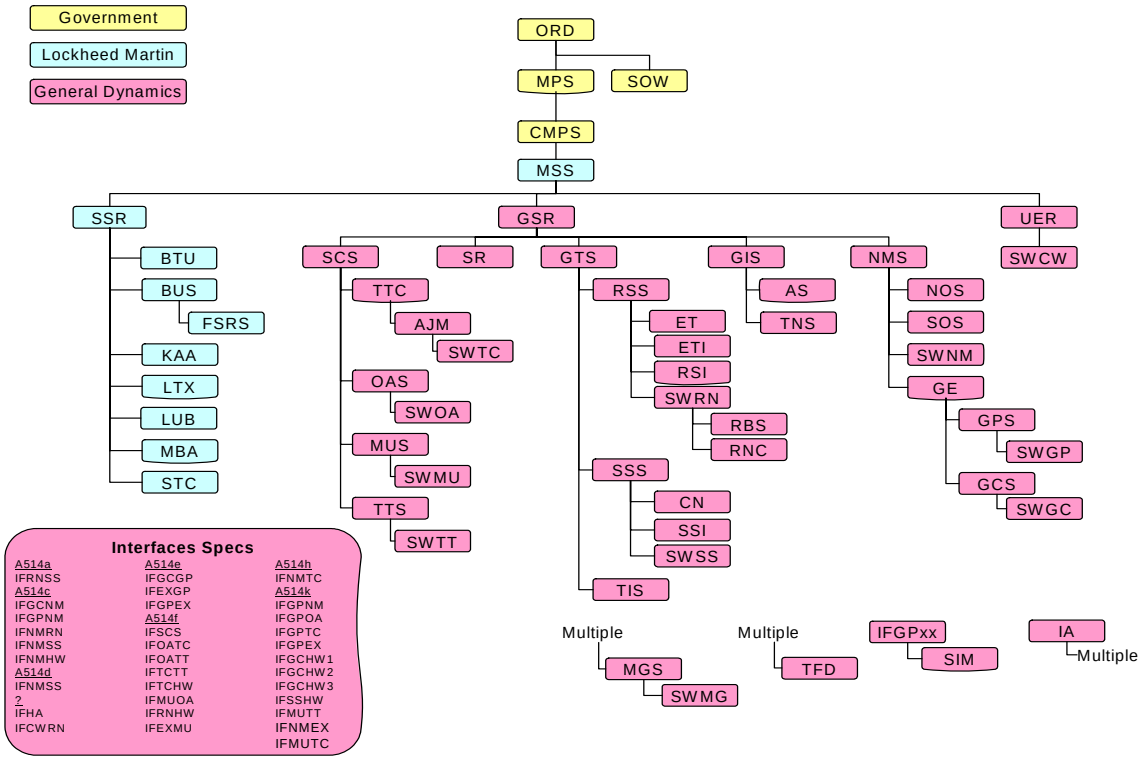
Our Approach

Contractor oversight by the program office…



- We work very closely with the developer to ensure proper treatment of contract requirements
  - Tracking requirements flow and interpretation through all levels of specification: system, segment, subsystem, software and hardware
    - Are contract specifications fully captured?
    - Have extraneous requirements been added?
    - What are the implications of a high-level requirements change or a low-level design change?
  - Strong participation in and oversight of requirement verification plan development
- Tools are key to our processes

Requirements Management Tool
Utilize and Customize



- **Large Program**
  - **160 specifications**
  - **500,000 rqmts**
- **Distributed Team**
  - **3 DOORS databases**
  - **weekly integrations**

→ **21,000 lines of code**

Tools are a must!

Requirements Management Tool
Involve the Requirements Managers

Requirement Managers

- active IPT members
- help the IPTs use the tools

Collaborate to use the tools

Requirements Management Tool
Customized Reports

SWGP/SWGC	CMPS Short text
[SWGP1010] Geo Processing CSCI shall archive received Mission Support Data, including:	**[SYS508], [SYS510]**

1. MUOS epl
2. UFO ephe
3. Deleted
4. IERS data
5. Smoothed
6. active grou

[SWGP1015] requests in ac
Processing Sc
[SWGP1020] archive in acc
Processing Sc
[SWGP1025] results in acc
Software Des
[SWGP1030] between the p
[SWGP2115] receive intern
Appendix B c
Description (r
[SWGP2120] internal comp
Geolocation F
294).
[SWGP1050] two simultane
[SWGP1055] timeline that i
time, stop tim
[SWGP1060] Processing co
[SWGP1065] run a task to p

[MSR8500] MUOS shall require 30% less than the number and type of satellite control and network management and control operations and maintenance personnel required for UFO.

[GSR8500] The MUOS Ground System shall require a staff of 103 or fewer full-time personnel to support full system op

[GT7010] The Ground Infrastr includes the capability for auto provided servers and workstati

[GT7010] The Ground Transp the capability for automatic up and workstations.

[RS7020] Any server, wo Subsystem shall implemen

[RS7021] Any server, wo Subsystem shall implemen software from the NMS.

[SS7044] Servers, and wo implement virus protection

[SWSS1400] Upon in Switching Software sh (MUOS Application S

[MAS1400] Upo MAS shall accept

[SWSS1430] Upon v indication of virus det

[MAS1430] Upo detection to the N

[SWSS1410] Upon in Server), the Switching function from the Netv

[MAS1410] Upo accept configurati Management CS

	A	B	C	D	E	F	G	H
1	Drop Page Fields Here							
2								
3								
4	MOE ID	CMPS All VTEs						
5	[MOE 10-1 (O)]	(blank)						
6	[MOE 10-1 (T)]	TS064 (SPT4-Post-Environmental, N/A,						
7	[MOE 10-2 (O)]	SCS010 (Build 1 (SCS) GS FAT)						
8		SCS050 (Build 1 (SCS) GS FAT, SPT4-						
9		TS120 (Build 2 GS FAT, Build 1 GS FAT,						
10		(blank)						
11	[MOE 10-2 (T)]	SYS620 (Build 1 GS FAT)						
12	[MOE 1-1 (O)]	(blank)						
13	[MOE 1-1 (T)]	(blank)						
14	[MOE 2-1 (O)]	(blank)						
15	[MOE 2-1 (T)]	SYS490 (Build 3 GS FAT, Build 1 UES						
16		(blank)						
17	[MOE 2-2 (O)]	SYS090 (Build 3 GS FAT, Build 1 UES						
18		SYS105 (Build 3 GS FAT, Build 3 GTS						
19	[MOE 2-2 (T)]	SYS090 (Build 3 GS FAT, Build 1 UES						
20	[MOE 3-1 (T)]	SYS574 (Build 3 GS FAT)						
21		SYS580 (Build 3 GS FAT)						
22		SYS582 (Build 3 GS FAT)						
23		SYS588 (Build 3 GS FAT)						
24		UES015 (Build 1 UES FQT)						
25		(blank)						
26	[MOE 3-2 (T)]	SYS052 (Build 2 GS FAT, Component						
27		SYS053 (Component Test (COMP), SPT4-						
28		SYS058 (Component Test (COMP), SPT4-						
29		TS030 (Build 1 GS FAT, Build 2 GS FAT, Build 3 GS FAT, Build 1 UES FQT, SPT4-						
30		(blank)						
31	[MOE 3-3 (O)]	(blank)						
32	[MOE 3-3 (T)]	(blank)						
33	[MOE 4-1 (O)]	(blank)						
34	[MOE 4-1 (T)]	SYS081 (Build 1 GS FAT, Build 3 GS						
35		SYS110 (Build 3 GS FAT)						

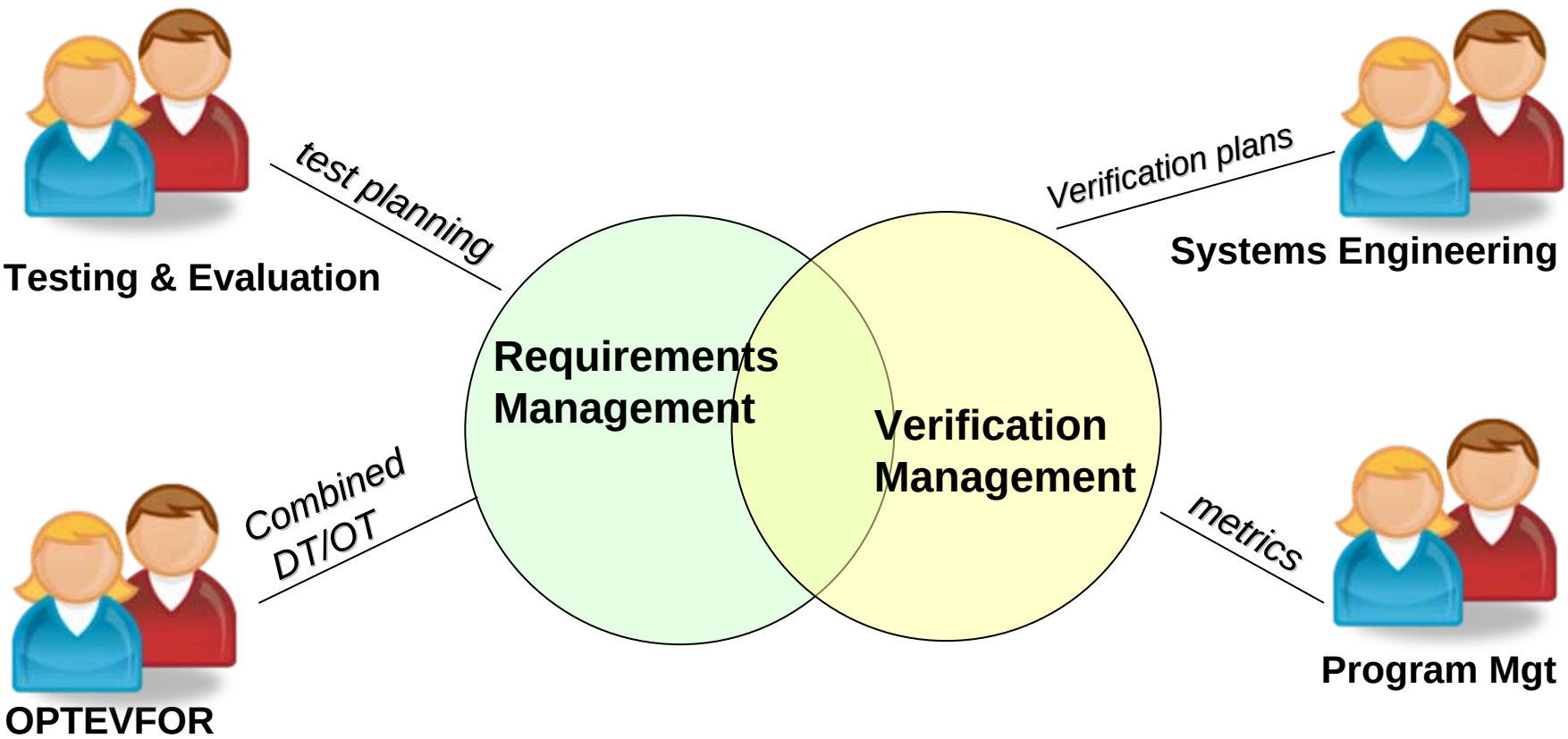
PivotTable Field List
Drag items to the PivotTable report
MOE ID
MOE Requirement
ORD REQID
ORD Requirement
MPS REQID
MPS Requirement
CMPS REQID
CMPS Requirement
CMPS GSS VTEs
CMPS UES VTEs
CMPS STS VTEs
CMPS All VTEs
S-RVP VL
S-RVP VM
Add To
Row Area

MOE-to-CMPS | Raw Data
Ready

- **Tabular traces**
- **Hierarchical traces**
- **Pivot tables**

Customized reports have become a central aspect to the daily management of MUOS

Requirements Management Tool
Customize the Requirements Database



Expanded existing tools to address changing Program office needs

Lessons Learned

- The Positive
  - Program management must be committed to managing project scope, yet have enough flexibility to respond to the changing environment
    - Examples: change to IP technology, evolving interfaces with DISN services
  - Rigorous interaction with the requirements community is crucial
    - Manage expectations by ensuring requirements are feasible, affordable and understood
  - Meticulous oversight of top to bottom requirements is a necessity
    - Tools are essential here: requirements traces, verification pivot tables, etc.
  - Invest in a robust Requirements Management System
  - Foster a cooperative environment that is receptive to change
    - Cooperation among SETA contractors significantly enhances productivity
    - Development contractor suggestions have resulted in many improvements
- Needs Improvement
  - Escalation of process problems
    - At times we wasted months trying to resolve process issues with the developer
  - Coordination with other projects
    - No overarching integrator

Challenges Ahead

- Broader systems engineering issues to keep our large, highly complex project on budget and schedule
  - We're already facing issues that are impacting budget and schedule
    - Technical issues
    - Security issues
- Continued reliance on other projects
  - User terminal developments are well behind MUOS development
  - Teleport funding is out of sync with MUOS development
  - Lack of an overarching integrator increases this challenge
- Dealing with future new requirements
  - New requirements have been proposed
  - We are currently working through a process to address these, potentially developing a CDD for a block upgrade