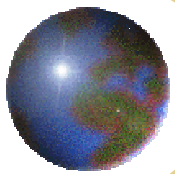


Space Acquisition Strategy – Just How Important is the Ground Segment?

Mary Rich, Steve Lazar, Joe Betser

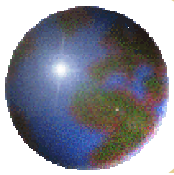
{Mary.A.Rich, Steven.Lazar, Joseph.Betser} @ aero.org

Ground System Architectures Workshop - GSAW 2003
Manhattan Beach, CA, 4-6 March, 2003



Agenda

- Overview
- Differences Between Ground and Space Software
- Ground System Risks
- Ground-Centric Acquisition Strategies
 - Options to Mitigate Risks
 - Evolutionary Acquisition Lessons
- Recommendations



Overview

✚ Space segment - exciting!

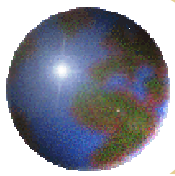
▣ Drives acquisition strategy

- You used to only get one chance
- It's Hardware (we understand that)
- Highest instant cost item

✚ Ground segment – who cares?

▣ Secondary consideration in acquisition strategy

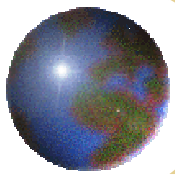
- You can always change it
- It's Software – (I can't see it)
- Higher Total Ownership Cost (TOC)



Ground System Risks (1)

Technical Risks

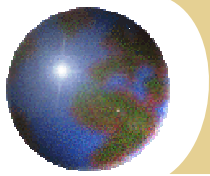
- ❖ Large, complex software intensive system
- ❖ COTS use and integration not adequately planned
- ❖ Many and complex interfaces
- ❖ Lack of architecture requirements and definition
- ❖ Lack of architecture evaluation
 - ❑ Source selection and after contract award
 - ❑ Products and processes



Ground System Risks (2)

Technical Risks continued

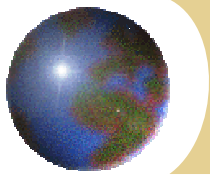
- Lack of complete and stable requirements
 - Operations concept space-centric
 - Vague or lacking Ground operational requirements
 - No user involvement nor prioritization
 - Transition schedule requirements unclear
 - No sustainment concept
 - Space/Ground trades still in work
 - Incomplete security requirements
 - Old security classification guide
 - Lack of program protection plan
 - Detailed legacy requirements not used
 - Lack of flexibility in capabilities/requirements



Ground System Risks (3)

Programmatic Risks

- ❖ Lack of focus on ground
 - ❑ Government and Contractors
 - ❑ Acquisition strategy and RFP
- ❖ Acquisition schedule & strategy often dependent on others
 - ❑ Integration with legacy and other components
 - ❑ Concurrent developments
- ❖ Lack of bottom-up government cost and schedule estimates lead to inaccurate
 - ❑ Program Office Estimate (POE)/Basis of Estimate (BOE)
 - ❑ Reuse potential of legacy components i
- ❖ Budget and POE disconnects
- ❖ Government budget volatility
- ❖ Sustainment of ground element(s) not planned



Software Differences

Ground

More Complex

- Requirements
 - + Functionality
 - + Interoperability
 - + Autonomy
- Architecture
 - + Distributed network
- Integration
 - + More COTS
 - + More external interfaces
- Team
 - + Dispersed
 - + Different Processes

Large

- + 2.0 – 4.0 M SLOC

Space

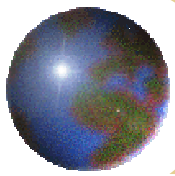
Less Complex

- Requirements
 - + Real-time embedded
 - Payload Specific
 - Reuse bus
- Architecture
 - + Processor constrained
- Integration
 - Standard Bus interfaces
- Team
 - Typically only 1 or 2 teams

Significantly smaller

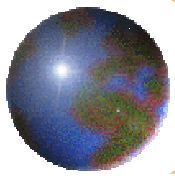
- 0.01-0.5 M SLOC

Ground Software is Highest Risk!



Acquisition Strategies – Options to Mitigate Risk

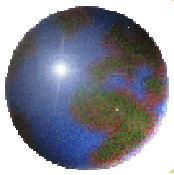
- Sustainment of ground element(s) not planned
- Single full contract for ground and space
- Two parallel contracts: one for space & integration and one for ground
- Single contract for space and add modernized ground to legacy ground sustainment contract
- Three contracts – One for space and integration and two for ground: ground contract will have requirements and architecture definition study phase then downselect
- Study contracts to refine and allocate requirements followed by full/open competition
- Two full contracts – first phase for requirements and architecture definition and then CFI downselect
- Four full contracts – two for space and two for ground. First phase for requirements and architecture definition and then downselect



Acquisition Strategies – When Evolutionary Acquisition Works

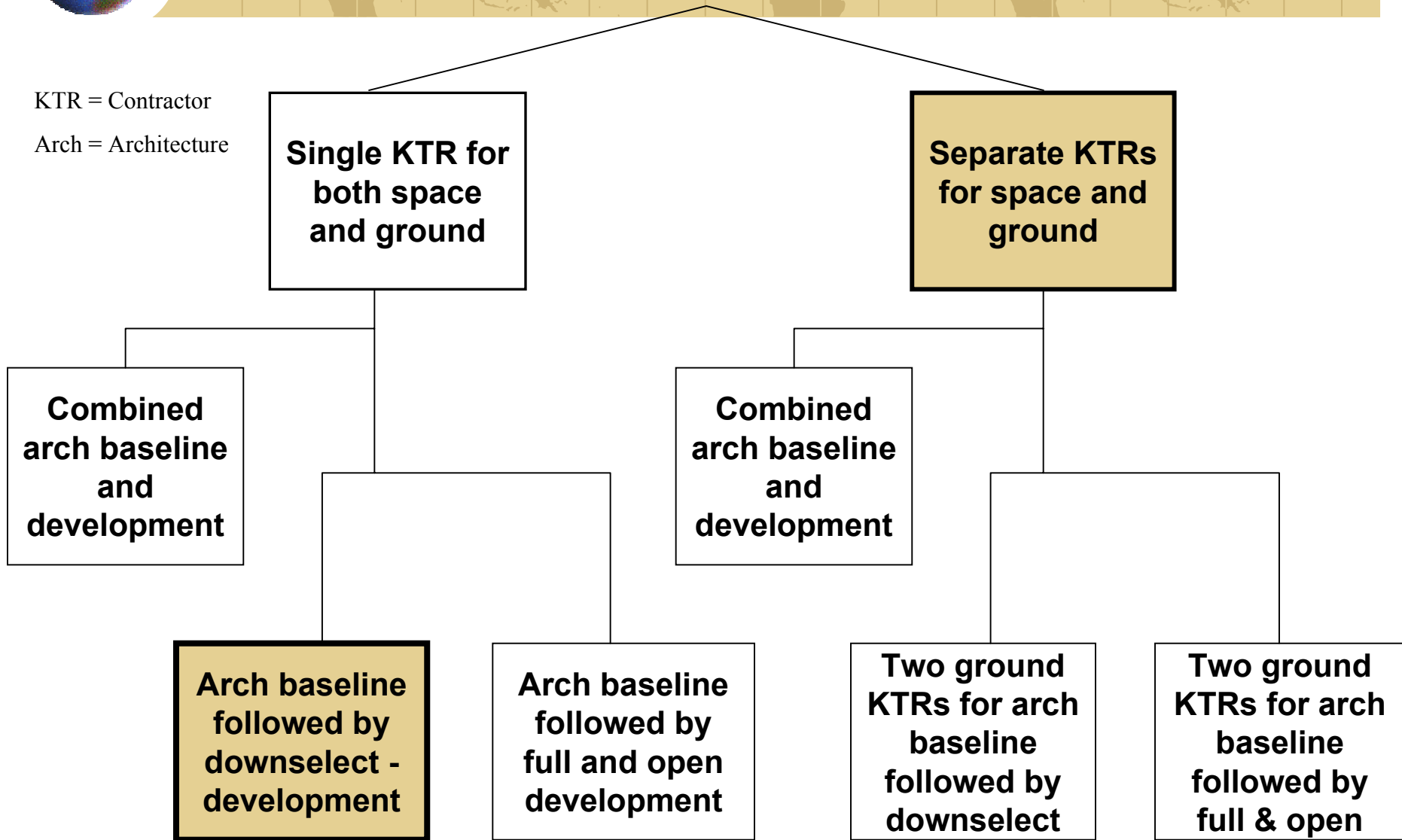
- ❖ Large proportion of commercial technology or reuse
- ❖ Need to shorten technology insertion life cycles
- ❖ Schedule urgency
- ❖ User is flexible when requirements are delivered
- ❖ Budget uncertainty

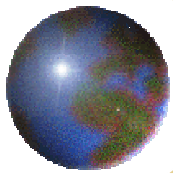
Appropriate for Most Space Ground Systems -
Spreads Risks and Development Costs



Acquisition Option Trade Tree

KTR = Contractor
Arch = Architecture





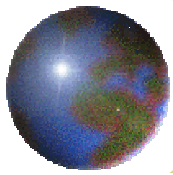
Two parallel contracts: one for ground & one for space and integration

PROS

- Use contractors respective strengths
- Increased competition
- Reduced ground risks: awards to most capable contractor
- Incentivizes space/ground contractors appropriately
- Model successfully used by commercial space

CONS

- Increased SPO requirements
 - PM & integration roles
 - Ground/space allocation
- Increased potential for space/ground contractor misalignment
 - RFP/contracts need to be well defined and flexible
 - Ensure cooperation in Interface definition, design, test, database calibration, etc
 - High potential for ECP to ground after contract award
- Reduced cost/schedule confidence
- Space contractor may lack integration capability



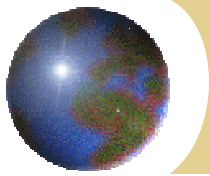
Two full contracts – first phase for requirements and architecture definition, then downselect

PROS

- Design before you buy
- Prolonged competitive phase will result in contractors 'best' ideas
- Requirements on contract
 - High cost/schedule confidence
- Reduced cost risk
- Better ground space trades

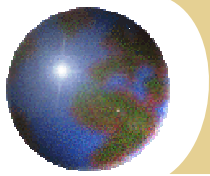
CONS

- 2 Source Selections (1 mini)
- ~1 year added to schedule
- Added SPO resources
- Best value determination process needs to be clearly defined during competition
- Additional cost for second phase 1 contractor



Impacts of Evolutionary Acquisition

- Complete, up-front program plan not possible
 - User willing to accept system installments
 - Acquirers/Budgeters accept ambiguity
- Significant User involvement in all phases
 - User must lead formalized spiral definition process
 - Continuous management of user expectations
- Evolutions will not be totally defined by prioritized requirements
 - Minimal interdependencies
- Flexible requirements process
- Program documentation structured to support spiral definitions
 - especially requirements, test, and training
- Modifiable, extensible architecture



Recommendations

✚ Every Acquisition Team Must

▣ Thoroughly Define All Risks

- Ground AND Space for Government/User AND Contractor
 - **Ground is Highest Risk!**

▣ Minimize Risks Through Acquisition Strategy

- Detailed Pro and Con for Option Selection
- **Implement Lessons Learned from Evolutionary Acquisitions**
- Have Accurate and Flexible Cost and Schedule Baselines
- Select Best Software Contractor Team
- Have Effective Architecture Requirements
 - Definition through Evolution
- Emphasize architecture in RFP Section L, Section M, and include architecture related documents in CDRL

▣ Continue to Manage Risks after contract award