

**Ground Systems Architecture Workshop 2003**

# **NASA Ground Network Evolution**

## **Designing for Best Value**

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NASA Ground Networks Program Executive

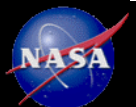
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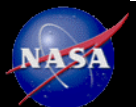
- ▶ **Introduction to the “GN”**
- ▶ Challenges and opportunities
- ▶ Experience with best value management
- ▶ Evolution options



# Ground Network (GN) Project overview

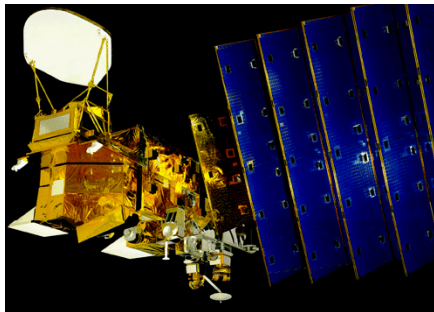
- ▶ **GN is customer driven**
  - Provides ground-based space communications for NASA missions
  - Provides reliable services to meet customer requirements
- ▶ **GN evolution goal is to provide best value service**
  - Manage costs to avoid large capitalization
  - Maintain minimum GN Project civil servant staffing
  - Balance long-term stability and flexibility of ground network capacity
  - Maintain high performance and reduce risk

GN Project Overview	
Enterprise	Earth Science
Program Executive	Mr. Bill Watson
Project Manager	Mr. Roger Clason
Lead Center	Goddard Space Flight Center (GSFC)
Performing Centers	GSFC, Wallops Flight Facility
Program Type	Space Communications Services
Authority	Space Communications MOA approved by NASA Enterprises September 2002



# The GN provides services to a diverse customer set

GN Customer Diversity Examples				
Organizations	Phases	Orbits/Trajectories	Frequency	Service Needs
<ul style="list-style-type: none"> <li>▶ NASA</li> <li>▶ Other Government</li> <li>▶ International</li> <li>▶ Commercial</li> </ul>	<ul style="list-style-type: none"> <li>▶ Launch</li> <li>▶ Early Orbit</li> <li>▶ On-orbit</li> <li>▶ Disposal</li> </ul>	<ul style="list-style-type: none"> <li>▶ LEO Polar</li> <li>▶ LEO low-inclination</li> <li>▶ GEO</li> <li>▶ Launch</li> <li>▶ Sub-orbital</li> </ul>	<ul style="list-style-type: none"> <li>▶ X-Band</li> <li>▶ S-Band</li> <li>▶ L-Band</li> <li>▶ VHF</li> <li>▶ UHF</li> <li>▶ C-band</li> </ul>	<ul style="list-style-type: none"> <li>▶ Telemetry</li> <li>–Housekeeping</li> <li>–Science Data</li> <li>▶ Commanding</li> <li>▶ Tracking</li> <li>▶ Range support</li> </ul>



**EOS Aqua**

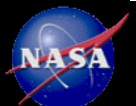


**Shuttle Launch**



**Ultra Long Duration Balloon**

Images obtained from: <http://eos-pm.gsfc.nasa.gov/>, <http://www-pao.ksc.nasa.gov/kscpao/captions/100missions/sts-106.htm>, <http://www.wff.nasa.gov/~code820/>



# The GN has developed into a complex heterogeneous system

- ▶ 50 ground station antennas;  
30 unique antenna systems
- ▶ 7 geographic antenna locations
- ▶ 4 different owner/operator models
- ▶ Numerous IDIQ contracts for additional commercial services as needed
- ▶ Scheduling of all orbital-support antennas performed from one location

GN Antenna Map (Number of Antennas)



## Primary Support Category

- Orbital S-Band
- Orbital X-Band
- △ Range
- ⊕ Shuttle
- ◇ Scheduling

## Owner/Operator Model

- # NASA/CSOC
- # NASA/university
- # NASA/commercial
- # Commercial



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- ▶ **Challenges and opportunities**
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# GN risk and cost challenges influence evolution options

## ▶ Challenges to GN system performance

- Aging systems increase risk to service performance
- Mission-driven non-standard interfaces and hardware limit interoperability
- Flat budget limits options for upgrades or new systems

## ▶ Challenges to GN system cost

- Maintenance needs for aging and heterogeneous systems
- Manually intensive systems
- Mission unique equipment
- Systems with low utilization



# Customer trends motivate and challenge evolution planning

## ▶ Future customer need predicted to change

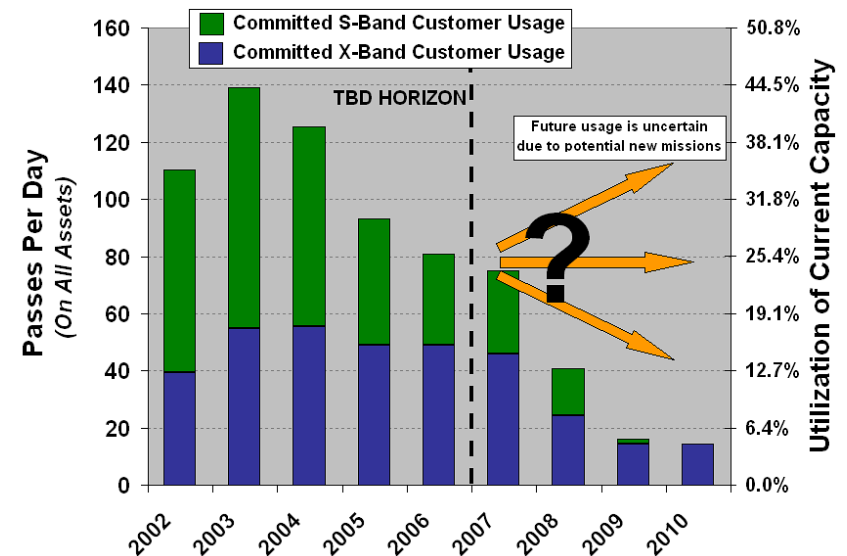
- GN S-band missions “flying out” with few new customers in short term
- X-band requirement through 2010 for Earth Observing System (EOS)
- Other mid-term high-rate missions planning to use other networks

## ▶ GN usage level uncertain beyond ~2007

- Far-term mission plans not yet developed
- Potential for large fluctuations due to possible constellations

## ▶ GN cannot afford overcapacity

## ▶ Must obtain flexibility in capacity



### GN Currently has Capacity to Support:

- More than 275 passes/day on NASA owned antennas
- 40 passes/day minimum on commercial contracts





# Community trends may enable opportunities for coordination

## ▶ NASA

- Shared support between NASA Space Network and GN will probably increase
- Some overlap in functionality between GN and DSN on Earth-orbit support

## ▶ NOAA

- Ample X- and S- band contingency capacity
- SafetyNet (NPOESS Ka-band architecture) planned to be operational in 2009

## ▶ DoD

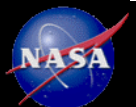
- Exploring interoperability with other government satellite control systems
- Exploring Transformational Communications for the long term

## ▶ Commercial

- Some providers maintain business viability in niche markets
- Other providers rely on NASA as their cornerstone customer while they seek to develop a broader market

## ▶ Partners

- Some NASA missions will continue to receive ground network services from University and International partners



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# Experience with best value management

- ▶ **NASA will continue to rely on GN services**
  - Space based systems do not fulfill all needs
  - GN can be preferable in certain tradeoffs of cost, mass, and power
- ▶ **Commercial services can provide benefits**
  - Utilization of commercial services enables evolution while maintaining flat budget
  - Commercial services can allow the GN to only pay for what it uses
- ▶ **Commercial services can be effective, but active risk management is crucial**
  - Government visibility into contractor processes is needed for effective risk management
  - Performance metrics should evaluate contractor risk management and mitigation processes in addition to past performance



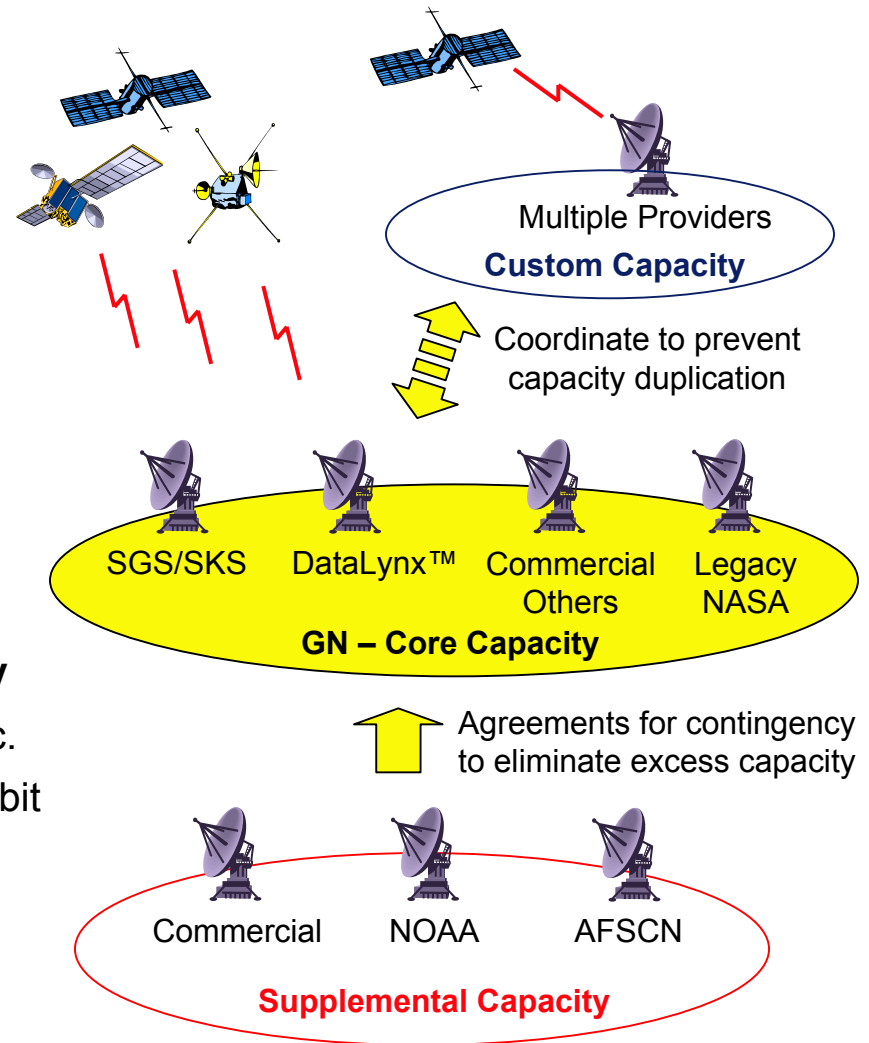
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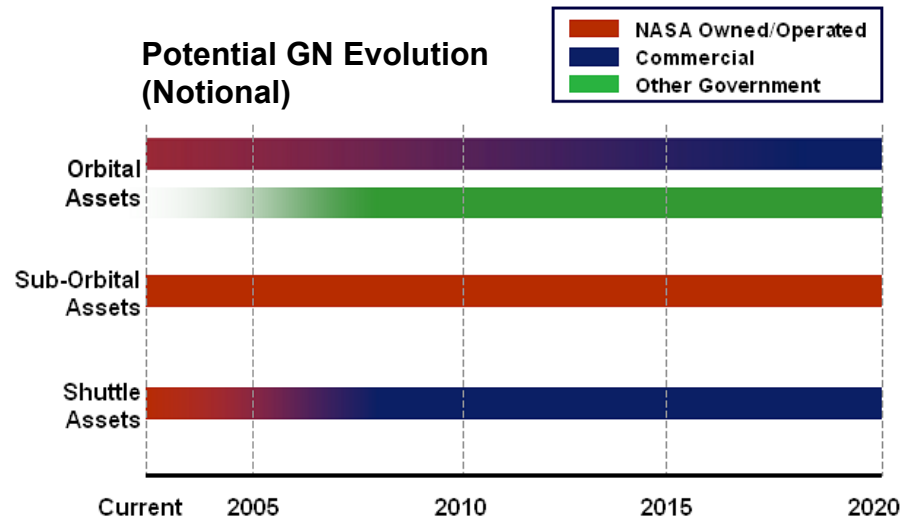
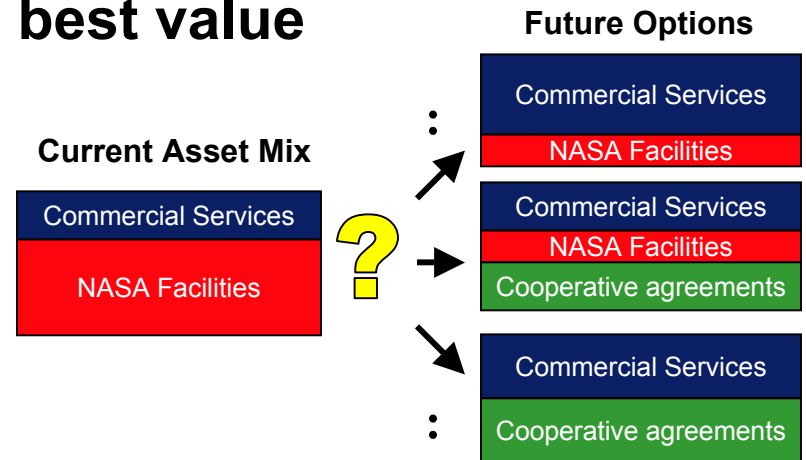
# Architecture Vision: Flexible, reliable, and competitive

- ▶ **GN provides core capacity**
  - Multi-mission shared capacity
  - Focus on mission requirements
  - Heavy reliance on commercially owned/operated systems
- ▶ **GN coordinates on custom capacity**
  - Mission-unique capabilities that GN cannot effectively provide
- ▶ **GN diversifies with supplemental capacity**
  - Partner with NOAA, DOD, commercial, etc.
  - Provides contingency, launch and early orbit support, and backup



# GN evolution options will focus on best value

- ▶ **NASA will play an active role in managing the GN**
  - Manage contracts and budget
  - Insight into contractor processes to enable risk management
  
- ▶ **General shift from NASA assets to commercial and cooperative**
  - Implementation decisions based on business case merit
  - Performance metrics to assess “future preparation” in addition to past performance



# Conclusion

- ▶ The GN is a heterogeneous system that supports many diverse customers
- ▶ Evolution planning is addressing GN risk and cost challenges
- ▶ With specific contract rules, commercial services can be effective and beneficial
- ▶ GN evolution planning will examine cooperation with commercial and government entities
- ▶ GN evolution implementation will be based on best value business cases

