StellarXplorers

Sample Scenario #1
Mission Requirements
"I Want My NBC!"

The Air Force Association

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Sample Exercise #1 Synopsis

Teams will be required to develop a mission orbit for a satellite to relay television signals between the NBC Control Center in New York City and the NBC studios in Los Angeles. Teams whose orbit successfully relays significant amounts of video data between the two cities will achieve high scores in this exercise.

Disclaimer: Information in this briefing was developed specifically for use during the StellarXplorers Challenge Summer Exercise. Although some information was collected from publically available sources, any similarity between items in this presentation and real world events is purely coincidental.

Mission Briefing

Network Video Relay

The Situation:

The National Broadcasting Company (NBC) is a commercial broadcast television and radio network. Founded in 1926 by the Radio Corporation of America (RCA), NBC is the oldest major broadcast network in the United States. The network is headquartered in the Comcast Building at Rockefeller Center in New York City, with additional major offices near Los Angeles at Universal City Plaza. NBC is sometimes referred to as the "Peacock Network", in reference to its stylized peacock logo, which was originally created in 1956 for its then-new color broadcasts and became the network's official emblem in 1979.

The major broadcast networks use geosynchronous satellites and ground-based fiber-optic links to ship their video signals across the nation. However with the advent of high-resolution video and the increased internet traffic caused by video on-demand networks such as Netflix and Hulu, these traditional long-haul data relay systems are reaching saturation. Without a significant increase in the capacity of these systems, the national broadcast networks may be unable to make their television programs available to the public.

Recognizing this potential problem, NBC is experimenting with using a low-cost relay satellite as a backup system to their traditional long-haul systems. This would be a low-cost spacecraft placed into low-earth orbit which could, on an as-needed basis, ship network programs between its studios in Los Angeles, California to its Network Control Center in New York City, NY. If this experiment verifies the feasibility of this concept, NBC will consider establishing a network of such satellites to provide a reliable backup to their main long-haul communications systems.

The Comcast Building at 30 Rockefeller Center is the headquarters of NBC, the New York facilities of NBC Studios, and NBC Universal Cable. The building's studios include Studio 8H, the home of Saturday Night Live. Studio 8H was once the largest radio studio in the world. It was converted into a television studio in 1950. The Tonight Show was also taped in Studio 6-B until 1972.

On the West Coast, NBC's network operations are located in the Brokaw News Center in Universal City, Los Angeles, California. The Brokaw News Center houses the West Coast operations of NBC News, CNBC, MSNBC and Telemundo News, plus the local Los Angeles television station, KNBC. The technologically advanced facility include four newsroom facilities; six production studios; state-of-the-art audio and video production systems to create news and entertainment programming on-air and digitally; and 40 satellite feeds monitored simultaneously. More than 600 people work out of the news center.
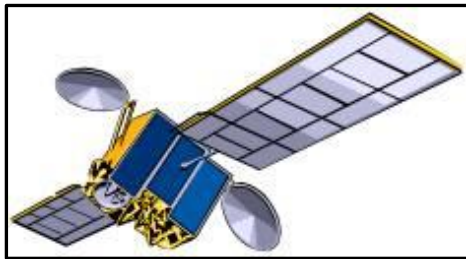
To test the ability to ship video data back and forth from Rockefeller Center to the Brokaw Center, NBC has selected the New Vision Space Systems Company of Huntington Beach, California to build a small, low-cost, high-capacity relay satellite that can be placed into a low earth orbit using a small launch vehicle. Utilizing state-of-art electronic systems, New Vision has designed and built the spacecraft and has named it **Peacock** in honor of the colorful NBC logo.

New Vision has hired the Venture Forth Rocket Company of Newport News, Virginia to launch to launch **Peacock** on their *Kratos* launch vehicle. *Kratos* is a small-class, three-stage launch vehicle capable of placing a 1,500 kilogram payload into low-earth orbit. Launching from the Mid-Atlantic Regional Spaceport, located on the Eastern Shore of Virginia, *Kratos* can place **Peacock** into any orbit between a 38° and a 60° inclination. The **Peacock** spacecraft weights 1,436 kilograms, so the maximum altitude that the *Kratos* launch vehicle can place the satellite is 5,000 kilometers. The minimum operational altitude for **Peacock** is 250 kilometers due to concerns with atmospheric drag disturbing the orbit.

New Visions Space Systems has hired your team to determine the best orbit to place **Peacock** that will provide the most opportunities to relay video data between New York City and Los Angeles.

The Task:

Select an orbit equal to or less than an altitude of 5,000 kilometers that provides the most continuous line-of-sight contact between the NBC studios in Los Angeles and NBC Headquarters in New York City over a fourteen day span.

To perform its relay mission, **Peacock** must be within direct line-of-sight of the Rockefeller Center and the Brokaw News Center underlinesimultaneously. The antenna on top of the Comcast Building in New York is located at 40° 45' 32.83" N; 73° 58' 46.20" W at an altitude of 260 meters. The antenna supporting the Brokaw Center in Los Angeles is located at 34° 08' 28.9" N; 118° 20' 46.5" W at an altitude of 147 meters. To determine the effectiveness of the selected satellite orbit, the team must evaluate satellite-to-ground station performance during the period from July 1, 2016; 0000 UCTG to July 15, 2016; 0000 UCTG.

Teams must calculate the access times between **Peacock** and each of the ground stations: 30 Rockefeller Center & Brokaw News Center. They must then determine when **Peacock** is within line-of-sight of **both** locations.

The satellite can be launched into any orbital inclination between 38º to 60º with orbit altitudes between 250 and 5,000 kilometers.

To reduce the workload on your team, the StellarXplorers Staff has provided an STK VDF file (NBCSat.vdf) that contains many elements of the scenario preloaded. The STK file includes the following data:
- Scenario Timeline (July 1, 2016, 00:00 UCTG to July 15, 2016, 00:00 UCTG)
- Comcast Building at Rockefeller Center (**30Rock**) Location
- Brokaw News Center (**Brokaw**) Location
- **Peacock** Satellite in Orbit (250 kilometers X 250 kilometers, 38º Inclination)

Team will not need to load these items into the STK scenario. Just click on NBCSat.vdf to launch STK and begin your evaluation.

SUMMARY:
The National Broadcasting System is pioneering an alternate method of shipping their networking programs across the nation. Let's find the best orbit to support this ground-breaking concept. Good luck!

Team Data Presentation

At the end of the exercise, each team will produce the following information for the **Peacock** spacecraft:

1. An STK VDF file with the team's final solution.
   Note: Teams must save the VDF with the following unique file name: STLX_Sample_Scenario_1_STLX04-0xxx.vdf where "xxx" is replaced with the team's number, i.e. STLX_Sample_Scenario_1_STLX04-0123.vdf

2. Mission Orbital Elements in text format containing the following data:
   a. Semi-Major Axis (in kilometers)
   b. Eccentricity
   c. Inclination (in degrees)
   d. Argument of Perigee (in degrees)
   e. Right Ascension of the Ascending Node (in degrees)
   f. True Anomaly (in degrees)
   g. Orbit Epoch (in UTCG)

During a competition round, the Staff would use the team's vdf file to score their solution and to verify that none of the **Peacock** altitude restrictions for Apogee, Perigee or Inclination were violated. If a violation is discovered, the staff would enter the correct altitude or inclination limitation and rerun the scenario, the team would receive a **5% penalty** deducted from their scenario score.

An example of the required document is shown in Appendix I of this package.

Teams will be provided a blank template for the document.

StellarXplorers Practice Scenario #1 Scoring

Teams will receive a score in this exercise based on their ability to relay video data between New York and Los Angeles using the **Peacock** spacecraft.

Mission Orbit Determination Data

Each team will be evaluated on their ability to provide **Peacock** relay coverage between New York City and Los Angeles from the start of July 1, 2016 until the end of the day on July 14, 2016. During this 14-day period, NBC needs the most relay coverage possible. Teams will receive one point for every 35 minutes of relay coverage. The score will be based on total coverage time achieved. For example: if a team relays data for 3,256 minutes over the 14-day period, they would score 93.029 points. (3,256 ÷ 35)

Final Score

The team's final score will be based on the total number of points accumulated from their Mission Orbit.

Appendix I

StellarXplorers
Practice Scenario #1
Mission Orbital Elements

Team: STLX04-1234

Organization: Smallville High School

a.	Semi-Major Axis:	6778.14	Kilometers
b.	Eccentricity:	0.0147533	
c.	Inclination:	28.54	Degrees
d.	Argument of Perigee:	15.32	Degrees
e.	RAAN:	85.1	Degrees
f.	True Anomaly:	132.25	Degrees
g.	Orbit Epoch:	1 Dec 2017 00:00:00.000	UTCG