



NORTHROP GRUMMAN

DEFINING THE FUTURE

Small Satellites Working Together
to Accomplish **Big** Missions

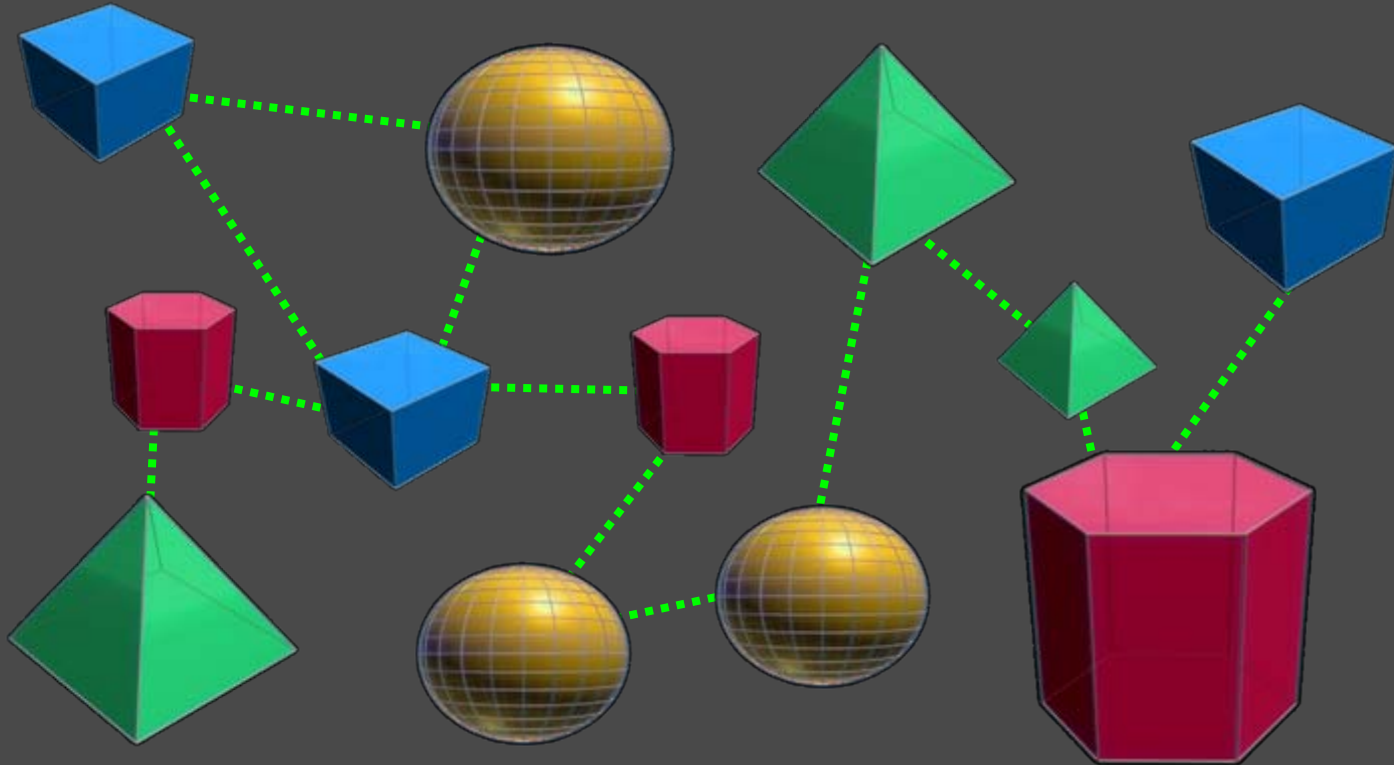
2008 Cubesat Conference
April 10

Hobson Lane
Sr. Systems Engineer

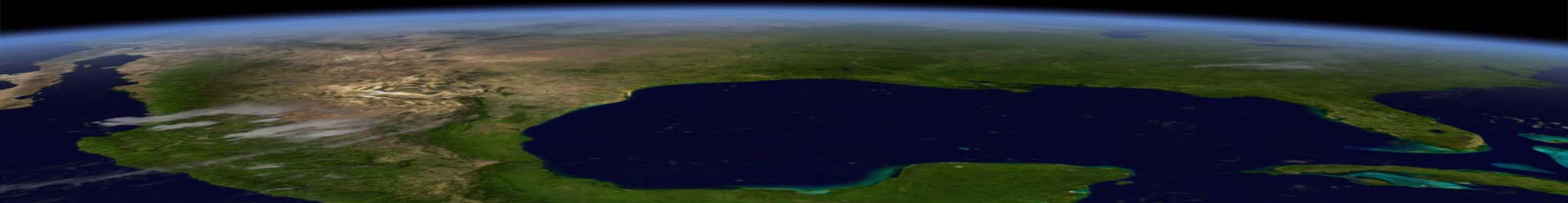
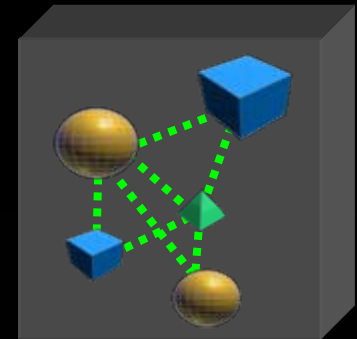
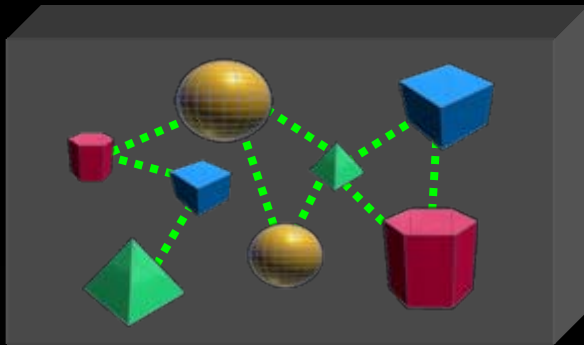
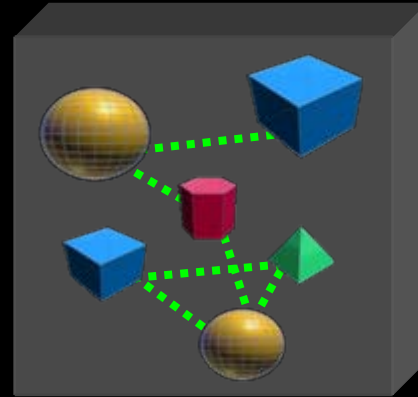
Spacecraft are Evolving



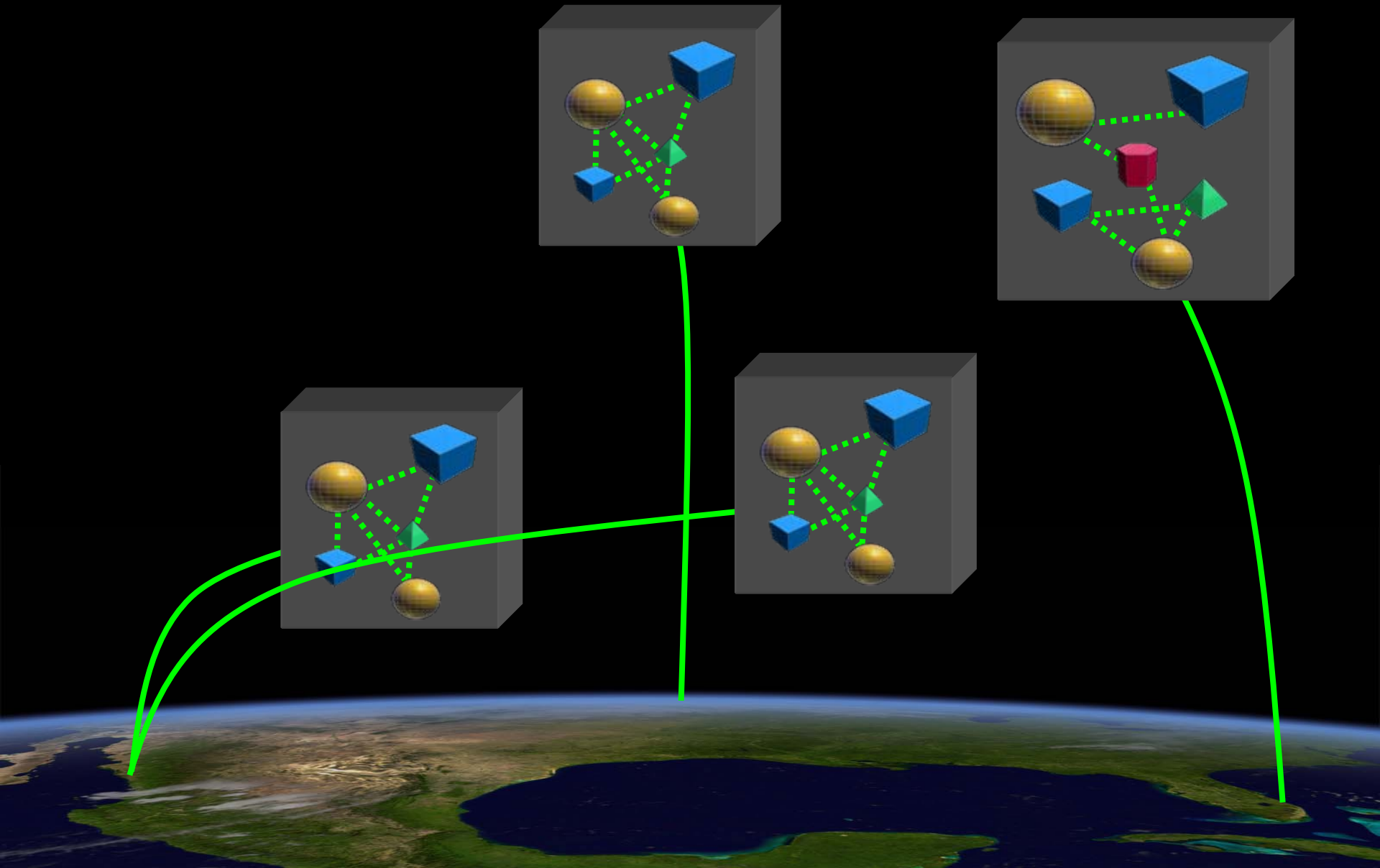
People want Larger Systems...



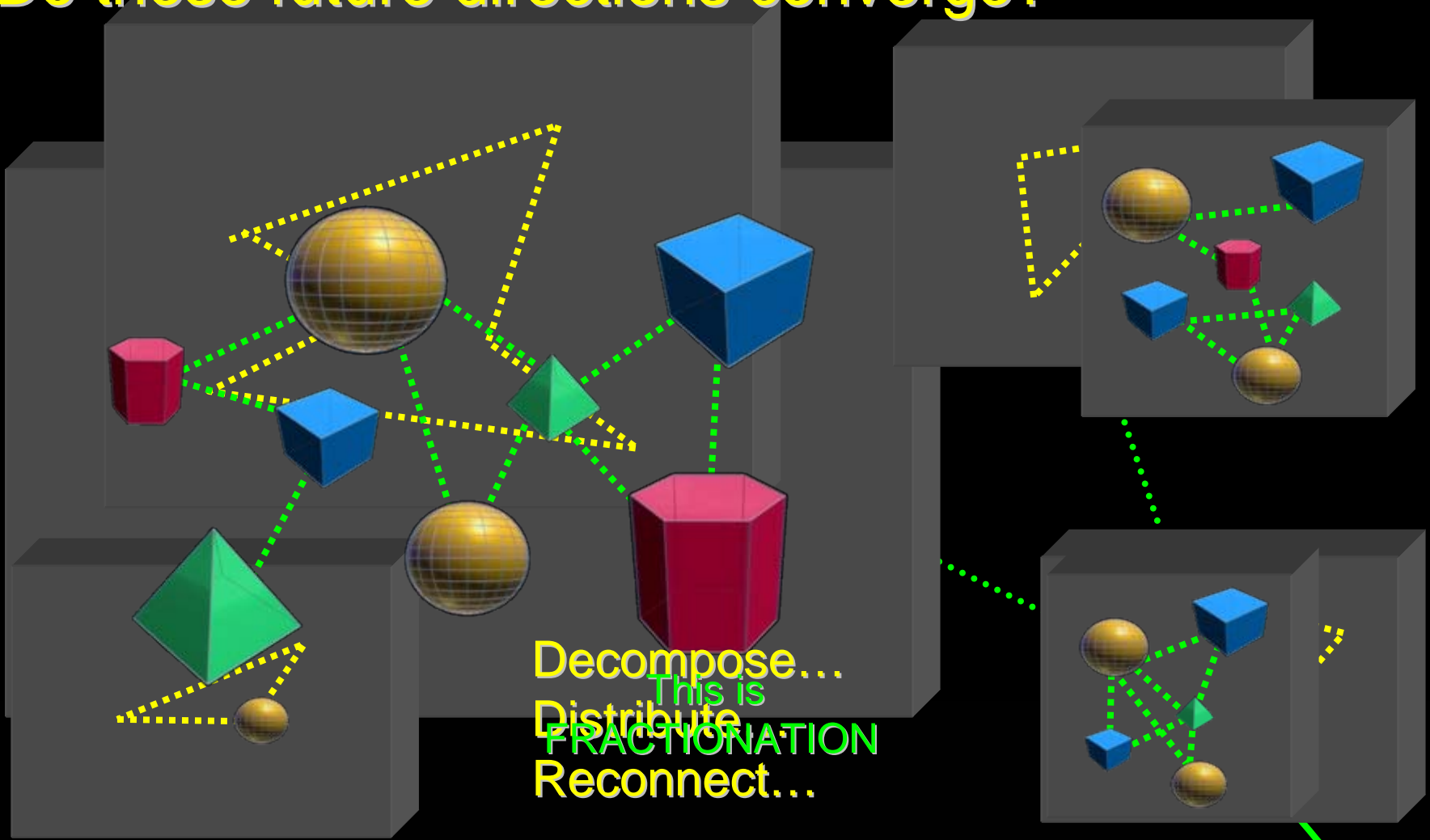
People want Smaller Satellites...



People want faster deployment...



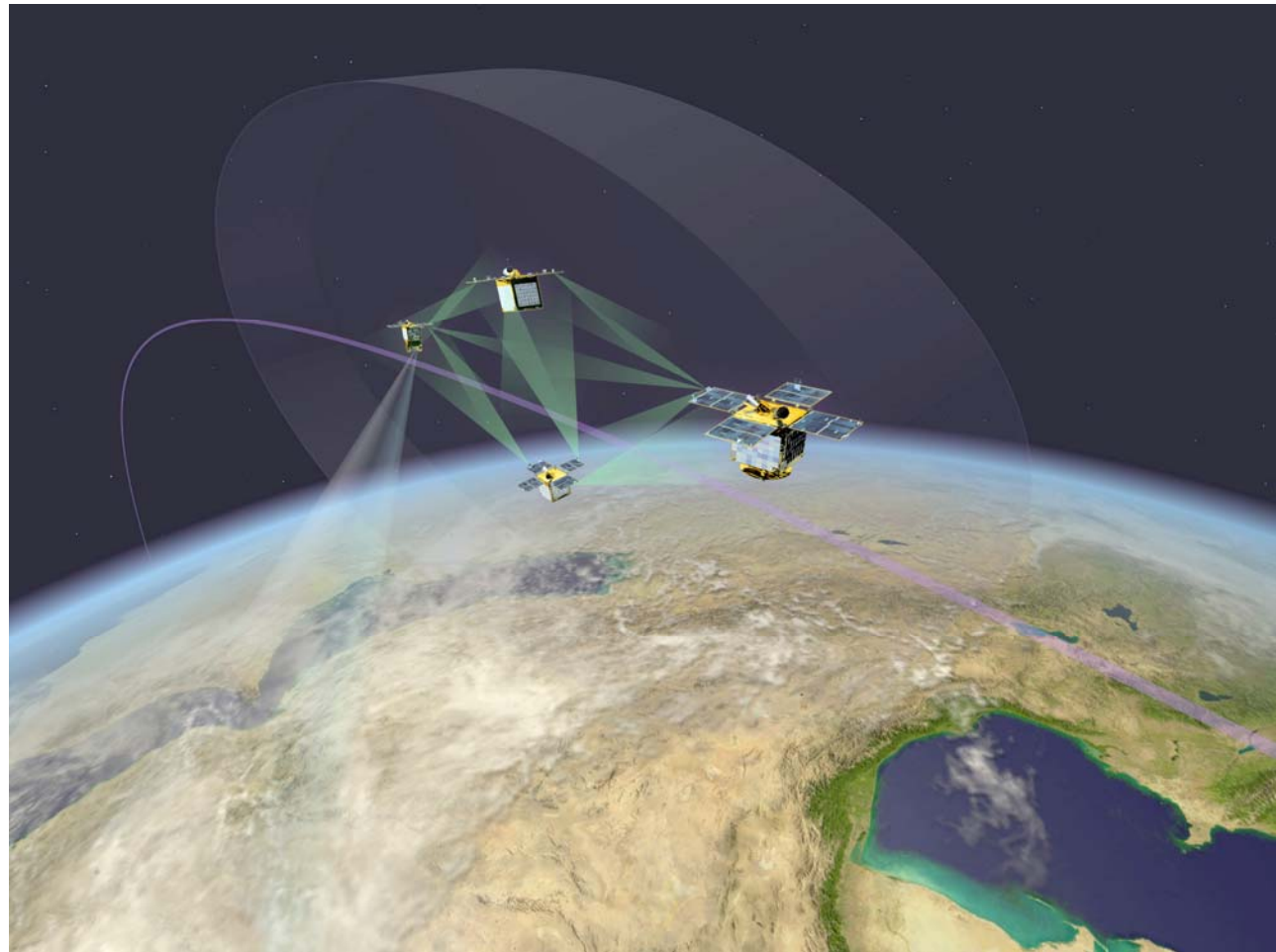
Do these future directions converge?



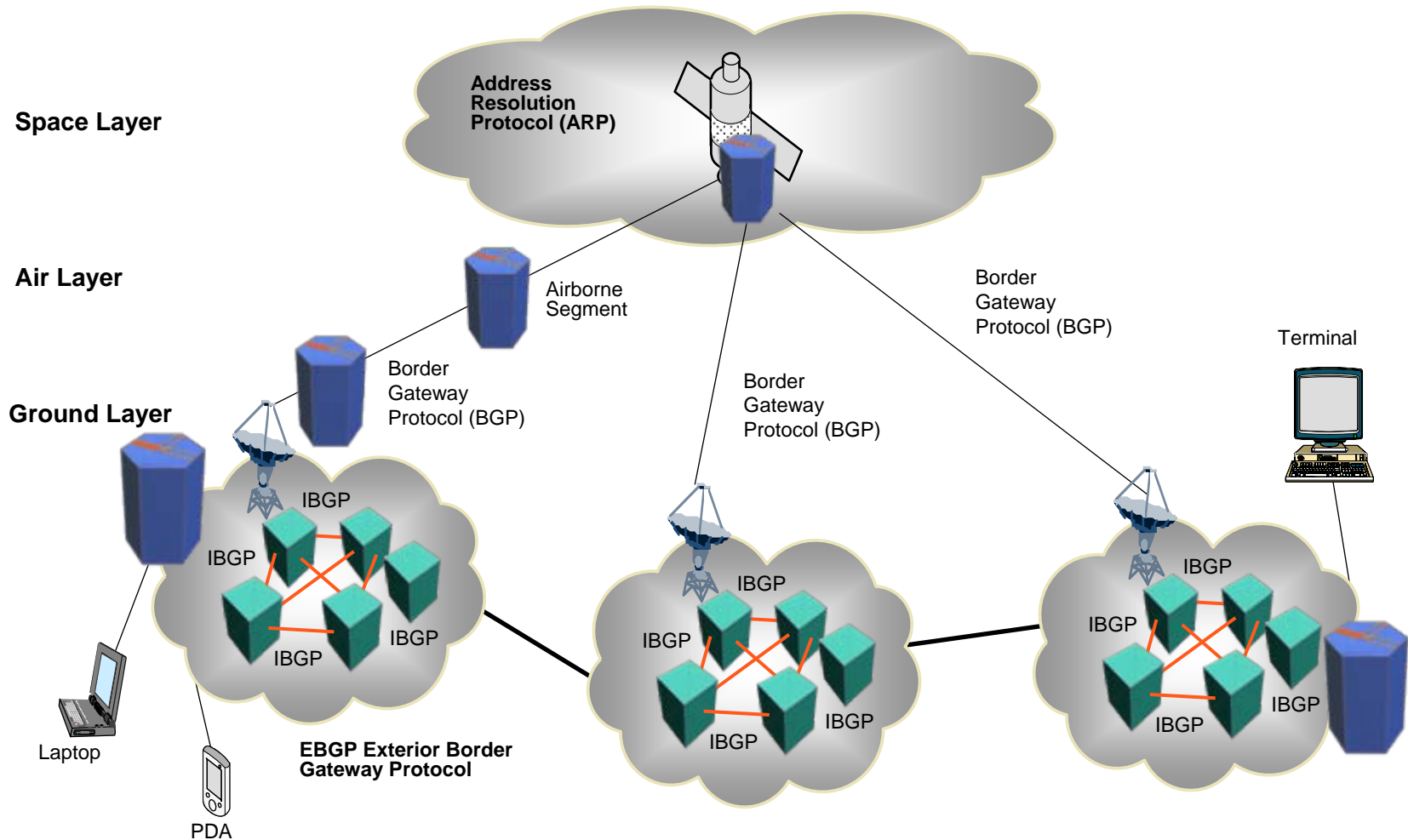
What does it mean to Fractionate?



- Divide system into identifiable and addressable elements
- Reconnect and reconstitute system level capabilities



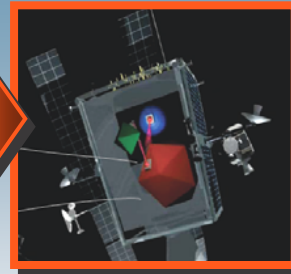
Networks Leverage Commercial Industry



An Example of Layered Gateway for Fractionated Networks

Key Technologies Enable Fractionation

Networks and Communication Enable Connectivity



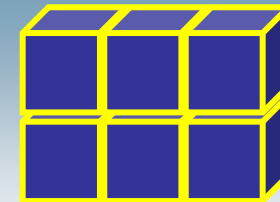
IP
Satellite



RF and
Laser
Comm



Cluster
Operations
Enable
Distribution



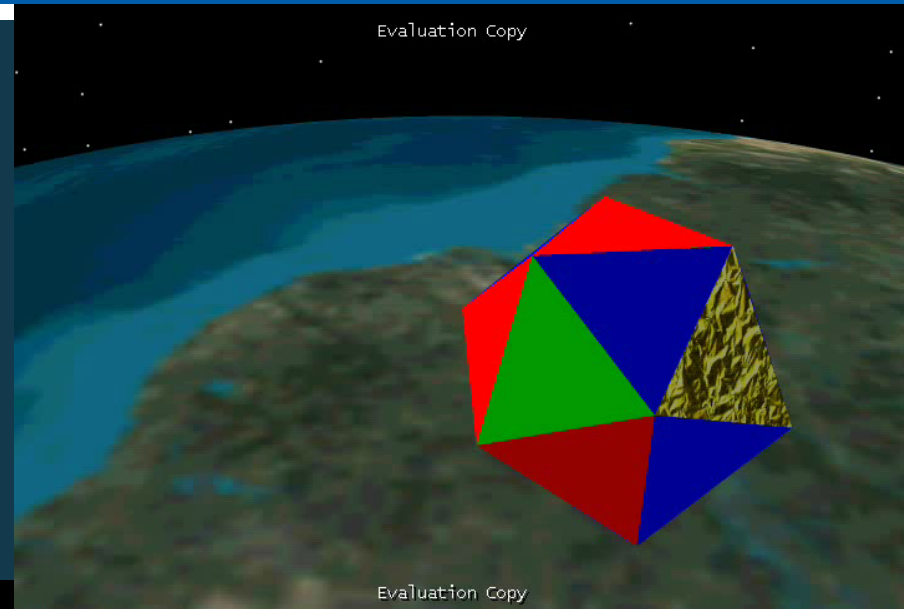
Production Modules
Enable Decomposition

Cluster Operations

Jan 01 2000 11:59:28.000
Target: center
Source: center(359° RA, -92° Dec, 4 km Radius)
FOV: 1°

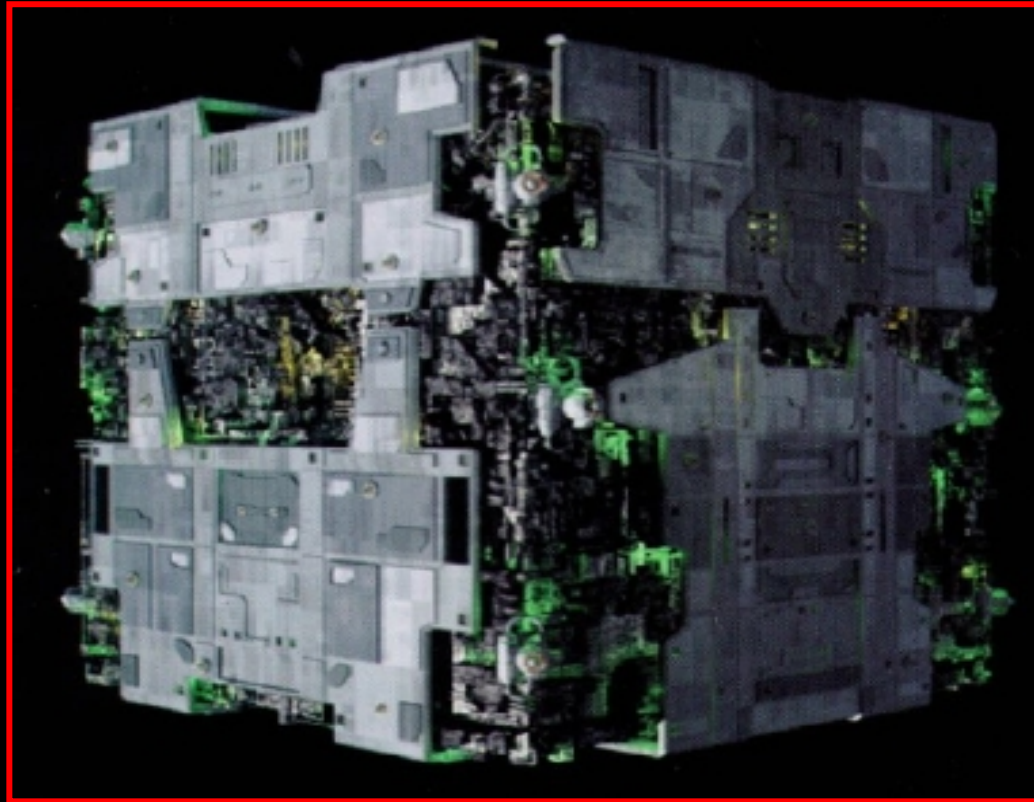


Jan 01 2000 11:59:28.000
Target: center
Source: center(271° RA, -180° Dec, 4 km Radius)
FOV: 1°



- Simulations provide basis operational orbits and cluster management techniques
 - Fuel use, revisit times, orbit utility
- Patent Pending on Cloud Flying

Fractionation Evolution is Unpredictable ...But the Benefits are Real



“When a drone is damaged beyond repair, it is discarded, but its memories continue to exist in the collective consciousness. To use a human term, the Borg are immortal.”

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