

# Arctic Region Communications Small Satellites (ARC-Sat)



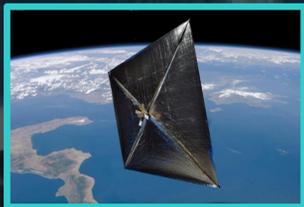
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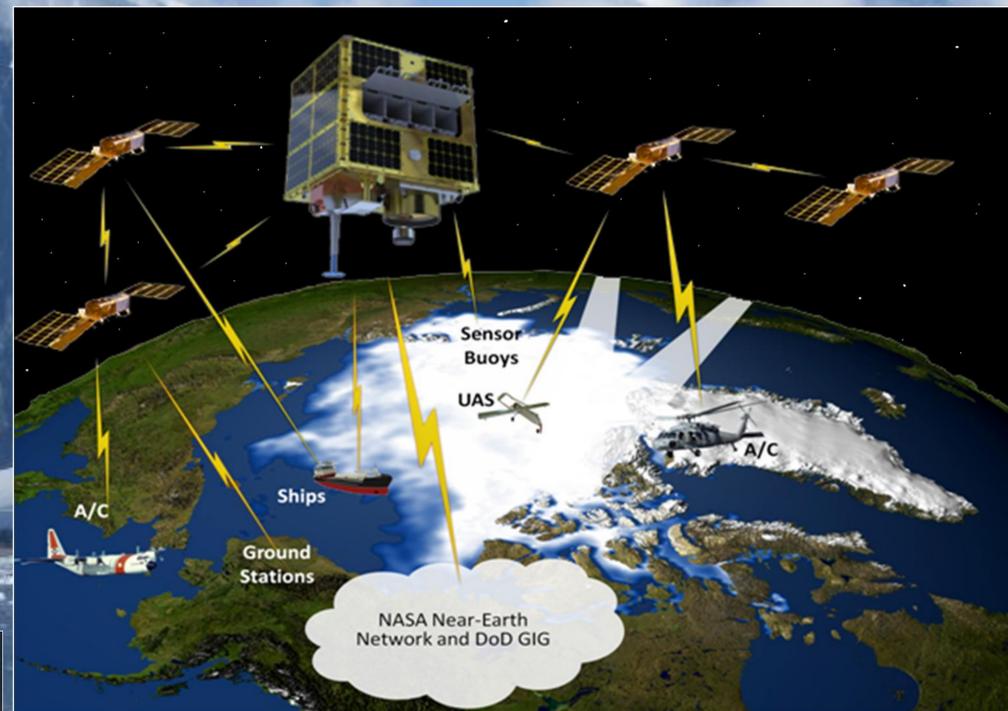
With the Arctic emerging as a national and economic security interest, ARC-Sat will help the international community to plan and execute cooperative security activities. The Arctic Region Communications Small Satellites (ARC-Sat) is a new mission concept under development that will help the international community with data communications relay, maritime domain awareness and environmental awareness. ARC-Sat is a multi-agency initiative that will launch a mini-satellite with a cluster of communications relay CubeSats for enhanced regional communications and an Automatic Identification System (AIS) for ship identification. ARC-Sat will integrate AIS data, expand communications coverage to support Arctic search and rescue (SAR), and demonstrate fractionated satellites to enable long-baseline interferometry from a low-earth orbit.

## Mission Concept

- ❖ 1 Mini-Satellite Mothership (NASA) [200 kg Class]
  - P-POD CubeSat Deployer (NASA)
  - AIS/Data-X (Naval Research Laboratory) (NRL/Canada)
  - Software Defined Radio (SDR) Communications package (Northrop Grumman Innovations) (NGI)
  - 4 Communications CubeSats (NGI) [ < 10 kg each]
- ❖ Up to 10Mbps total payload data throughput
- ❖ UHF SatCom
- ❖ SAR beacon receiver
- ❖ NanoSail deorbiter



Artist's Concept of NanoSail – D  
Deployed by FASTSAT-HSV01



## Launch Candidates

### FASTSAT-HSV-01 Launch



Minotaur IV Launch



Kodiak Launch Complex  
Alaska Aerospace Corporation

### Current Options



Athena Class



Falcon Class

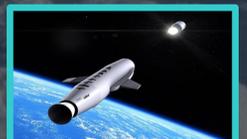
### Near Future



Stratolaunch Carrier Aircraft &  
Falcon 9



Super-Strypi



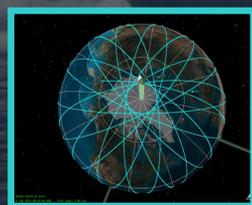
LauncherOne

## Candidate Orbit

With a track overlap of 50.8% at the Equator, ARC-Sat will cover the Earth twice per day. ARC-Sat will provide service to each point on the Earth from 4 times per day at the Equator, up to 14 times per day at the Poles

### Orbit:

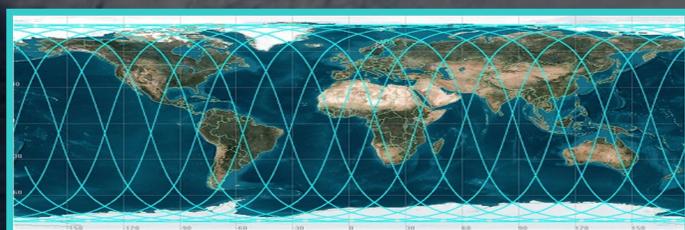
- ❖ Altitude: 650 km
- ❖ Eccentricity: 0 (Circular)
- ❖ Inclination: 98°
- ❖ Period: 97.7 minutes



Orbit Simulation – AGI Viewer

### Ground Track:

- ❖ Diameter: 5,529 km
- ❖ Area: 24 million km<sup>2</sup>
- ❖ Speed (Ground): 6.836 km/s
- ❖ Time in view: 13.48 min



Orbit Simulation – STK

### Flexible

- ❖ Controllable Virtual Beam
- ❖ Each SDR has wide-beam for total-area coverage
- ❖ Steerable beams for greater link margin and higher throughput (NASA uses 3db reserve)
- ❖ Reprogrammable in-flight from the ground

### Powerful

- ❖ 5 SDR's total
  - 1 SDR on 4 CubeSats
  - 1 SDR on the Mothership
- ❖ UHF (0.3–3.0 GHz)
- ❖ 24 Channels per CubeSat
- ❖ 2 Mbps per SDR
- ❖ Mothership has S-Band and X-Band downlinks for combined 11 Mbps

### Compatible

- ❖ Joint Tactical Radio System (JTRS)
- ❖ Airborne & Maritime/Fixed Station (AMF)
- ❖ Wideband Network Waveform
- ❖ Soldier Radio Waveform (SRW)
- ❖ Mobile User Objective System (MUOS)

## Launch Configuration

- ❖ Shared Launch cost with multiple satellite payloads
  - ESPA Class Satellite
- ❖ Less complex vehicle integration
- ❖ Alternate payload configuration on multiple launch vehicles
- ❖ On-orbit storage
- ❖ Flexible configuration for additional spacecraft



Minotaur IV Faring With  
Multiple Payload Adapter

## Mission Operations

- ❖ Daily operations require minimal upkeep
  - NASA, DoD, University of Alaska in Fairbanks
- ❖ Option for constant and reliable operations for emergency scenarios
- ❖ Data is shared for a multi-national, multi-agency effort for collaboration

## Future Application Approaches

- ❖ Communications relay for other regional coverage, including mid latitudes and areas of tactical military and naval interest
- ❖ Additional CubeSats can provide wider coverage and persistence of service