Report and Status of the Small Satellite DCS Use Concept Validation Project

Technical Working Group Meeting

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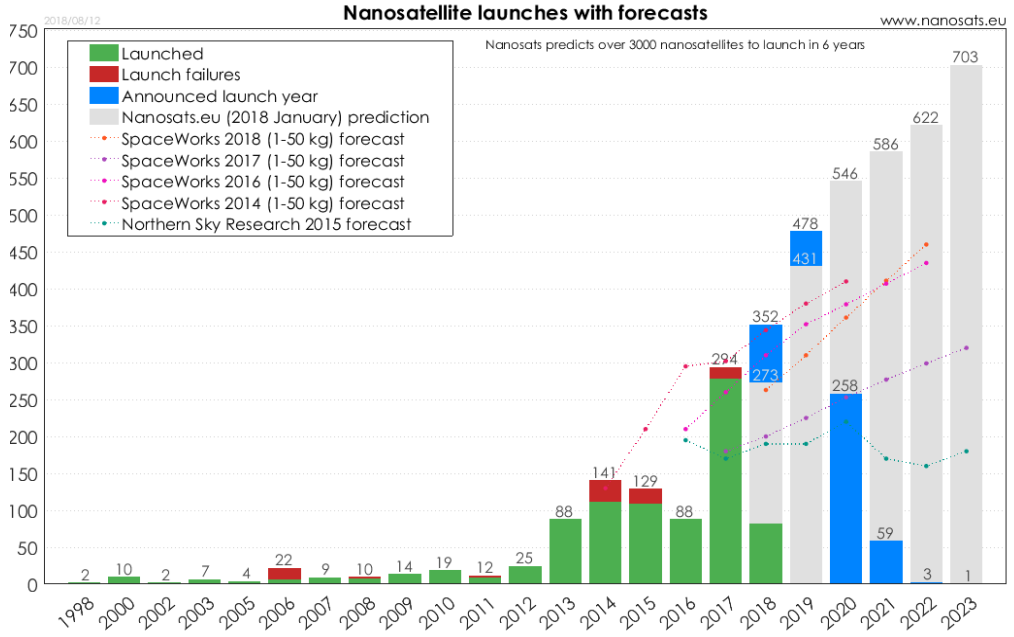
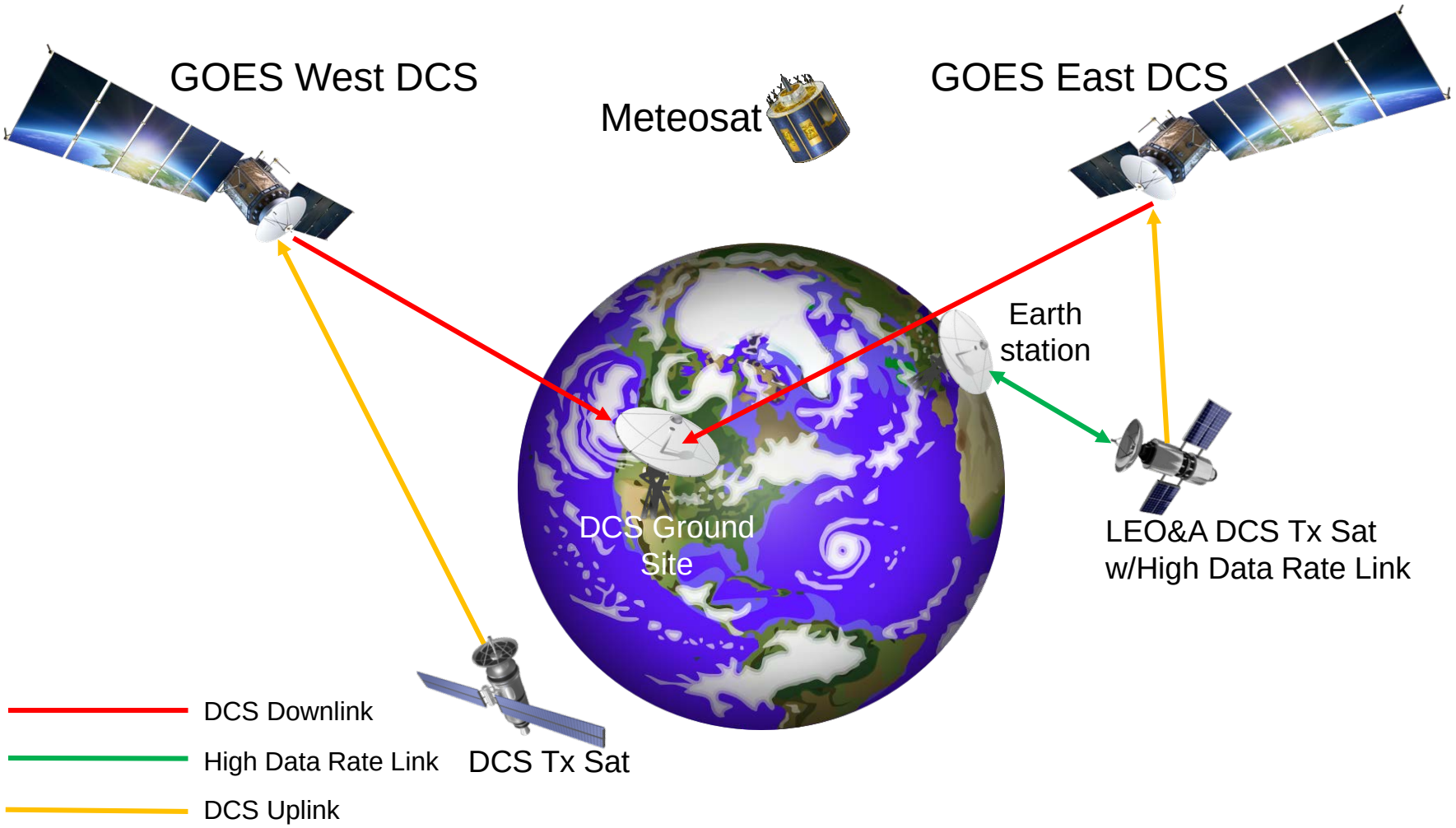
Issue: Growing Demand for 400 MHz

- DCS Transmitters, located throughout the United States & Protectorates (US&P) as well as many other countries, use the 401 MHz band to uplink to the DCPR on GOES (and others) satellites in geosynchronous and non-geosynchronous orbits.
- Satellites are also allocated to use this band (space-to-Earth) for space operations purposes.
  - Typically, these satellites transmit in all directions relatively equally and thus also radiate in direction of GOES and other DCS receiving satellites.
  - This energy, aggregated across multiples of these satellites (even multiples of constellations) is expected to become a significant source of RFI to the DCS system in time.

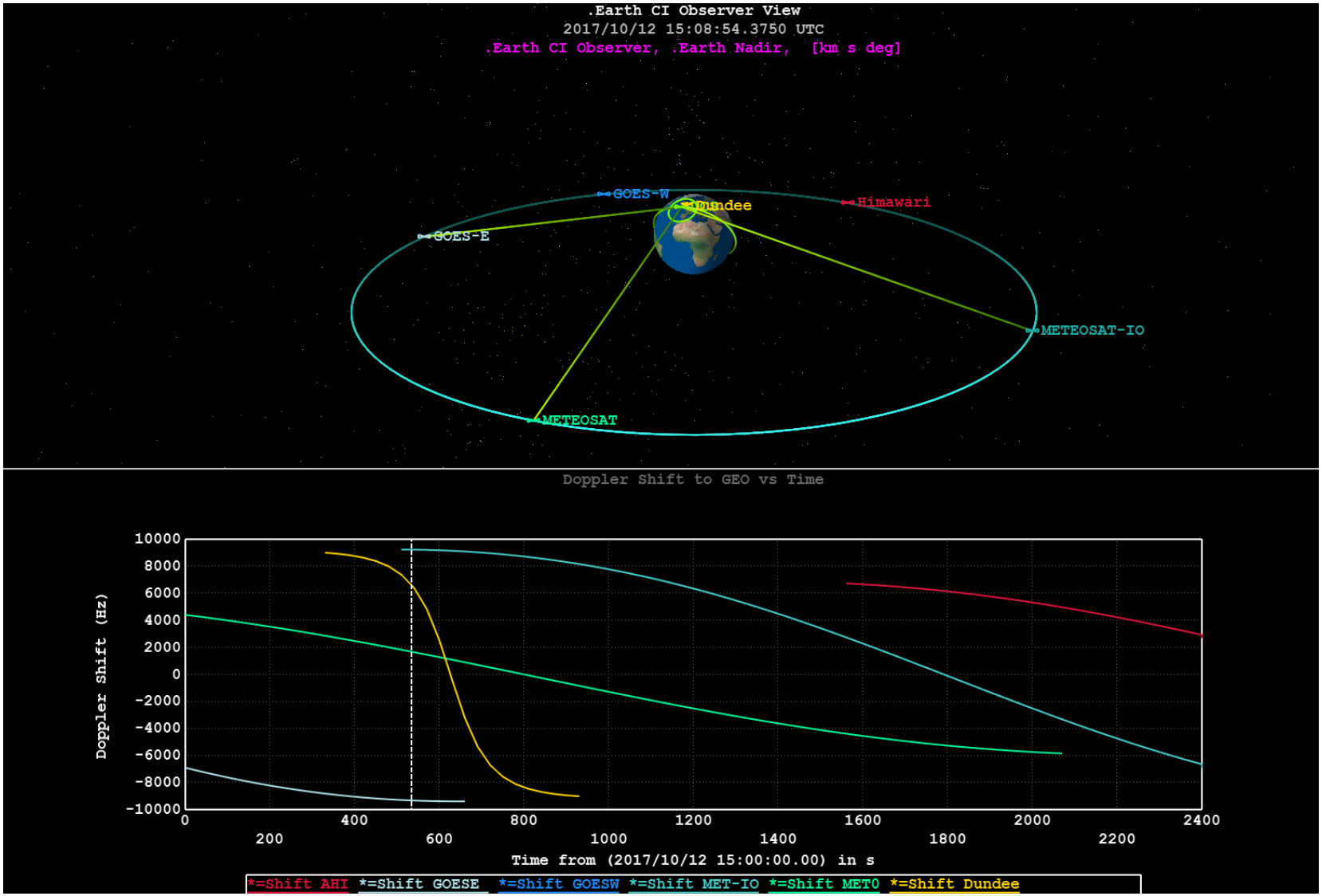


DCS – Data Collection System
DCPR – Data Collection Platform Radio
RFI – Radio Frequency Interference

Concept: Use of DCS for Satellite Telemetry, Tracking and Small Data

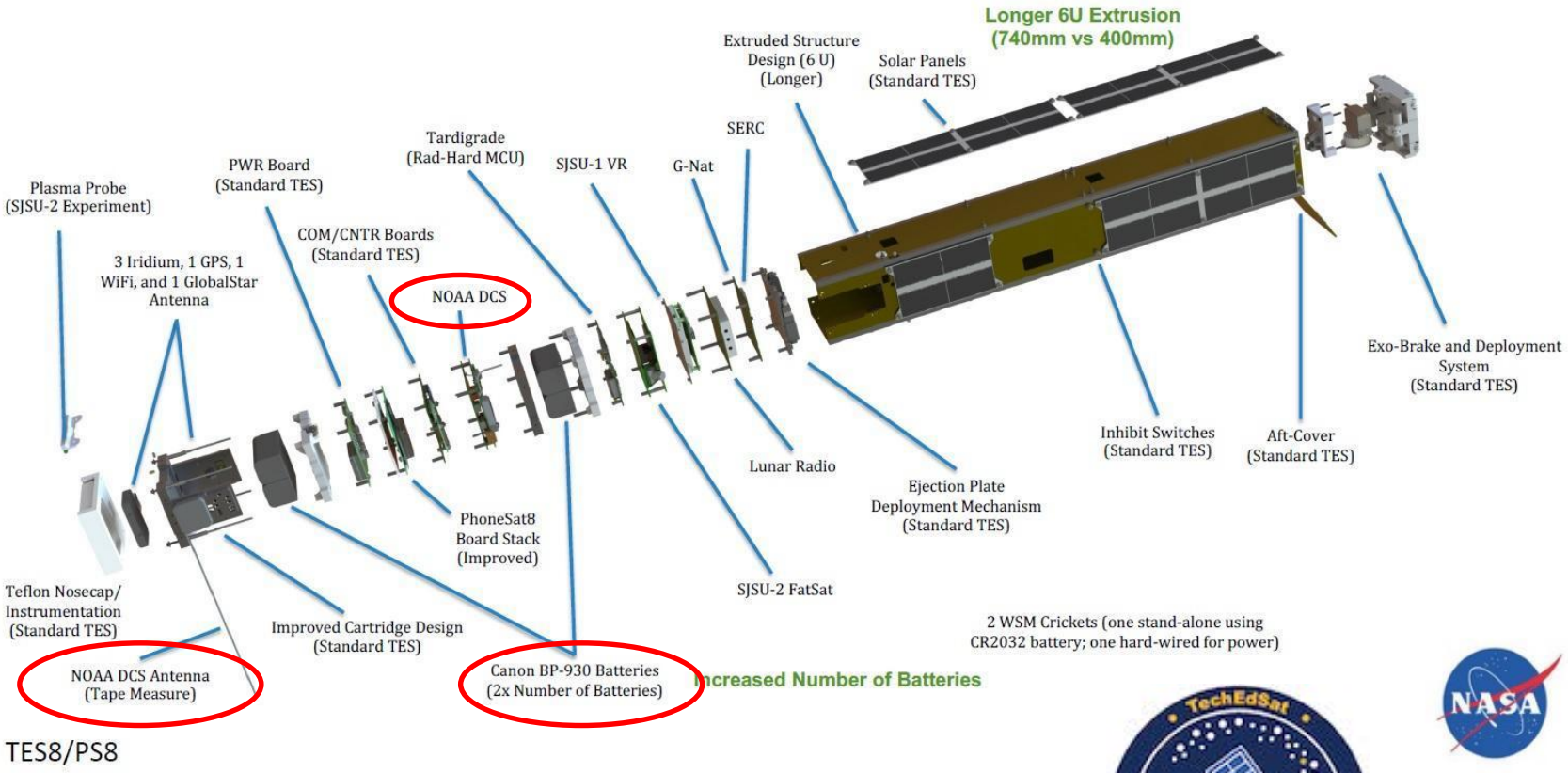


Most Challenging Issue: Doppler



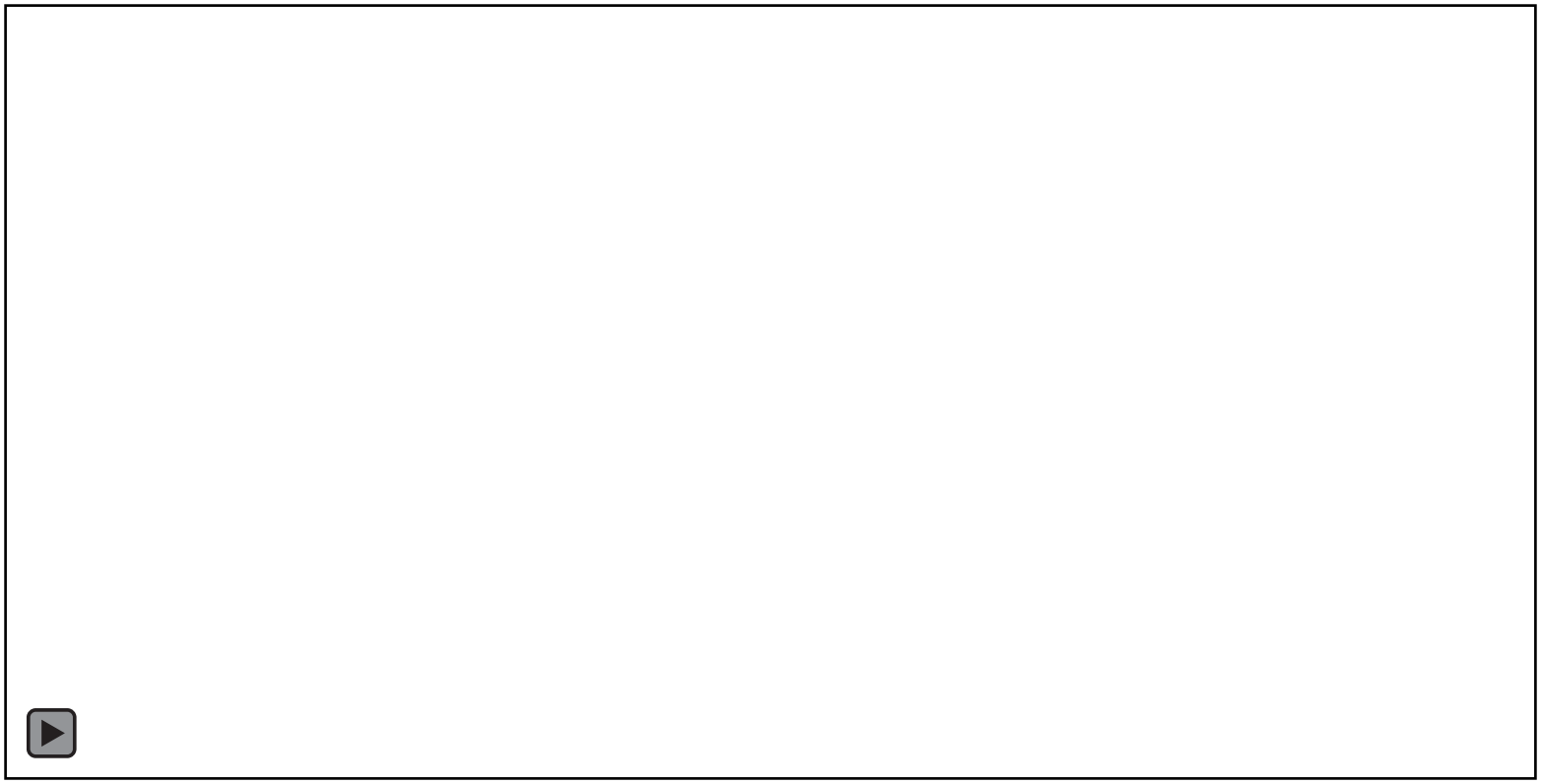
TechEdSat-8

TES-8 Exploded View - with TES-6 Comparison



TES8/PS8

TechEdSat-8 Ejection



Satellite DCS Use Test Status

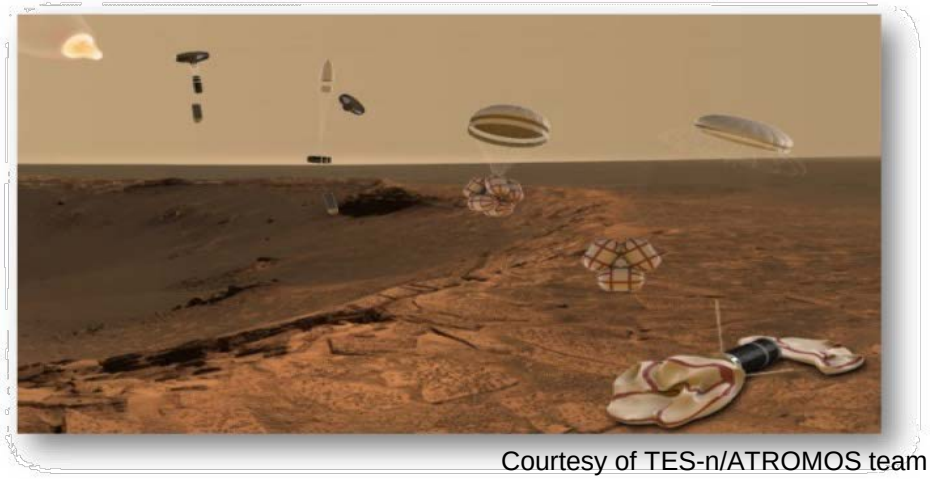
- TechEdSat-8
  - Satellite Failure – loss of solar power regeneration.
  - No actual testing of Satellite DCS use prior to failure
- TechEdSat-9
  - Launch in late summer
  - Test concept for satellite DCS use
  - Some tests without Doppler correction
  - Plan for ground site collection for additional validation
  - Work with EUMETSAT on detecting TES-9 tests

Satellite DCS Use Test Status *(cont.)*

- TechEdSat-10
  - International DCS testing with EUMETSAT/Meteosat
  - Develop an operational case for satellite use of DCS
  - Remove Doppler correction
    - Modify DMODs to support Doppler shifts
    - Use random transmit DCS channels
  - Enable command selection between 300 bd/100 bd with respective modulations
  - Command select frequency/channels
  - Launch in early 2020

Satellite DCS Use Future Work

- Develop two way communications (via GOES)
- Use of higher data rates (1200/1600 bd)
- Alternative modulation schemes for improved efficiencies
- Exploring potential use of DCS for monitoring the surface of Mars



Courtesy of TES-n/ATROMOS team

Assessment of Benefits

- Risk Reduction
  - Band allocated to allow space to Earth transmission for satellite operations
  - Satellites primarily transmit in all directions (omnidirectional antennas)
    - Radiate in the direction of GOES and other DCS receiving satellites
    - Radiated energy, aggregated across multiples of these satellites is expected to become a problematic source of RFI to the DCS
  - DCS enables improved control of the radiated energy to work with the other DCS transmitters and minimize interference
  - DCS will assist in decreasing risk of interference but will not eliminate it
- Other Benefits to GOES DCS
  - Increased use of the DCS channels, some of which are currently underutilized.
  - Low cost enablement of scientific, educational, and development satellite low data rate communications to respective mission centers
  - Ability to enable LEO&A during clustered deployments
  - Projected demand for enabling two-way communications capabilities of the DCS – while in view of GOES
  - Demonstrated continued efforts by meteorological community to facilitate good spectrum stewardship and efforts towards *responsible* sharing of spectrum resources.

Conclusion

- The Satellite DCS Use Concept Validation Project is proceeding well.
  - We experienced a roughly 6 month schedule change due to TES-8 host power failure
  - TES-9 and TES-10 are on tracking well to the schedule.
- Team, consisting of NOAA NESDIS, NASA Ames, Microcom Design, and EUMETSAT, are confident of a successful outcome.
- Validation of the satellite DCS use concept and operational considerations over the next 18 months.
  - In cooperation with the international EUMETSAT DCS community
  - Intent to expand the availability of DCS satellite use on an international basis.


Thank you