NASA Earth Science Briefing to National Research Council (NRC) Board on Physics and Astronomy (BPA) Committee on Radio Frequencies (CORF)

May 2012

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Program Executive, Earth Science Division
Science Mission Directorate, NASA HQ

Purpose of Briefing

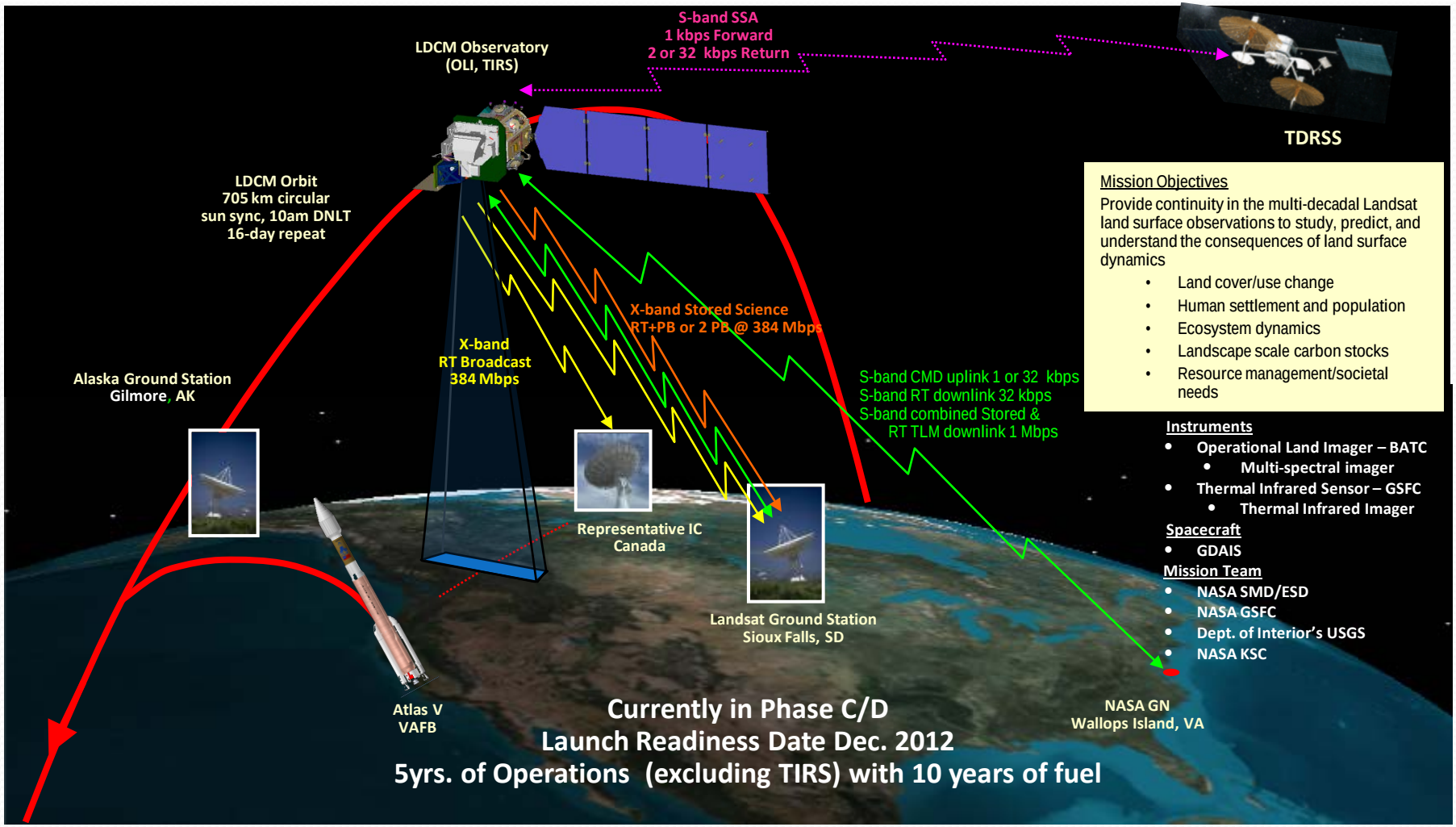
- To describe some of the current and near-term spectrum requirements from the NASA Science Mission Directorate
- Focus is on Earth science missions

Earth Science Operational Mission Set

Near-Term Earth Science Missions

- LDCM
- GPM
- OCO-2
- SAGE-III
- SMAP
- ICESat-2
- GRACE F/O
- SWOT

Landsat Data Continuity Mission (LDCM) Mission Overview



Mission Objectives

Provide continuity in the multi-decadal Landsat land surface observations to study, predict, and understand the consequences of land surface dynamics

- Land cover/use change
- Human settlement and population
- Ecosystem dynamics
- Landscape scale carbon stocks
- Resource management/societal needs

Instruments

- Operational Land Imager – BATC
  - Multi-spectral imager
- Thermal Infrared Sensor – GSFC
  - Thermal Infrared Imager

Spacecraft

- GDAIS

Mission Team

- NASA SMD/ESD
- NASA GSFC
- Dept. of Interior's USGS
- NASA KSC

PE: Dave Jarrett PS: Garik Gutman

Global Precipitation Measurement (GPM) Mission Overview

Mission Science Objective: Initiates the measurement of global precipitation, providing uniformly calibrated measurements every 3 hours for scientific research and societal applications.

Key Science Products: Precipitation intensity and distribution, instantaneous precipitation rate, 3-hourly precipitation rate, daily and monthly precipitation accumulation, latent heat distribution and outreach precipitation products

Mission Description:
S/C: Core Observatory (GSFC-industry)
Instruments:
- Core: Dual-frequency Precipitation Radar (JAXA)
  - Ka-band (35.5 GHz) and Ku-band (13.6 GHz)
- GPM Microwave Imager (Ball)
  - 10 – 183 GHz

Launch Vehicle:
- Core - H-IIA 202A (JAXA)

Orbit: 65º inc., 407 km
Mission Life: 3 years
Mission Project Management: GSFC
Launch Date: 02/2014

PE: Steven Neeck PS: Ramesh Kakar

Orbiting Carbon Observatory-2 (OCO-2) Mission Overview

Mission Science Objective: Collect the first space-based global measurements of atmospheric CO_2 with the precision, resolution, and coverage needed to characterize its sources and sinks on regional scales and quantify their variability over the seasonal cycle

Key Science Products: Retrieve estimates of the column-averaged CO_2 dry air mole fraction (X_{CO_2}) on regional scales (≥ 1000 km) from space-based measurements of the absorption of reflected sunlight by atmospheric CO_2 and O_2, collected in cloud-free scenes over ≥80% of range of latitudes on the sunlit hemisphere at monthly intervals for 2 years.

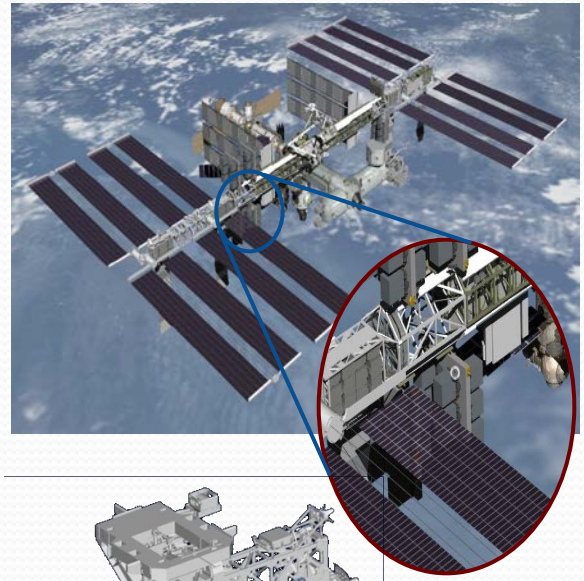
Mission Description:
S/C: LEOStar-2 (OSC)
Instruments:
- 3 Channel Grating Spectrometer (passive) (JPL)

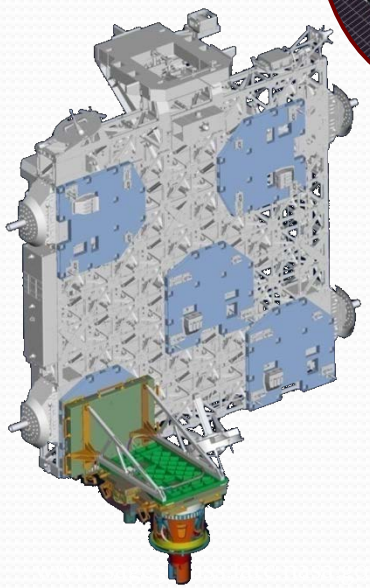
Launch Vehicle: TBD
Orbit: Sun-synchronous; A-Train
Downlinks: S-band (TT&C); X-band (science)
Mission Life: 2 years
Mission Project Management: JPL
Launch Date: NET Jul 2014

PE: Richard Slonaker PS: Ken Jucks

Stratospheric Aerosol and Gas Experiment (SAGE III) on ISS Mission Overview

www-sage3oniss.larc.nasa.gov





SAGE III on ISS directly supports NASA Strategic Goals to extend and sustain human activities across the solar system; expand scientific understanding of the Earth and the universe in which we live

Primary Science Objective:
Monitor the vertical distribution of aerosols, ozone and other trace gases in Earth's stratosphere and troposphere to enhance understanding of ozone recovery and climate change processes in the upper atmosphere

Mission Implementation	
Partners	**LaRC** (Science; Project Management; System Engineering and Mission Design; SMA; I&T; Launch Support; Mission Operations; Science Data Processing and Delivery) **JSC/ISSP** (System Engineering Support, Hexapod Pointing System and ISS mounting adaptors, ISS Mounting Location, Launch Processing and Access to Space, Infrastructure and Telemetry Data)
Launch	August 2014
Orbit	ISS Mid-Inclination orbit
Life	3 years (nominal) / ISS manifest through 2020 for extended mission
Payload	Sensor Assembly (LaRC), Hexapod (ESA), CMP (LaRC), ExPA (JSC/ISS), ICE (LaRC), HEU (ESA), IAM (LaRC), DMP (LaRC) Nadir Viewing Platform (LaRC) UV/Vis spectrometer (passive)

PE: Nand Topiwala PS: Richard Eckman

Soil Moisture Active/Passive (SMAP) Mission Overview

Mission Science Objective: Make pioneering space-based measurements of soil moisture and freeze/thaw state (together termed hydrosphere state) to enable understanding of natural seasonal variations and to characterize their impacts on surface energy, water, and carbon balances.

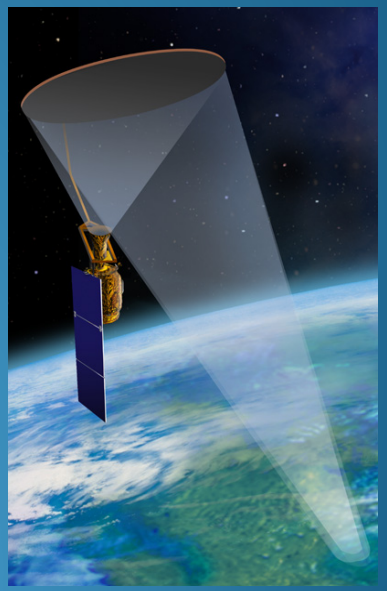
Key Science Products: Soil Moisture estimate of top 5 cm of soil at 10km spatial resolution and 3-day average intervals over the global land area, excluding regions of snow and ice, frozen ground, mountainous topography, open water, urban areas, and vegetation water content greater than 5kg m-2 (averaged over the spatial resolution scale); Freeze/thaw state north of 45N latitude which includes the boreal forest zone.

Mission Description:
S/C: in-house at JPL, with industry contributions
Instrument:

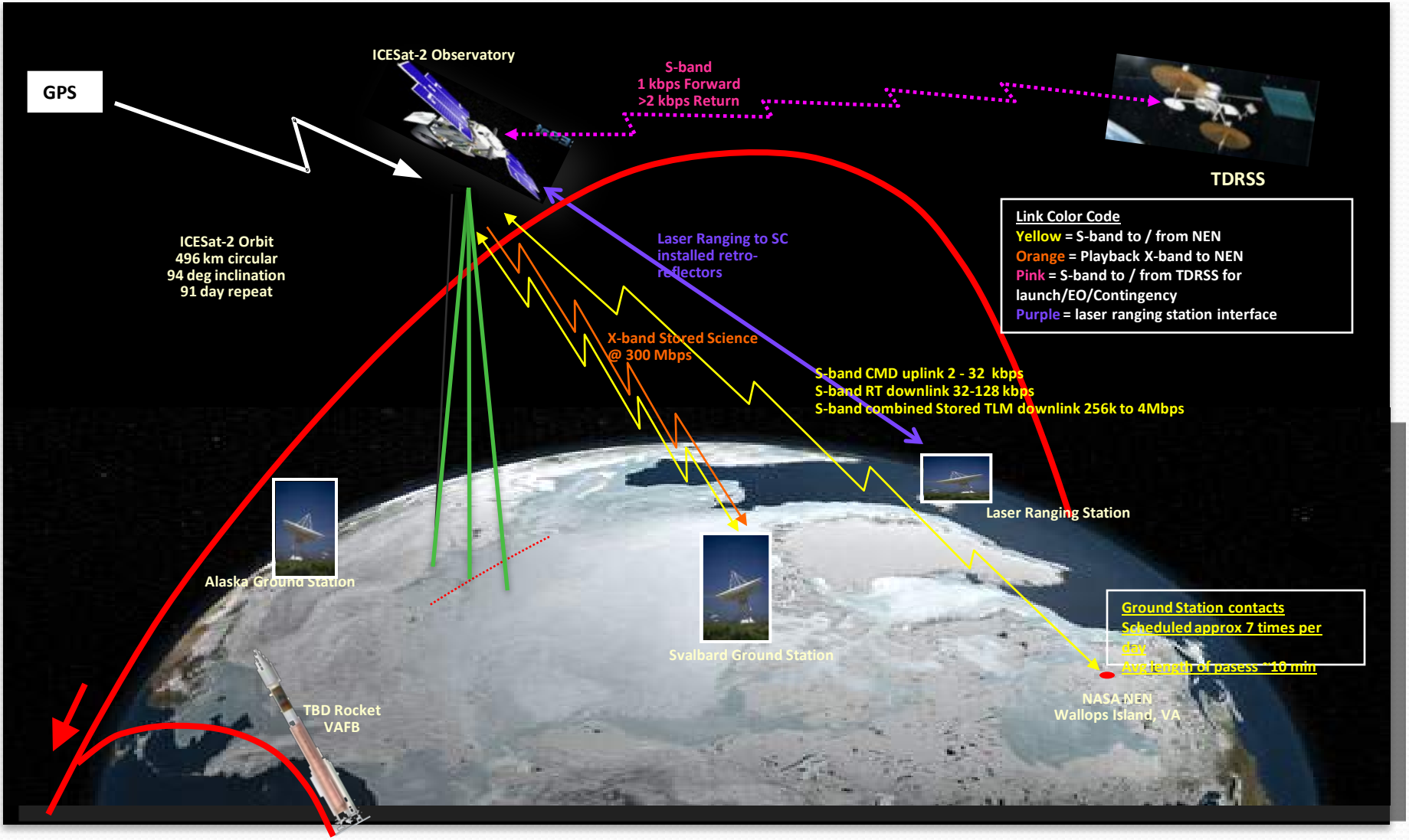
- L-Band Radar (1.26 GHz)/Radiometer (1.41 GHz) with shared antenna
- Radar developed by JPL; Radiometer developed by GSFC

Orbit: Polar sun-synchronous at 670 km; 6:00 AM/PM orbit
Mission Life: 3 years
Mission Project Management: JPL
Launch Date: Oct 2014

PE: Chris Bonniksen PS: Jared Entin



Ice, Cloud, and land Elevation Satellite-2 (ICESat-2) Mission Overview



PE: Richard Slonaker PS: Tom Wagner LRD: 7/2016

Gravity Recovery and Climate Experiment Follow-on (GRACE-FO) Mission Overview

Description:	Continue to obtain the same extremely high-resolution global models of Earth's gravity field, including how it varies over time, as in the original GRACE mission
Contractor Team:	Astrium, ONERA
Partners:	Germany
Center Participants:	JPL, KSC
Orbit:	Polar
Mission Life:	5 years
S/C TO S/C:	24 & 32 GHz Crosslink
Downlink:	S-band (1 Mbps Down)
Launch Readiness Date:	August 2017

PE: Dave Jarrett PS: John LaBrecque

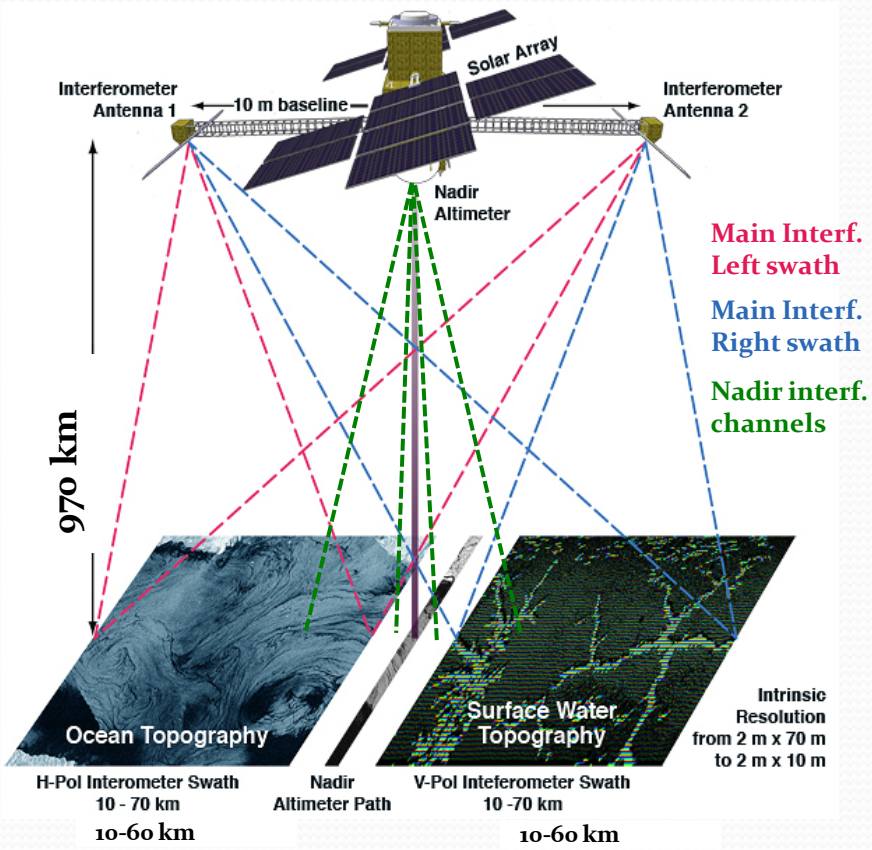
Surface Water and Ocean Topography (SWOT) Mission Overview

Mission Science

Oceanography: Characterize the ocean mesoscale and sub-mesoscale circulation at spatial resolutions of 10 km and greater.

Hydrology: To provide a global inventory of all terrestrial water bodies whose surface area exceeds $(250m)^2$ (lakes, reservoirs, wetlands) and rivers whose width exceeds 100 m (requirement) (50 m goal) (rivers).

- To measure the global storage change in fresh water bodies at sub-monthly, seasonal, and annual time scales.
- To estimate the global change in river discharge at sub-monthly, seasonal, and annual time scales.



Mission Architecture

- Ka-band SAR interferometric (KaRIn) system with 2 swaths, 50 km each (goal of 60 km)
- Produces heights and co-registered all-weather imagery
- Use conventional Jason-class altimeter for nadir coverage, radiometer for wet-tropospheric delay, and GPS/Doris/LRA for POD.
- On-board data compression over the ocean (1 km^2 resolution). No land data compression onboard.

- Partnered mission with CNES and CSA
- Mission life of 3 years
- 970 km Orbit, 78º Inclination, 22 day repeat
- Mission Risk Class: C (TBC)
- Readiness for launch 2019 (TBC)

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