



# NASA's Deep Space Network

**Brad Arnold - DSN Project Manager**  
**24-April-2019**

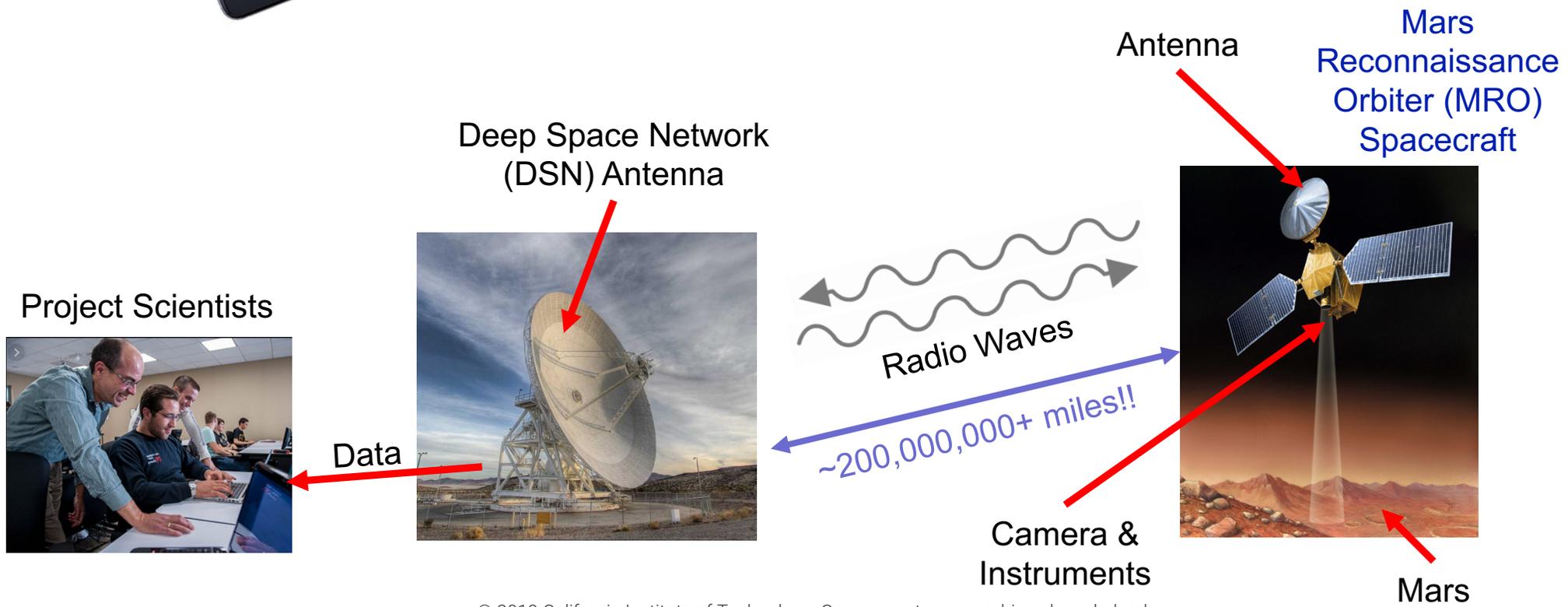
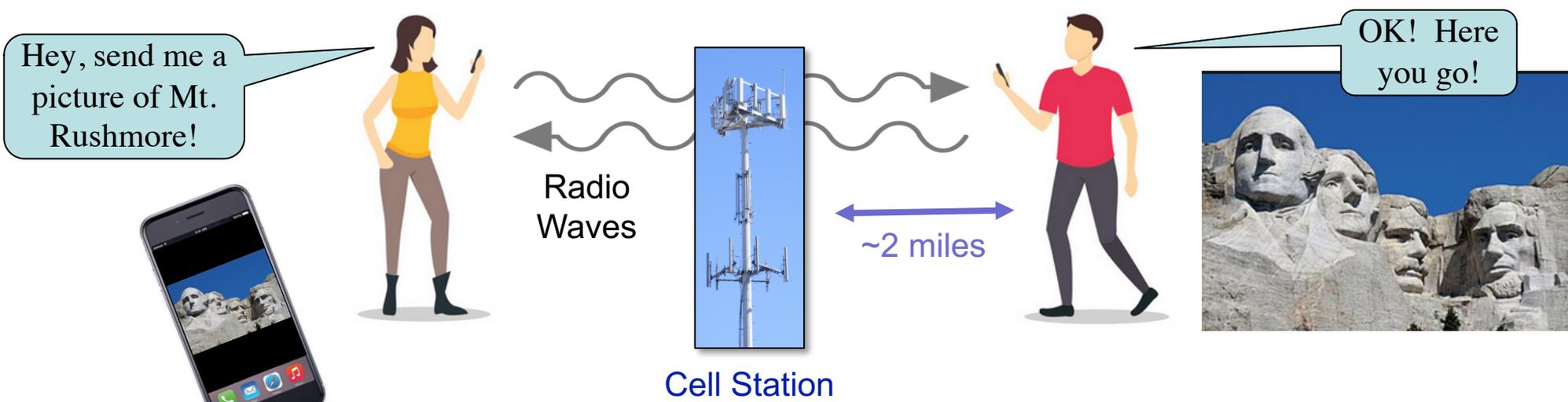


# Agenda

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- Deep Space Network = DSN
- Remote missions and communication
- Why do we need the DSN ?
- What services does the DSN provide ?
- What is at a DSN station ?
- Where is the DSN ?
- Future space exploration
- The future of the DSN
- Who is Brad Arnold

# Remote Missions and Communications



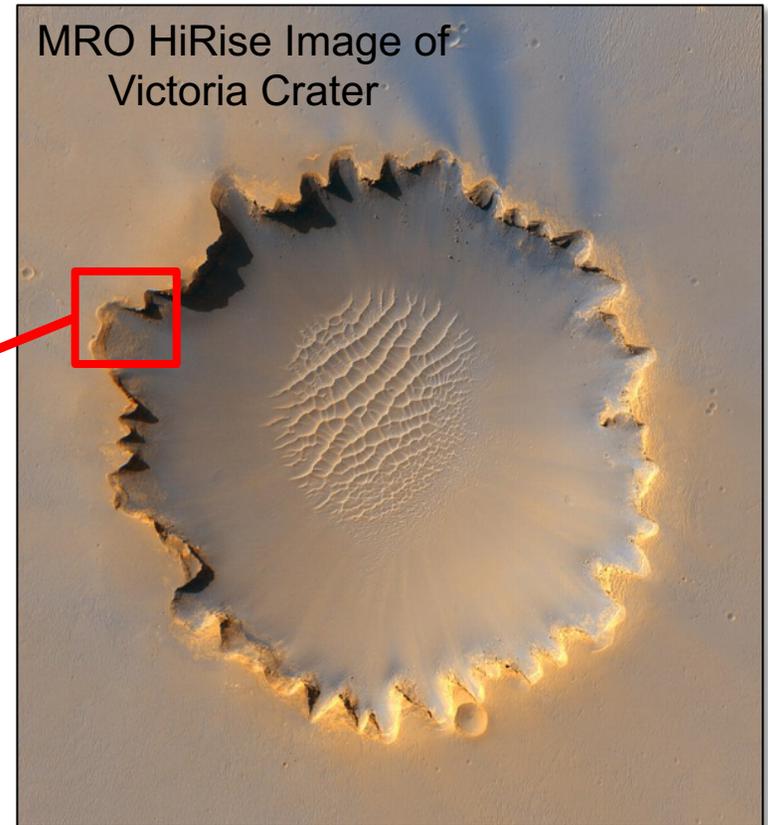
# Mars Victoria Crater – From MRO and Opportunity



MRO Assembled  
At Lockheed Martin



Opportunity Mockup  
Testing at JPL



MRO HiRise Image of  
Victoria Crater



Opportunity Panorama of Victoria Crater

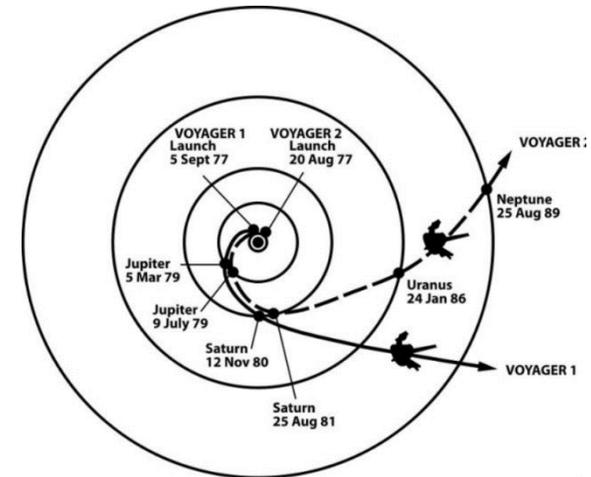
# Why do we need the DSN ?

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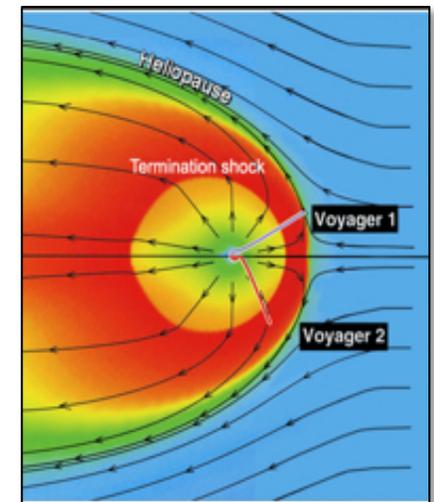
- Mankind has always been curious about the earth, planets and stars. In the last 60 years, we have developed technology to leave earth and explore our solar system the space beyond
- NASA and other organizations have dozens of spacecraft exploring today! More are coming every year
- The scientists and projects who operate these spacecraft need to know where they are, send them commands, and receive data from them
- Between the spacecraft and earth, these data are sent by radio waves
- The DSN provides the earth side link for these radio wave transmissions to and from the spacecraft

# What Services does the DSN provide ?

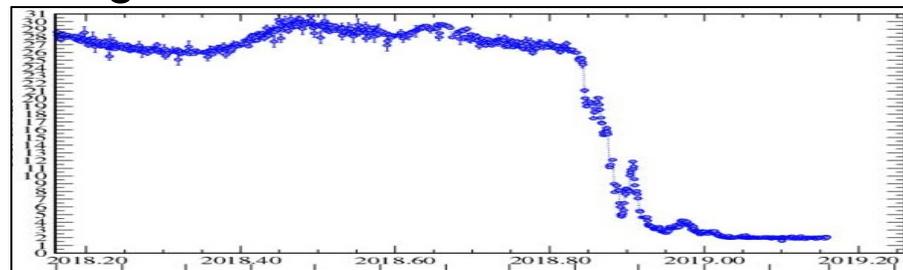
- Navigation
  - Where is my spacecraft
  - What direction and how fast is it flying
  - Entering into orbit around another planet
  - Landing on another planet
- Command services
  - Commands for operations
  - Configuring the spacecraft
  - Emergencies
- Telemetry data services
  - Science data - pictures, instrument measurements
  - Spacecraft engineering data
- Other



Voyager Mission Design



Voyager 2 Transition Through the Heliopause



Voyager 2 Particle Count Through Heliopause

# What is at a DSN Station ?

- Control rooms and operators
- Antennas
- Radio receivers
- Transmitters
- Positioners & controllers
- Generators
- Data systems
- Cafeterias
- Dorms
- Burros



Control Room



Antennas (34m)



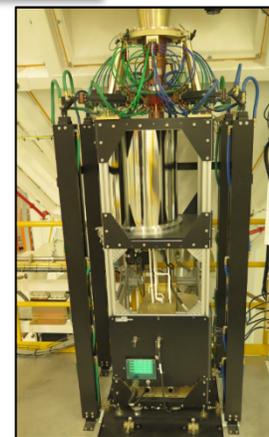
Generators



Burros



Electronics



Receiver



Transmitter

# The DSN's 70m Antennas



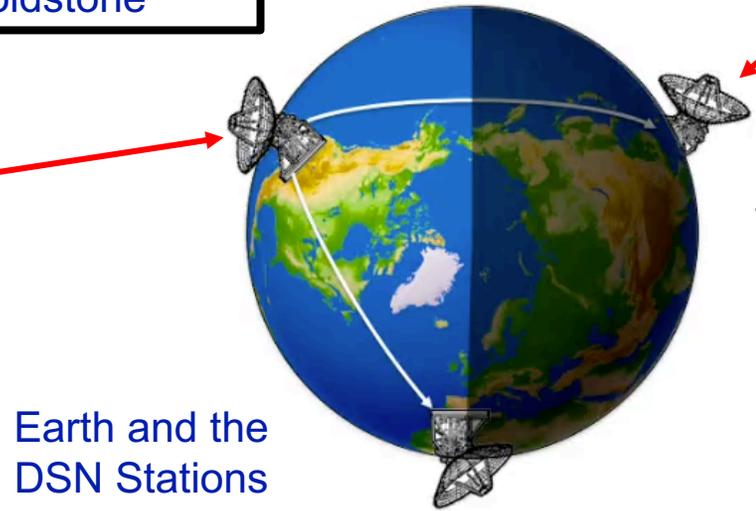
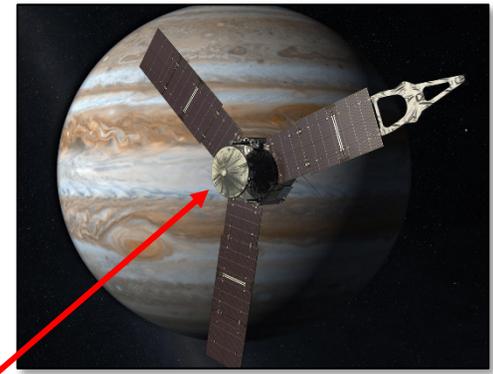
2-story  
6-bedroom  
house

*There is one 70m  
antenna and four 34m  
antennas at each of the  
three DSN stations*

What if we put the DSN 70m in the Rose Bowl?

# Where Is NASA's DSN ?

- The DSN operates three communication stations around the earth: **Goldstone, California**; **Madrid, Spain**; **Canberra, Australia**
- The DSN also operates the Control Center at JPL in Pasadena, CA



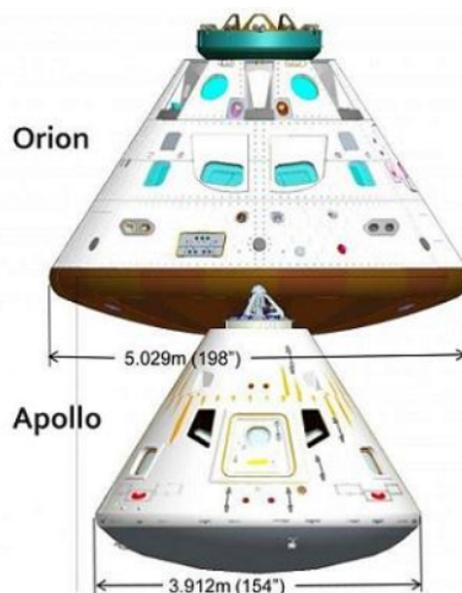
*The three DSN stations are spaced ~120-degrees apart in longitude around the world. A deep space probe can always see one of the DSN's antennas!*

# Future Space Exploration

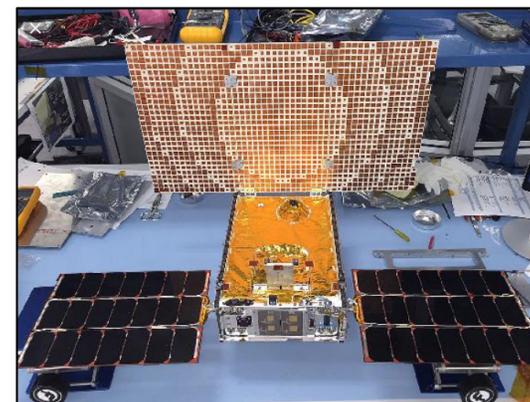
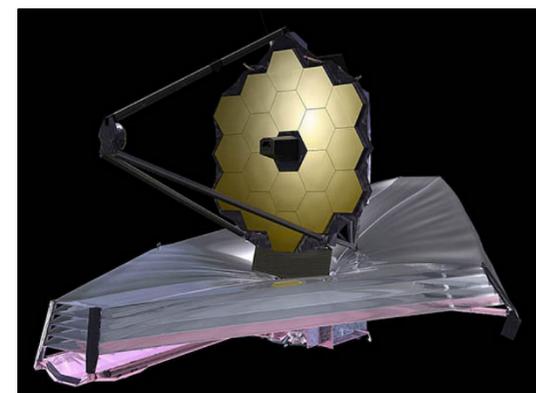
- Places to explore
  - Planets
  - Asteroids
  - Astrophysics
  - Our moon and other moons
- Technology and projects coming up
  - More DSN antennas
  - James Webb
  - Cubesats
  - Foreign partnerships
- Humans in Space
  - Back to the moon
  - Off to Mars



OsirisREx  
At  
Bennu



James  
Webb  
Telescope



MarCO  
Cubesat

# The Future of the DSN

- Increasing number & types of customers
  - Challenging changes coming
- High reliability
  - Human spaceflight
- More data is needed
  - Voyager (launched: 1977) – 160 bits/second
  - NISAR (launches: 2021) – >1,000,000,000 bits/second
- Increasing partnerships
  - European Space Agency (ESA)
  - Commercialization: Goonhilly
  - Other: Italy / Sardinia
- Future is bright, the DSN will be there !!



Goonhilly Earth Station Limited



Italian Space Agency (ASI)  
Sardinia 65-meter Antenna

# Mr. Bradford Arnold

- Project Manager for the NASA's Deep Space Network (DSN)
  - Caltech's Jet Propulsion Laboratory (JPL)
  - On the job for 6-months
- Other jobs at JPL - since 2002
  - Deputy Division Manager – Telecommunications, Tracking and Radar Division
  - GRACE Follow On - Earth gravity mapping mission – Instrument Manager
  - ESA's ExoMars Trace Gas Orbiter – Delivery manager for Mars UHF relay radios
  - GRAIL – Moon gravity mapping mission - delivery manager for instrument
  - Other flight telecom engineering work – lots of other Mars missions
- Other jobs before JPL
  - Globalstar – provider of space based telecom systems (satellite phones)
  - Hughes Space and Communications – builder of telecom satellites (like DirectTV)
  - A couple smaller antenna companies – all sorts of antennas!
- Education
  - Master of Science in Electrical Engineering – California State University, Northridge
  - Master of Business Administration (MBA) – California Lutheran University

