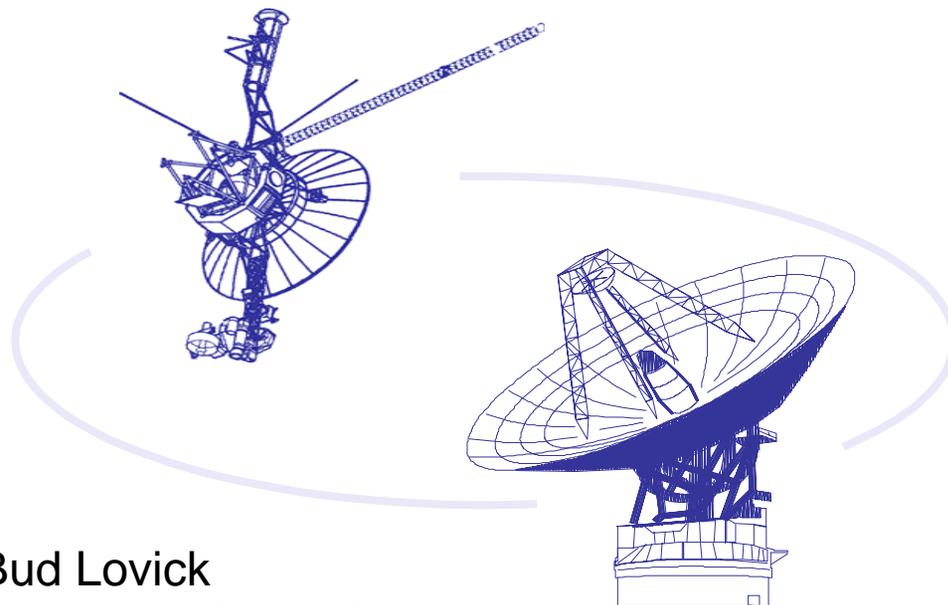




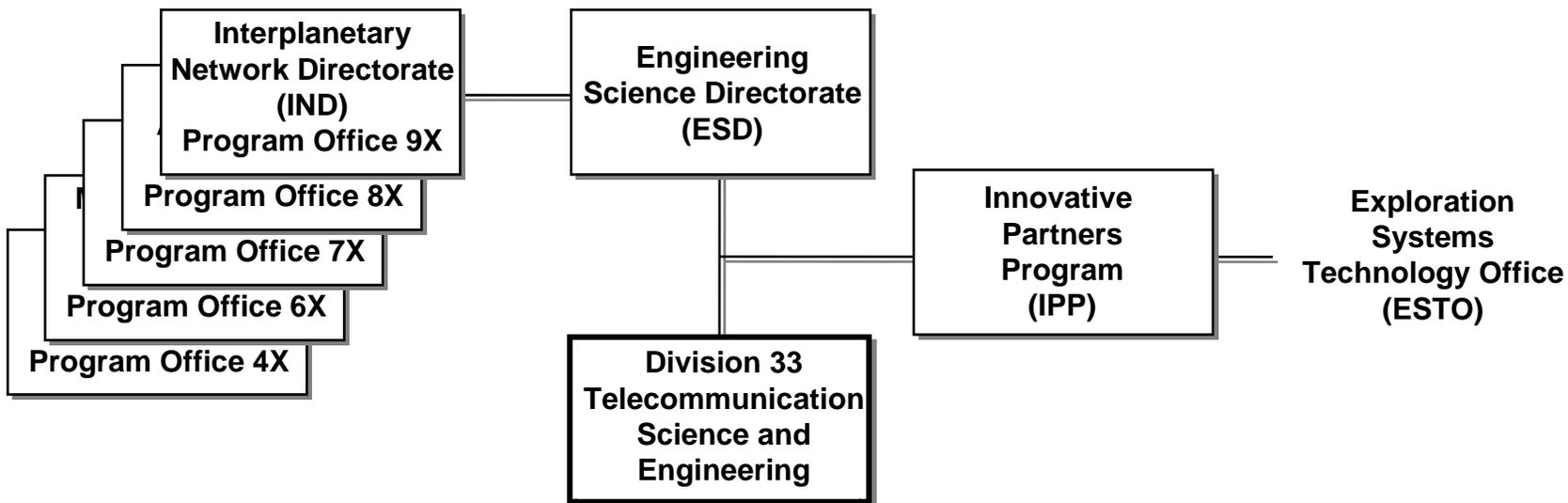
JPL Telecommunication and Tracking Capabilities



Bud Lovick
IPP Program Rep for Comm/Nav
April 2005



JPL Telecom Capability
Infrastructure
Telecom Organization



- **Five organizational Sections with over 600 employees and major development activities in:**
 - Optical Communications
 - Telecomm Architectures, Communication Networks
 - Deep Space Network (DSN) ground communication system
 - Advanced Radar Technology and Implementation
 - Frequency & Timing Adv Development, Global Positioning Satellite Systems
 - Antennas, RF Subsystems, Transmitters, Transponders & Signal Processing
- **Telecom support Laboratories**
 - 10 Major World-class labs for research, development, test
- 37 Development Labs: Radio, Microcircuit, Wireless, DSN, Optical, Radar, GPS
 - 74 Integration and Testing Labs: Radio, DSN, Optical, Radar, GPS, Radar



Section 332

Communications Architectures & Research

- Deep Space and Ground Telecom System Engineering
- Optical Communication R&D and Implementation
- Coding and Data Compression
- Information Processing
- Optical and RF Communication Networks
- Digital Signal Processing Research
- Digital Projects
- Planetary Radar
- Spectrum Engineering
- Telecomm Architectures
- Quantum Sciences & Technology
- Radio Science Systems

Section 333

Communication Ground Systems

- Ground Antenna RF Engineering and Design
- High Power Exciters and Transmitters
- Cyro-Electronics Front-End Equipment
- Exciter & RF/Millimeter Subsystems
- Transmitter Engineering
- Telecom Signal Processing Engineering
- Antenna Front End System Engineering
- Front End Controller
- Antenna Mechanical & Structural Engineering, Design, Implementation
- Antenna Microwave Engineering
- Deep Space/Ground Communications System

Section 334

Radar Science & Engineering

- Advanced Radar Concepts, Technology & Implementation
- Experimental Radar
- System Engineering and Implementation
- Algorithm Development and Data Processing
- IFSAR Phenomenology & Product Verification
- Scatterometer/ Radiometer System Engineering
- Scatterometer Processing Algorithms & Analysis
- Polar Remote Sensing
- Atmospheric Radar Science & Engineering
- Radar Science Applications
- SAR Phenomenology and Product Verification

Section 335

Tracking Systems & Applications

- Advanced Radio Metric Instrument Development
- Astronomical Measurements
- Deep Space Tracking Systems, Delta DOR, VLBI, Antenna Arraying
- Precision Frequency & Timing Advanced Instrument Development
- Precision GPS Systems and Networks
- Ionospheric, Atmospheric Remote Sensing
- Orbiter & Radiometric Systems
- Processor Systems Development
- Satellite Geodesy & Geodynamics Systems
- Space Geodetic Science & Applications
- Autonomous Formation Flying

Section 337

Flight Communications Systems

- Spacecraft Antennas
- Spacecraft Radio Frequency Subsystems
- Spacecraft Transmitter Systems
- Spacecraft Antenna Research and Design
- Spacecraft Transponders & Signal Processing
- Proximity Radios
- Software Defined Radios
- Communications Systems & Operations
- Spacecraft High Voltage High Power Electronics
- Antenna EM Scattering Modeling, Simulation and Metrology



JPL Telecom Capability
Infrastructure
JPL Points-of-Contact



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- **World-Class Facilities**

- Spacecraft Assembly Facility
- Antenna Development/Measurement Range (Mesa)
- Environmental Test
 - 28 Thermal-Vacuum Chambers including 25 ft Solar Thermal Vacuum, Vibration, Shock, ESD
- Micro Devices Lab
 - Crystal growth, deposit, etch, substrates, bonding
- Optical Comm Telescope Lab (Table Mountain)
- Frequency and Timing Lab
- DSN Technology Facility -21 (DTF-21)
 - S/C to DSN compatibility testing
- DSS 13 Development Antenna at Goldstone
- Mechanical Lightweight Structures Facility
- Telecom Development Lab
 - Modulation, coding, protocols

- **Division 33 Facilities**

- 37 New Product Development Labs
 - Microcircuit, Radar, Optical, Digital, Wireless Comm, DSN components
- 74 Product Integration and Test Labs
 - Telecom, Radar, GPS, DSN, Optical
- 14 Software Development Labs





Current Activities that Support Future Telecom*

- **Installation and commissioning of the Optical Communications Telescope Laboratory (OCTL)**
- **Establishment of a world-class optical detector evaluation laboratory for low light level signals**
- **Establishment of a development contract: 100 Watt Ka-band TWTA**
- **A universal encoder design for a family of LDPC Codes**
- **Design for a compact wide-bandwidth Ka-band maser LNA**
- **An early prototype Z-fold deployment technique for a large aperture ka-band inflatable antenna**
- **Novel techniques for combining Ka-band SSPA signals**
- **End-to-end coding and protocols**
- **Design for a single chip transceiver for planetary surface comm**
- **Phased array (transmit and receive) antenna that uses no phase shifters**
- **A method for achieving real-time position knowledge of earth orbiting spacecraft to 10 cm level**
- **Demonstration of key attributes of an atomic reference standard (clock oscillator) for use in space**
- **Installation of the advanced Water Vapor Radiometer in Madrid and its use in intercontinental Ka-band VLBI**
- **Flight demonstration terminal on Mars Telecom Orbiter (MTO) with GSFS and Lincoln Labs 1-10 Mbps from Mars**
- **Large aperture ground Antenna Array**

*** Partial List of Activities**



Current Activities that Support Future Telecom* (con't)

More new developments that JPL personnel and facilities are currently supporting:

- **Design Coding for High Data Rate Link**
- **Autonomous Radio Proximity Links**
- **Fresnel Lens Ground Receivers**
- **X-band Agile Beam Transmitter**
- **Fast Accurate EM Modeling**
- **UHF/X-band Proximity Link Antenna**
- **Mars Proximity Micro Transceiver**
- **Reprogrammable Transceiver**
- **Lite version of ELECTRA Proximity Radio**
- **Beyond Ka-band RF communications (90 GHz or above) power efficient amplifiers**
- **Very large effective antenna apertures and antenna pointing technology**
- **Auto-tracking antennas and proximity transmission technologies for in-situ exploration transmission and relay including formation flying**
- **Deep space optical communications**
- **Adaptive optics to compensate adverse effects due to atmospheric distortions, including phase tilt**
- **Architectures, protocols for autonomous, efficient, reliable data delivery over planetary distances**
- **Direct aerial platform to Earth communications from distant planets**
- **Ground Lunar communication antenna arrays and ground Deep Space antenna arrays**
- **and much more.....**



Examples of Established & Advanced DS Radar Capability in Past 40 Years

ESE Knowledge Required	Measurement Technique
Ocean Topography, sea level height	Wide Swath Altimeter
Ocean Surface Winds	Ku-band Scatterometer
Sea ice extent	Ku-band Scatterometer
Sea surface salinity	L-band passive/active Microwave Instrument
Strain field, Deformation, Stress accumulation, Surface topology	L-band interferometric SAR
Polar ice sheet velocity field	L-band interferometric SAR
Global precipitation	Dual frequency (14 & 35 GHz) rain radar
Cloud particle properties & distribution	W-band (94 GHz) cloud profiling radar
Soil moisture	L-band passive/active Microwave Instrument
Snow cover and accumulation	Dual frequency (Ku- and L-band) polarimetric SAR
River stage height and discharge rate	Ka-band radar altimeter
Land freeze and thaw transition	L-band SAR
Carbon Sources and sinks	Low frequency (P- or L-band) polarimetric SAR
Terrain profiling and topography	SAR interferometric radar (Shuttle Radar Topography Mapper)
Note: ESE measurements can be applied to Planetary science.	