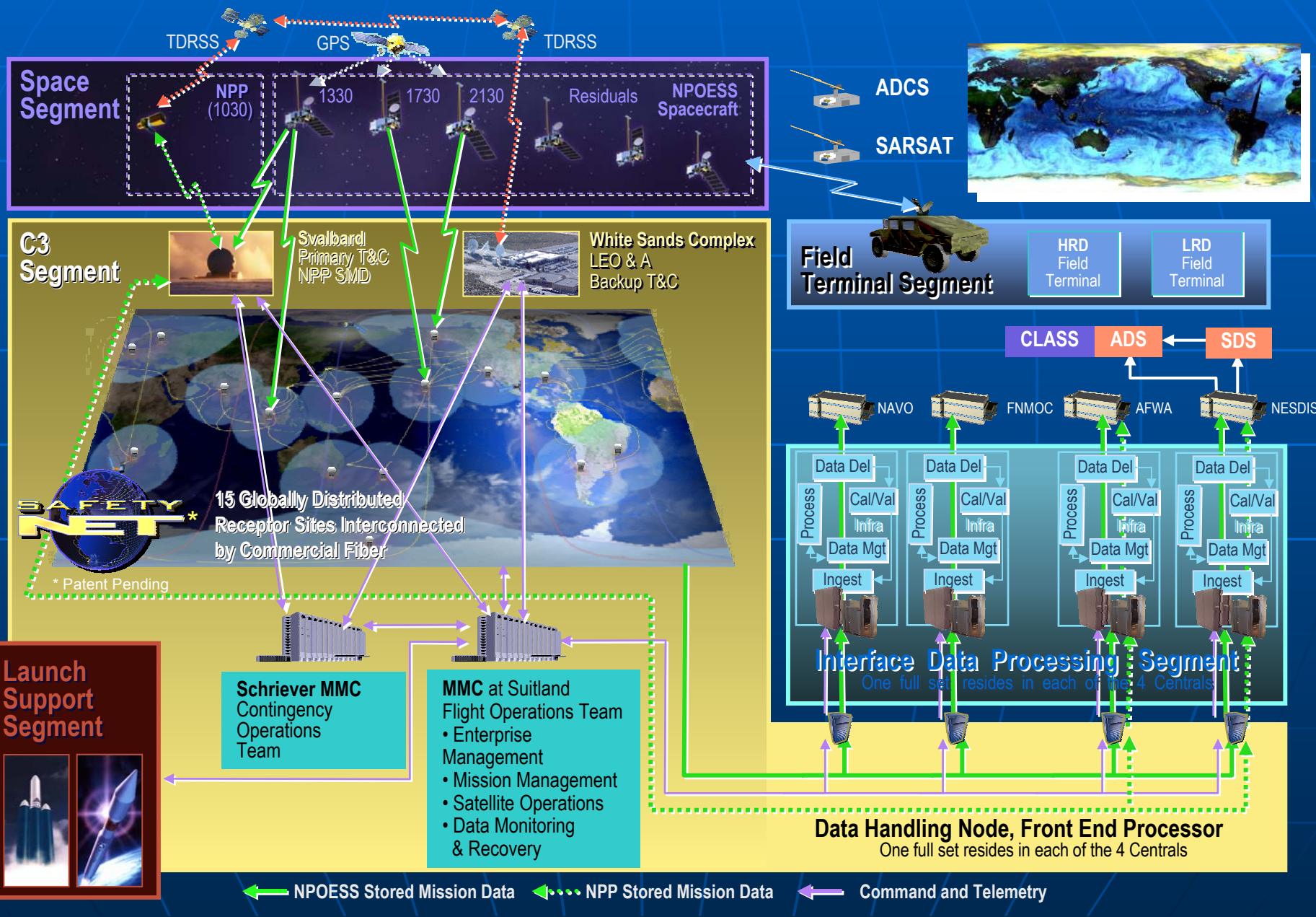
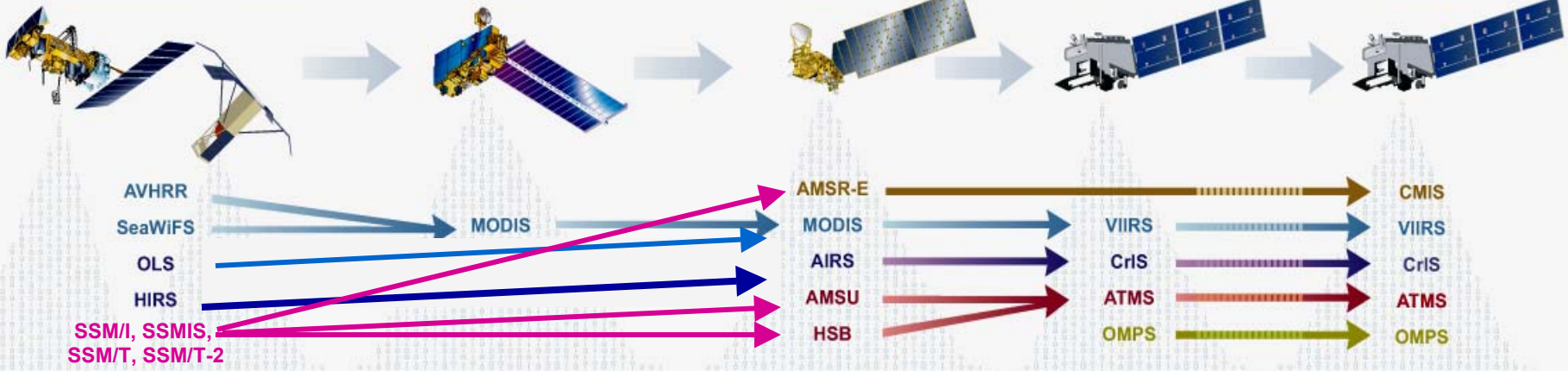
NPOESS
Direct Readout Mission

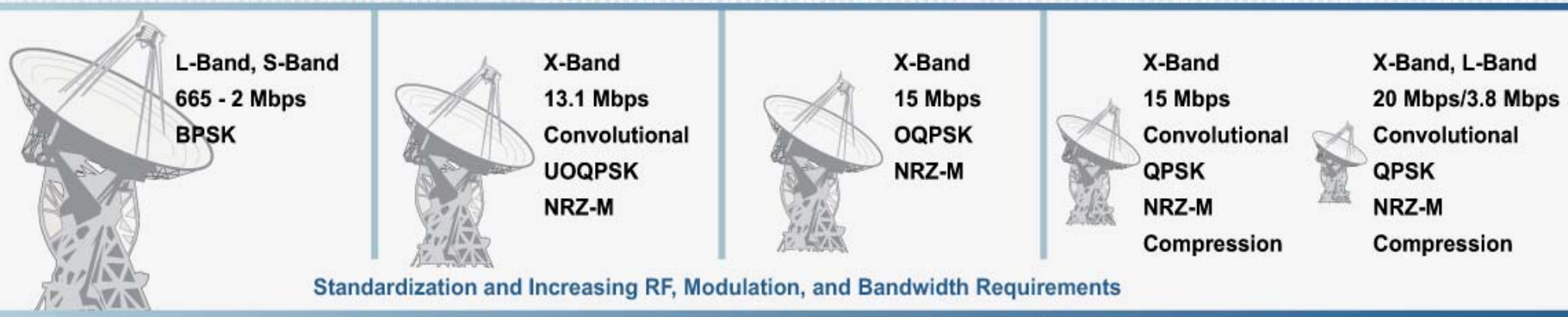
# Fully Integrated System Architecture



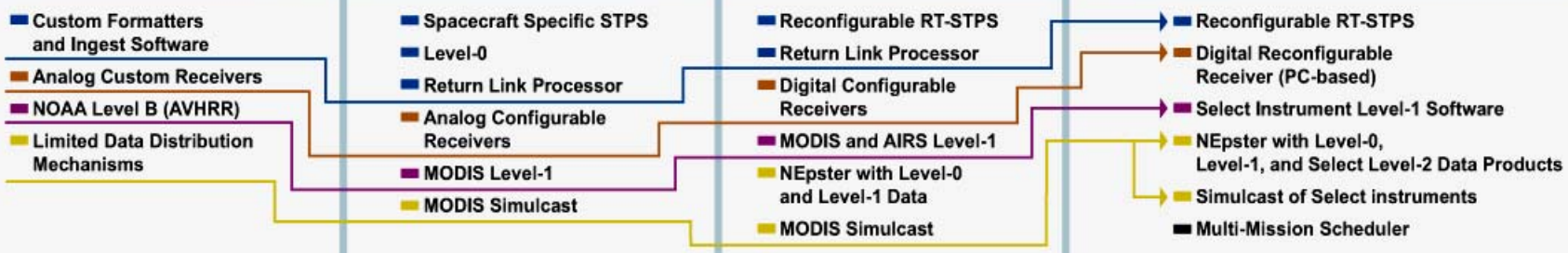
# Ensuring Direct Broadcast Continuity




Spacecraft and Instrument Evolution

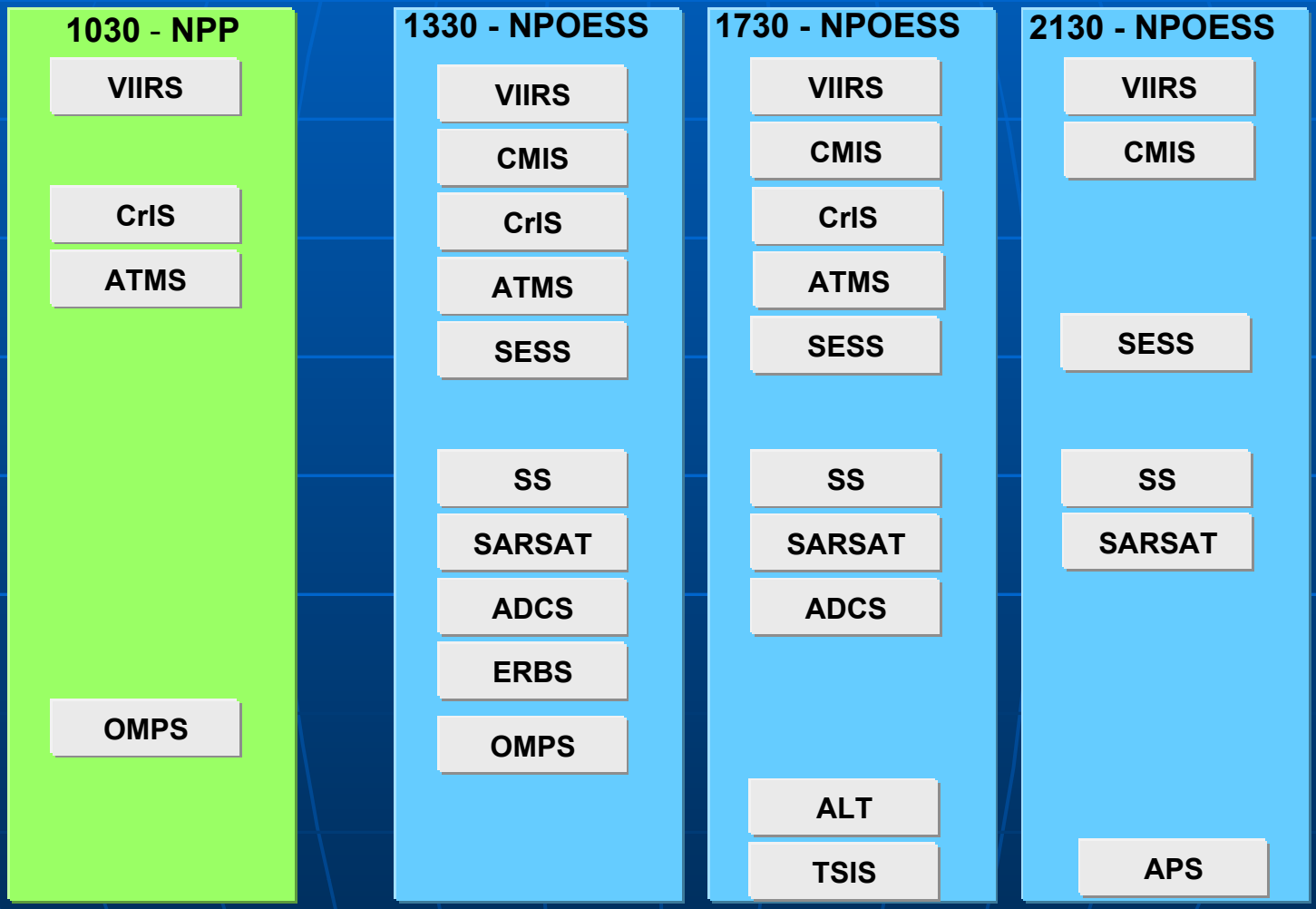



Standardization and Increasing RF, Modulation, and Bandwidth Requirements




Evolution of Concurrent Ground Systems Supporting Technologies and Algorithm Development

# NPOESS / NPP Sensor Manifest



# NPP Sensors Contribute 27 of 55 Environmental Data Records

- Atm Vert Moist Profile
- Atm Vert Temp Profile
- Imagery
- Sea Surface Temperature
- Sea Surface Winds
- Soil Moisture
- Aerosol Optical Thickness
- Aerosol Particle Size
- Aerosol Refractive Index
- Albedo (Surface)
- Auroral Boundary
- Auroral Energy Deposition
- Auroral Imagery
- Cloud Base Height
- Cloud Cover/Layers
- Cloud Effective Part Size
- Cloud Ice Water Path
- Cloud Liquid Water
- Cloud Optical Thickness
- Cloud Particle Size/Distrib
- Cloud Top Height
- Cloud Top Pressure
- Cloud Top Temperature
- Down LW Radiance (Sfc)
- Down SW Radiance (Sfc)
- Electric Fields
- Electron Density Profile
- Energetic Ions
- Geomagnetic Field
- Ice Surface Temperature
- In-situ Plasma Fluctuation
- In-situ Plasma Temp
- Ionospheric Scintillation
- Med Energy Chgd Parts
- Land Surface Temp
- Net Heat Flux
- Net Solar Radiation (TOA)
- Neutral Density Profile
- Ocean Color/Chlorophyll
- Ocean Wave Character
- Outgoing LW Rad (TOA)
- $O^3$ – Total Column Profile
- Precipitable Water
- Precipitation Type/Rate
- Pressure (Surface/Profile)
- Sea Ice Characterization
- Sea SFC Height/TOPO
- Snow Cover/Depth
- Solar Irradiance
- Supra-Therm-Aurora Prop
- Surface Type
- Active Fires (Application Product)
- Surface Wind Stress
- Suspended Matter
- Total Water Content
- Vegetative Index

## LEGEND

- VIIRS (24)
- CMIS (19)
- CrIS/ATMS (3)
- OMPS (1)
- SES (13)
- GPSOS (2)
- ERBS (5)
- TSIS (1)
- ALT (3)
- APS (4)

NPP EDRs in BLACK font

# NPOESS High Rate Data (HRD) Environmental Data Records (EDRs)

| | | |
|---|---|---|
| ★ Atm Vertical Temp Profile | Cloud Top Height | Ozone; Total Column/Profile |
| ★ Atm Vertical Moisture Profile | Cloud Top Pressure | Precipitable Water |
| ★ Sea Surface Temperature | Cloud Top Temperature | Precipitation Type/Rate |
| ★ Sea Surface Winds | Downward LW Radiance (Sfc) | Pressure (Surface/Profile) |
| ★ Soil Moisture | Downward SW Radiance(Sfc) | Sea Ice Characterization |
| ★ Imagery | Electric Field | Sea Surface Height/Topo. |
| Active Fires (Application Product) | Electron Density Profile | Snow Cover/Depth |
| Aerosol Optical Thickness | Energetic Ions | Solar Irradiance |
| Aerosol Particle Size | Geomagnetic Field | Supra-Thermal-Auroral Part. |
| Aerosol Refractive Index | Ice Surface Temperature | Surface Type |
| Albedo (Surface) | In-*situ* Plasma Fluctuations | Surface Wind Stress |
| Auroral Boundary | In-*situ* Plasma Temperature | Suspended Matter |
| Auroral Energy Deposition | Ionospheric Scintillation | Total Water Content |
| Auroral Imagery | Medium Energy Charged Particles | Vegetation Index |
| Cloud Base Height | Land Surface Temperature | |
| Cloud Cover/Layers | Net Heat Flux | |
| Cloud Effective Particle Size | Net Solar Radiation (TOA) | |
| Cloud Ice Water Path | Neutral Density Profile | |
| Cloud Liquid Water | Ocean Color/Chlorophyll | |
| Cloud Optical Thickness | Ocean Wave Characteristics | |
| Cloud Particle Size/Distribution | Outgoing LW Radiation (TOA) | |

| | |
|---|---|
| VIIRS | 25 |
| CMIS | 19 |
| CrIS/ATMS | 3 |
| OMPS | 1 |
| SES | 13 |
| ERBS | 5 |
| TSIS | 1 |
| ALT | 3 |
| APS | 4 |

★ EDRs with Key Performance Parameters

# NPOESS Low Rate Data (LRD) Environmental Data Records (EDRs)

| | | |
|---|---|---|
| ★ Atm Vertical Temp Profile #2 | Cloud Top Height | Ozone; Total Column/Profile |
| ★ Atm Vertical Moisture Profile #3 | Cloud Top Pressure (P) | Precipitable Water |
| ★ Sea Surface Temperature #8 | Cloud Top Temperature | Precipitation Type/Rate |
| ★ Sea Surface Winds #4 | Downward LW Radiance (Sfc) | Pressure (Surface/Profile) #7 |
| ★ Soil Moisture | Downward SW Radiance(Sfc) | Sea Ice Characterization |
| ★ Imagery #1 | Electric Field | Sea Surface Height/Topo. |
| Active Fires (P) (Application Product) | Electron Density Profile | Snow Cover/Depth |
| Aerosol Optical Thickness | Energetic Ions | Solar Irradiance |
| Aerosol Particle Size | Geomagnetic Field | Supra-Thermal-Auroral Part. |
| Aerosol Refractive Index | Ice Surface Temperature | Surface Type (P) |
| Albedo (Surface) | In-*situ* Plasma Fluctuations | Surface Wind Stress |
| Auroral Boundary | In-*situ* Plasma Temperature | Suspended Matter |
| Auroral Energy Deposition | Ionospheric Scintillation | Total Water Content |
| Auroral Imagery | Medium Energy Charged Particles | Vegetation Index (P) |
| Cloud Base Height #5 | Land Surface Temperature | |
| Cloud Cover/Layers #6 | Net Heat Flux | |
| Cloud Effective Particle Size | Net Solar Radiation (TOA) | |
| Cloud Ice Water Path (P) | Neutral Density Profile | |
| Cloud Liquid Water | Ocean Color/Chlorophyll | |
| Cloud Optical Thickness | Ocean Wave Characteristics | |
| Cloud Particle Size/Distribution | Outgoing LW Radiation (TOA) | |

| | |
|---|---|
| VIIRS | 25 |
| CMIS | 19 |
| CrIS/ATMS | 3 |
| OMPS | 1 |
| SES | 13 |
| ERBS | 5 |
| TSIS | 1 |
| ALT | 3 |
| APS | 4 |

★ EDRs with Key Performance Parameters

# NPOESS EDR-to-Sensor Mapping

**MISSION AREAS**

- Atmosphere
- Climate
- Space
- Land
- Ocean

## CMIS (19)

- SOIL MOISTURE
- CLOUD LIQUID WATER
- PRECIPITABLE TYPE/RATE
- PRECIPITABLE WATER
- SEA SURFACE WINDS
- CLOUD ICE WATER PATH
- Surface Wind Stress
- Total Water Content
- CLOUD BASE HEIGHT
- Ice Surface Temperature
- VISIBLE / IR IMAGERY
- LAND SURFACE TEMP
- Sea Ice Characterization
- Snow Cover/Depth
- Surface Type
- SEA SURFACE TEMPERATURE

## SESS (13)

- Auroral Boundary
- Auroral Energy Deposition
- Electric Fields
- Electron Density Profile
- Auroral Imagery
- Energetic Ions
- Geomagnetic Field
- In-situ Plasma Fluctuation
- In-situ Plasma Temp
- Ionospheric Scintillation
- Med Energy Chgd Parts
- Neutral Density Profile
- Supra-Therm-Aurora Prop

## VIIRS (22)

- ALBEDO (SURFACE)
- CLOUD COVER/LAYERS
- CLOUD EFFECTIVE PART SIZE
- CLOUD OPTICAL THICKNESS
- CLOUD TOP HEIGHT
- CLOUD TOP PRESSURE
- CLOUD TOP TEMPERATURE
- Net Heat Flux
- Ocean Color/Chlorophyll
- Suspended Matter
- Vegetative Index
- ACTIVE FIRES

## CrIS/ATMS (3)

- ATM VERT MOIST PROFILE
- ATM VERT TEMP PROFILE
- PRESSURE (SURFACE/PROFILE)

## ERBS (4)

- Down LW Radiance (Sfc)
- Down SW Radiance (Sfc)
- Net Solar Radiation (TOA)
- Outgoing LW Rad (TOA)

## APS * (4)

- AEROSOL OPTICAL THICKNESS
- AEROSOL PARTICLE SIZE
- Aerosol Refractive Index
- Cloud Particle Size/Distrib

## TSIS (1)

- Solar Irradiance

## ALT (2)

- OCEAN WAVE CHARACTERISTICS
- Sea Surface Height

## OMPS (1)

- $O^3$ Total Column & Profile

**KEY**

Underlined = NPP EDRs (25)

○ = NPOESS Key Performance Parameters

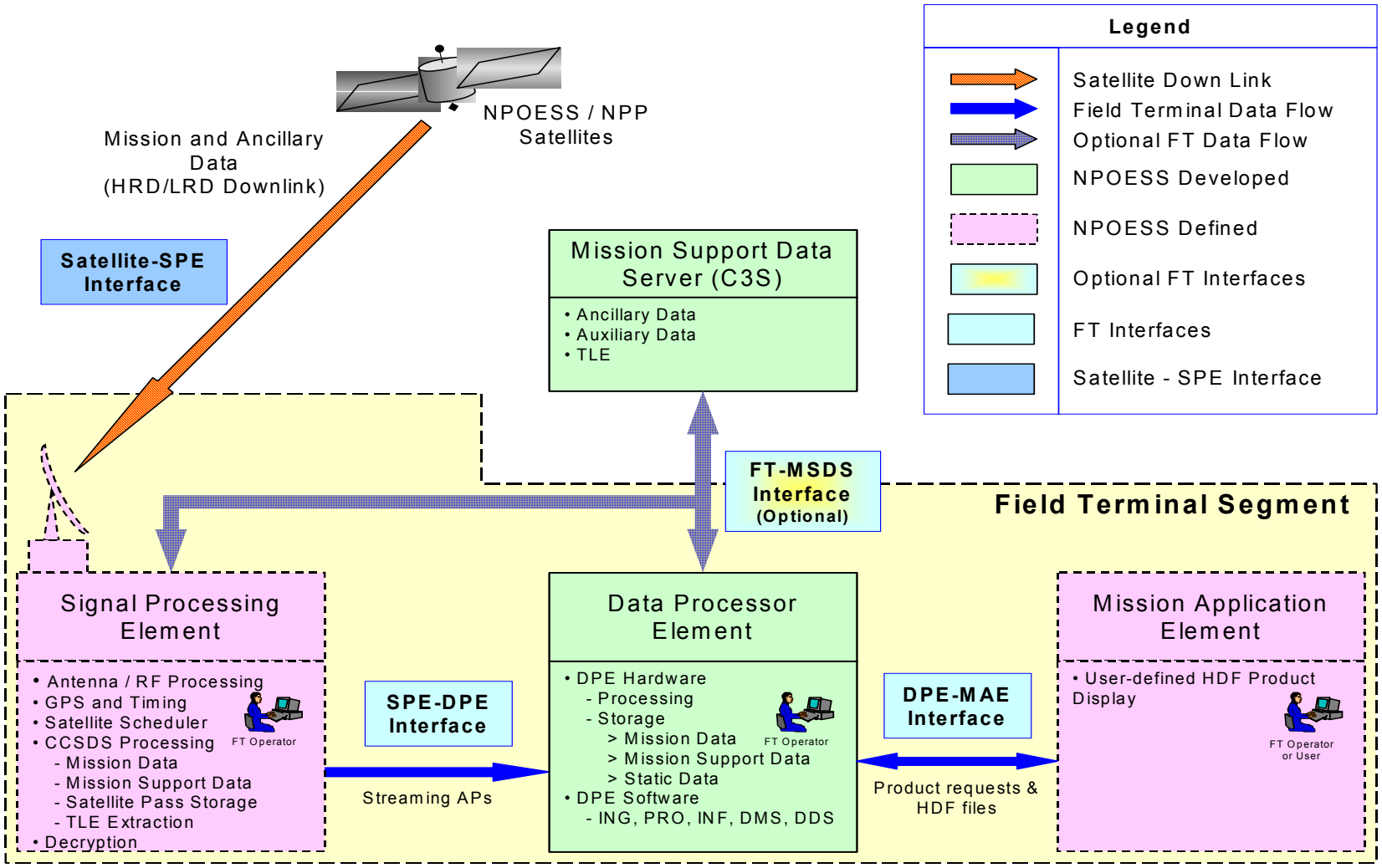
BOLD CAPS = LDR Environmental Data Records

* = not yet on contract

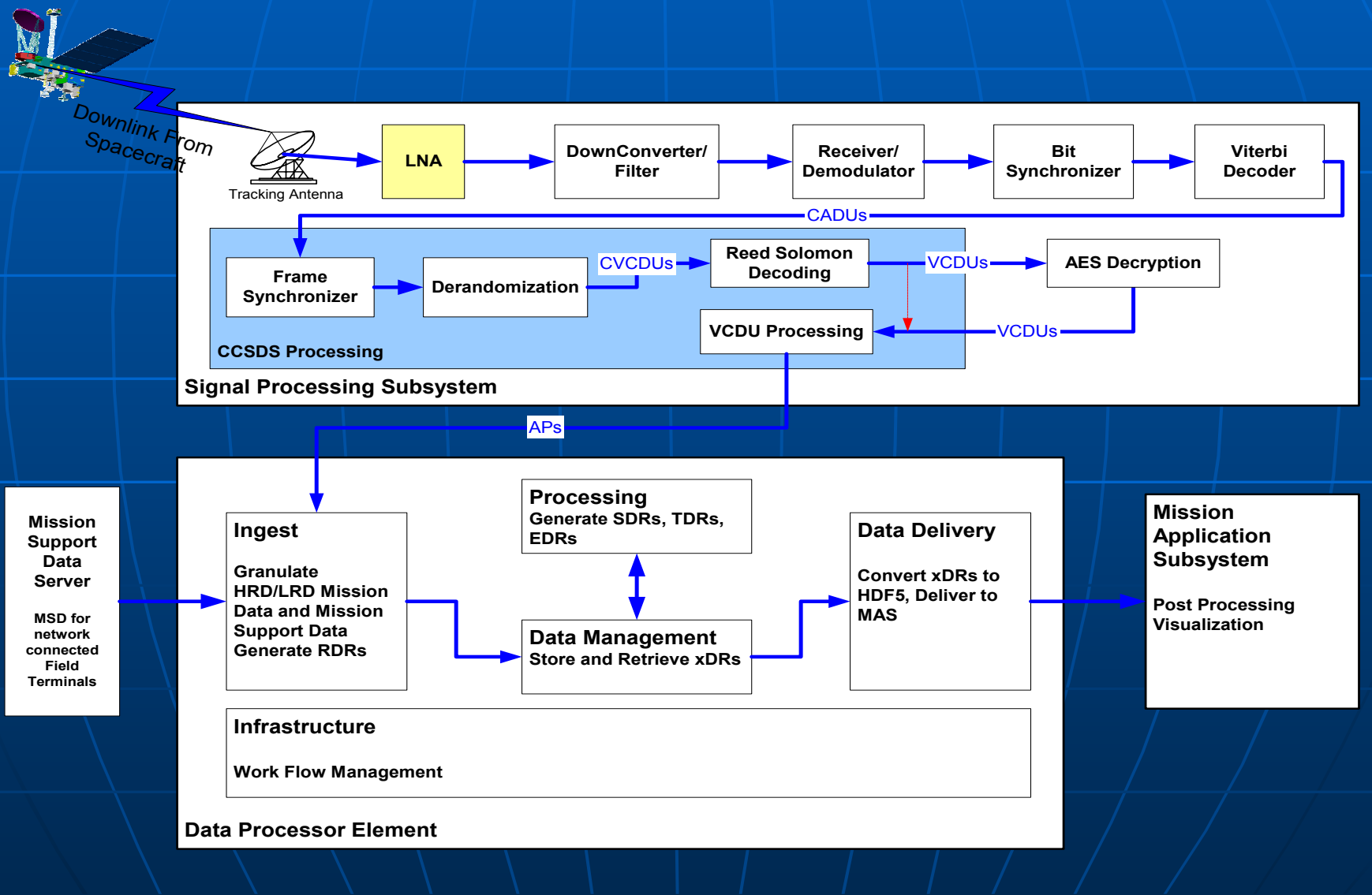
16 Nov 2004

DOC, NOAA, NESDIS,
Integrated Program Office
D. Pierce, J. Whitcomb, J. Schaeffer

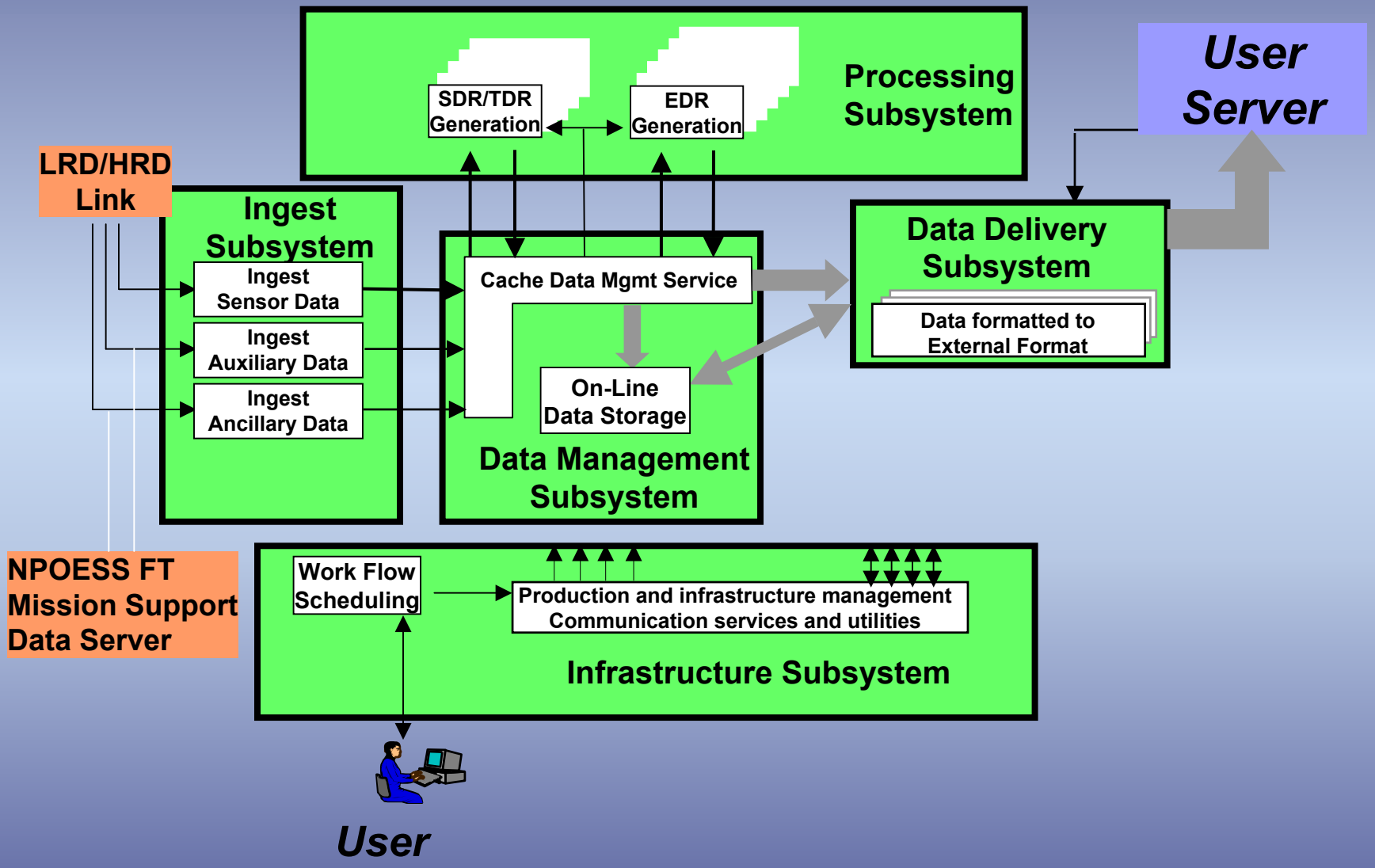
# Direct Readout Interfaces



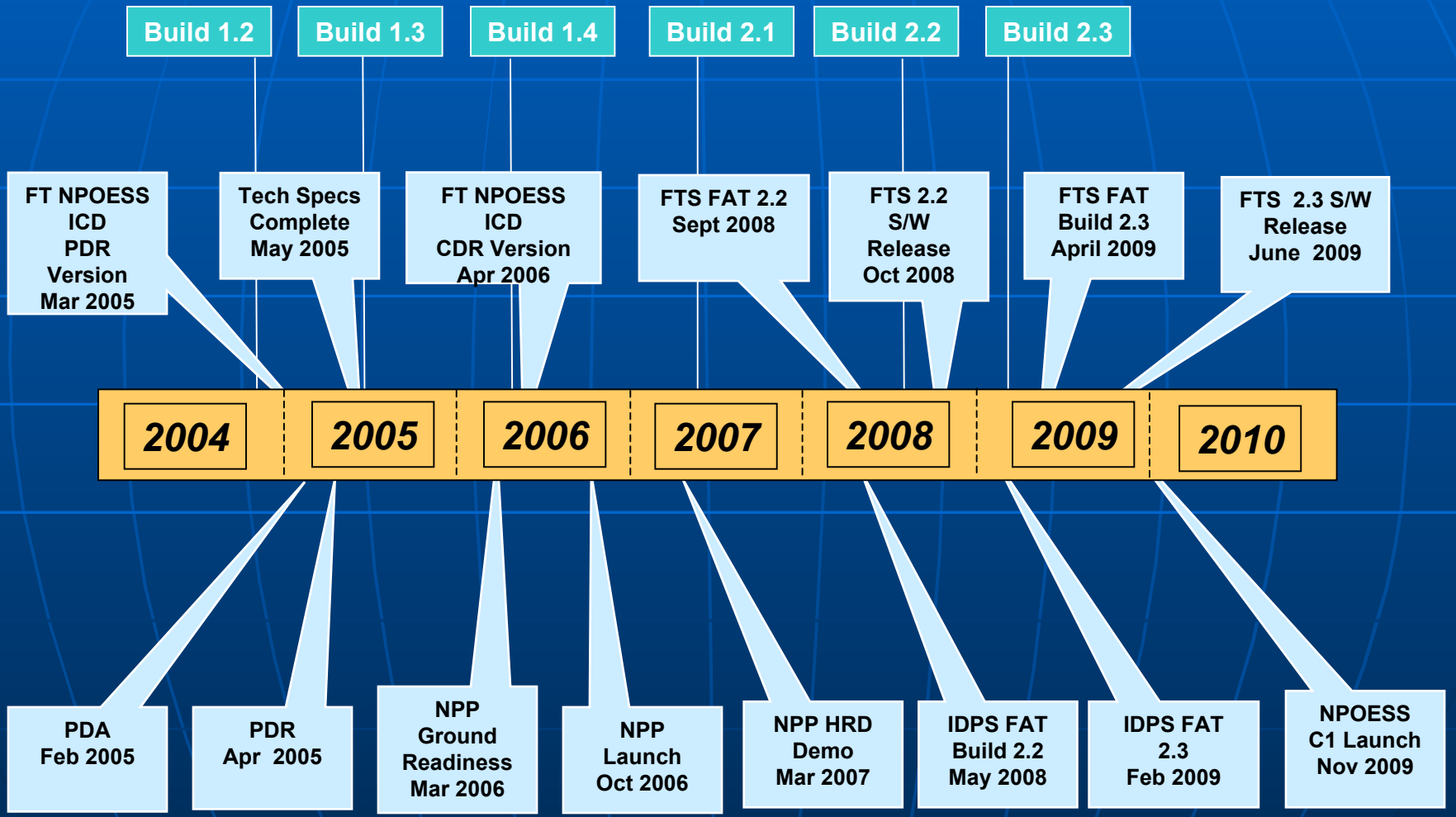
# NPOESS FTS Architecture



# Data Processor Element Architecture



# NPOESS Field Terminal Segment Schedule



# Field Terminal Data Processor Element Software Design

- Open Systems Group standards compliance at interfaces minimizes configurations
- Programmable downlinks
- Onboard VIIRS data compression (6:1) rates by APID for LRD
- Dynamic ancillary data delivery via satellite downlink
- Optional ancillary data delivery via internet
- NPOESS Mission Support Data Server via Internet access

# Field Terminal Ancillary Data in Data Stream

- Dynamic ancillary data contained within LRD and HRD downlinks to meet specified performance levels

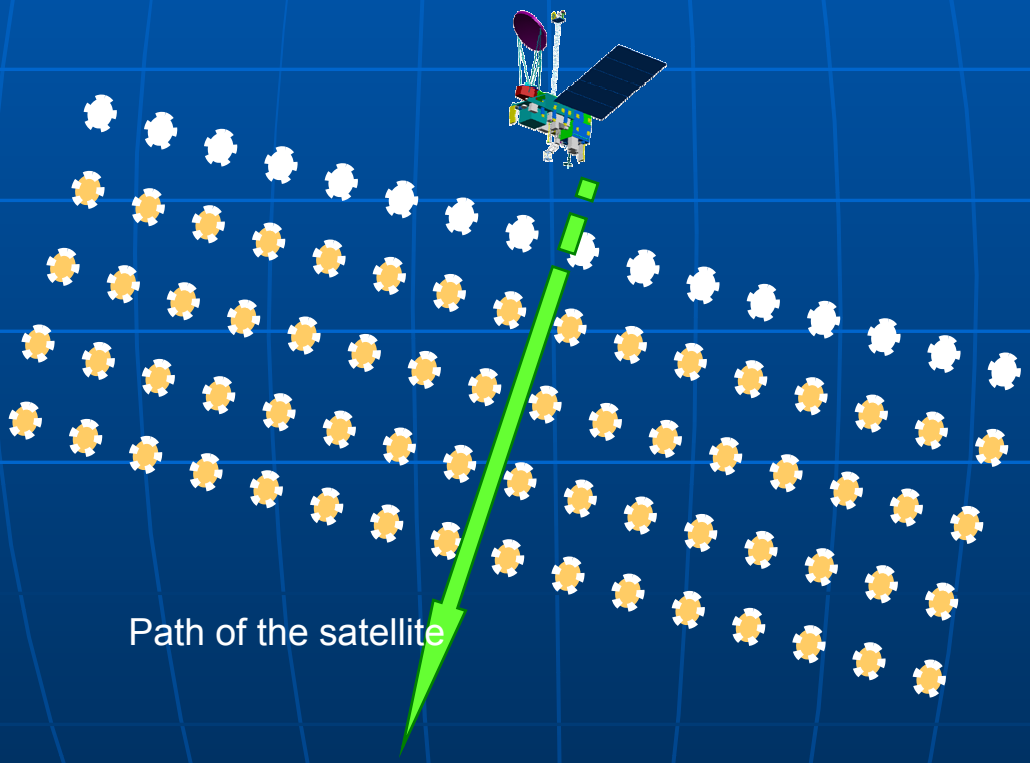
- Data for six pressure levels from the NWP forecast model:
  - Temperature
  - Humidity
  - Surface pressure
  - Standard pressure levels
  - Wind speed, wind direction
  - Perceptible water

- For SESS EDR production
  - Effective sunspot number and global geomagnetic Kp

- NPOESS mission support data server, accessible via internet

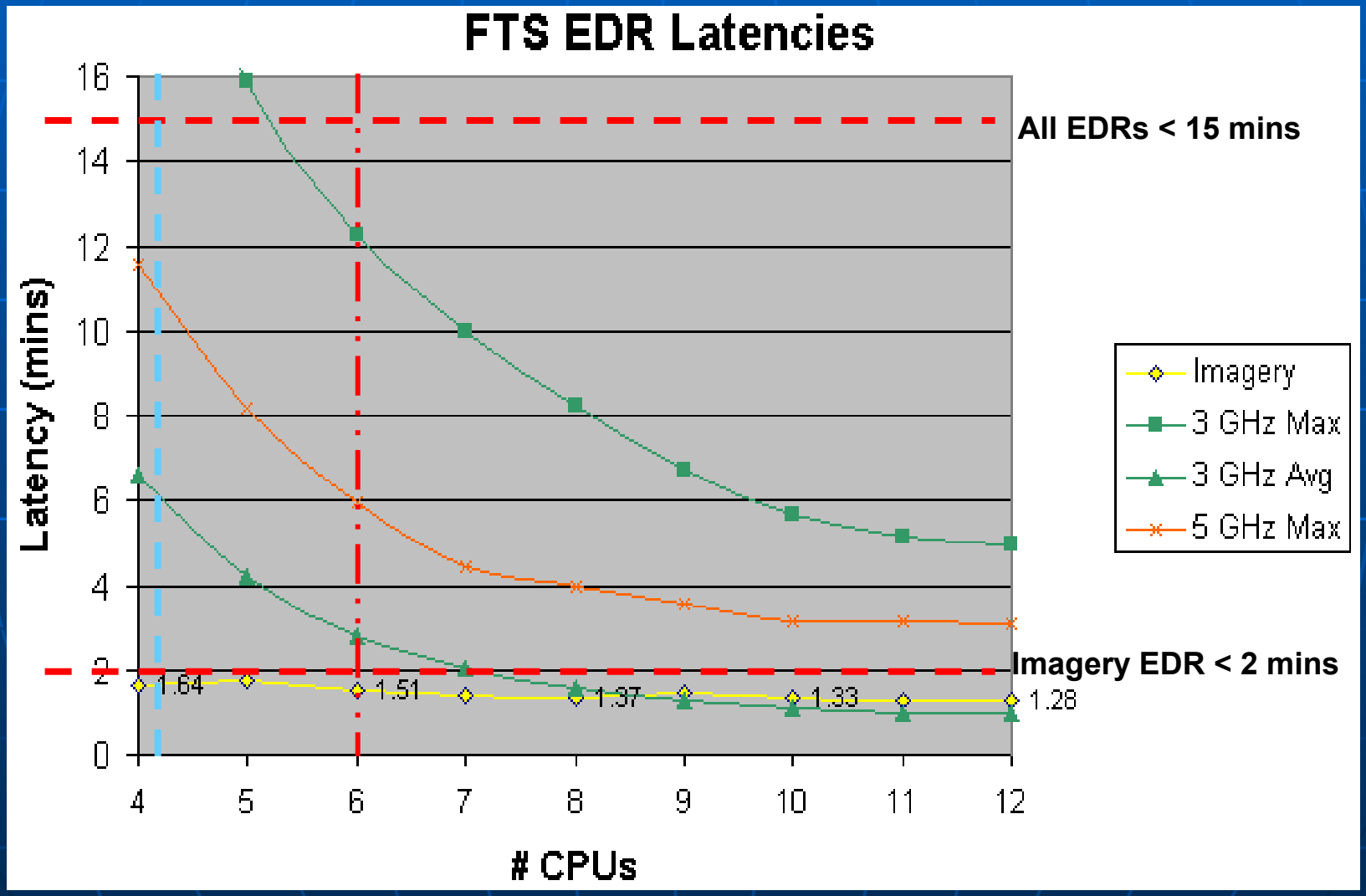
# Ancillary Data Downlink Graphical Representations

- 16 points spaced 200 kilometers apart at right angles to the ground track
- Completely covers the area viewed by all sensors




- Successive lines 200 kilometers apart
- Each line transmitted twice to ensure receipt by the ground

# FTS Latency Status
# All EDRs & Imagery EDR



# NPOESS Direct Readout Mission Points of Contact


| | |
|---|---|
| John Overton: | john.overton@noaa.gov |
| Bill Munley: | bill.munley@noaa.gov |
| Joe Mulligan: | joe.mulligan@noaa.gov |
| John van de Wouw: | johnvandewouw@ngc.com |
| Patrick Coronado: | patrick.coronado@nasa.gov |
| Kelvin Brentzel: | kelvin.brentzel@gsfc.nasa.gov |


## ***NPOESS websites***

http://www.npoess.noaa.gov

http://npoesslib.ipo.noaa.gov/ (electronic bulletin board)

## The Direct Readout Web Portal:

http://directreadout.gsfc.nasa.gov