European Data Relay Satellite System

EDA Workshop

Brussels

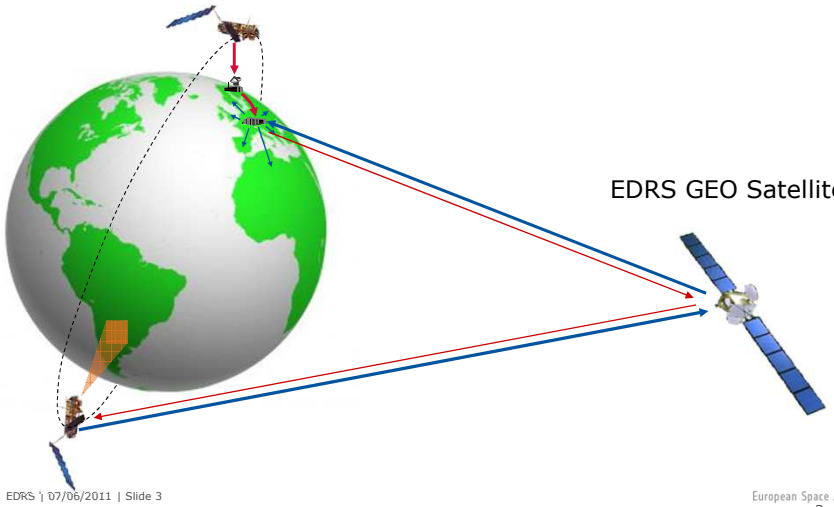
7/06/2011

European Space Agency

Agenda

1. **Rationale for Data Relay Services**
2. **Potential benefits for Earth Observation systems**
3. **EDRS Programme principles, targeted Services and Users**
4. **EDRS system architecture and capability**
5. **Programme status**
6. **Service Offer and Conclusion**

Data Relay Concept



EDRS system concept

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Potential benefits for Earth Observation systems

1. **Largely improved reaction time with much faster access to data** through rapid tasking allowing to
   a. re-configure the LEO satellite mission without having the wait for the satellite to pass over the TM/TC ground station.
   b. and retrieve the wanted observation data in Near Real Time and over broader zones

2. **More data can be acquired**
   a. EDRS supports the downlink of LEO observation data to Ground, complementary to the existing X-Band ground station network
   b. E.g. increasing the duty cycle use of observation instrument otherwise limited by the X band downlink capability

Potential benefits for Earth Observation systems

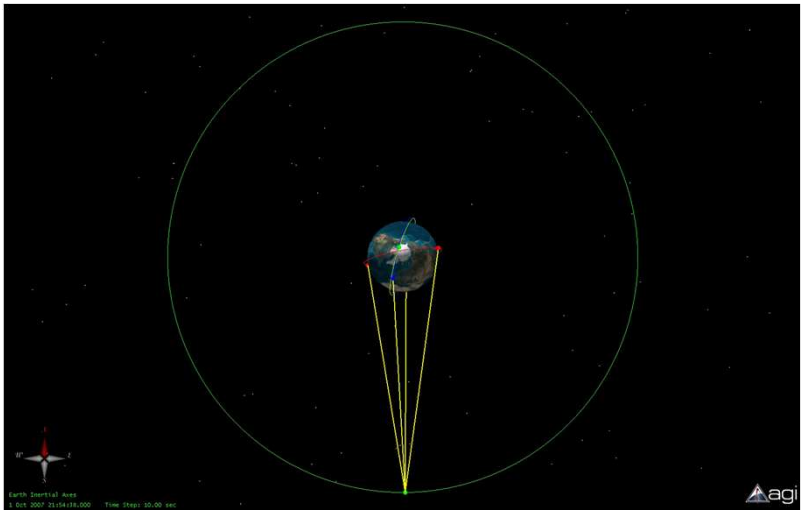
4. **Increased Availability and Reliability**
   a. EDRS, in combination with the X-band ground stations improves the availability and reliability of services to the user

5. **Protected Data Transmission through encryption capability**
   a. EDRS provides the encryption capability to protect data transmission from Space to Ground.
   b. For user already implementing encryption at source on board the LEO it is expected that encryption by EDRS will not be required although still possible.

6. **Optimised mission planning**
   a. The increased contact time duration with EDRS also provides a very high flexibility to programme contact data transfer sessions from the LEO satellite
   b. Allowing to optimise the mission planning of the LEO satellites data transfers from space to ground

7. **Improves efficiency in the ground segment data circulation from stations to processing and archiving centers**
   a. The raw data received at the ground stations then need to be distributed to Processing and Archiving Centers
   b. The data transmitted through EDRS is entirely, simultaneously and directly sent to all Processing and Archiving Centers

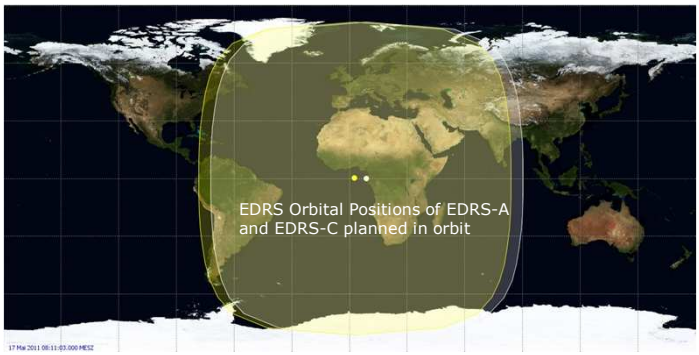
Faster delivery & more data: Sentinel – EDRS contact time (1/2)



Faster delivery & more data: EDRS contact time (2/2)

1. LEO to GEO coverage with LEO visibility nearly 50% of the orbit duration on average.

2. EDRS-LEO contact times around 45 minutes / on average orbit, i.e. 3-4 times the contact time of a polar ground station (based on polar orbits)



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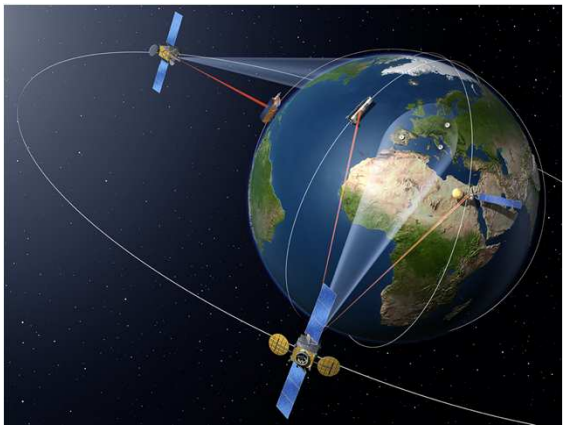
EDRS programme basic principles

Basic EO trends:

- Higher resolution and new wavelength → higher data volumes
- Congestion in traditional telecom means (X-band)
- Need for near-real-time data and rapid tasking

EDRS capabilities:

- Increased contact time
- Higher data rates
- Higher capacity
- Flexible data distribution



EDRS programme basic principles

Service-oriented approach:

- **Operational** system able to fulfil user requirements with required service availability (redundancy)
- **Open** system able to serve all interested user communities with different technologies to meet different needs

Public-Private Partnership:

- Selection of EDRS Operator / Service Provider
- Operator owner of EDRS system infrastructure
- Commitment to operate EDRS system
- Provide services to ESA users
- Commercialise data relay services to all interested user communities

Foster creation of data relay market

A Public Private Partnership initiative

Service-oriented approach with a PPP between ESA and the selected Data Relay Service provider (EADS Astrium Services)

- ESA covers the technological risk related to the development of the EDRS infrastructure
- EDRS Service Provider covers the service provision risk
  - Committed to operate EDRS system and provide services to GMES-Sentinel system with high quality of service (in orbit redundancy) and according to a Service Level Agreement
  - Extend utilisation of data relay services through commercialisation towards other interested user communities

GUARANTEED HIGH QUALITY
DELIVERY OF NEW SERVICES

EDRS targeted services

Data relay services retrieving data from LEO satellites to ground

- Very high data rate at 1.8 Giga bit per second through optical Inter-satellite Link (ISL)
- High data rate of 600 Mega bit per second (Mbps) through optical ISL
- Medium data rate 150-300 Mbps through Ka ISL
- Data provided to customers either directly to own User EDRS ground station (5-6 m antenna) or via terrestrial links from EDRS Central Hubs

Rapid Tasking service re-programming LEO satellites

- A few kilo bits per second through optical ISL
- Up to 1 Mbps through Ka ISL

Equivalent services could be provided to UAV (using the Ka ISL)

EDRS targeted Users

ESA as "anchor user":

GMES programme provides committed start-up user

- Data relay service for Sentinel-1+2 for min. 50% of mission data
- Embarkation of data relay terminal
- EDRS system deployment in time with Sentinel constellation launch schedule
- Operational showcase for other potential users

Any other potential EO operator and in particular military EO systems

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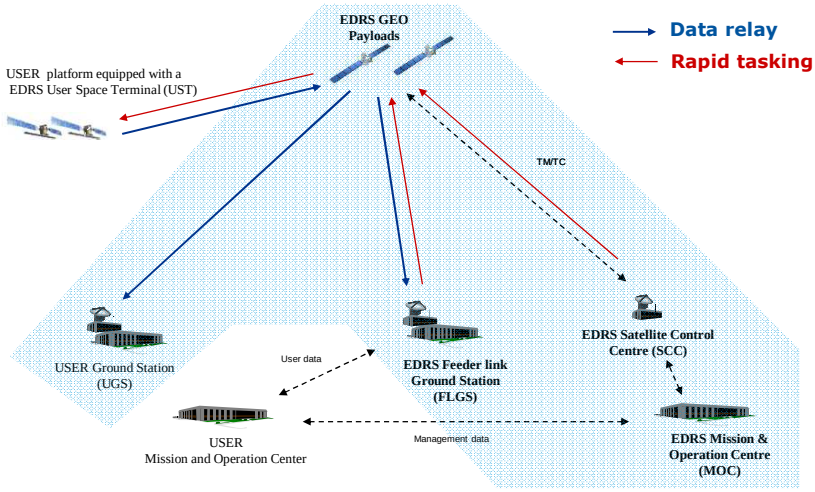
EDRS system architecture



EDRS Space Segment architecture

Space segment formed by 2 elements:

Piggyback payload (EDRS-A)
- On board EUTELSAT commercial satellite to guarantee early in-orbit system element (by 2013) available to provide services to first users (GMES)

Dedicated satellite (EDRS-C)
- Fully controlled by EDRS Operator

=> High service availability through in orbit redundancy

Possible extension if required by user demand (not covered by currently defined programme)
- Other payloads to address other users' needs (e.g. S-band)
- Additional elements (higher system capacity and/or availability)

EDRS system Capabilities

Through EDRS-A piggy back payload:

- Optical ISL data relay services (1.8 Gbps/600 Mbps)
- Optical ISL rapid tasking services (few kbps, through Eutelsat GEO encrypted TM/TC link)
- Ka ISL data relay services (up to 300 Mbps)
- Ka ISL rapid tasking service (up to 1 Mbps through dedicated RF data link)
- High performance Feeder Link in Ka EESS bands (26 GHz) with European coverage
- By-passable data encryption for the optical data relay service at 600 Mbps only

Through EDRS-C satellite:

- Optical data relay services (1.8 Gbps/600 Mbps)
- Optical rapid tasking services (few kbps, through ASV EDRS-C GEO encrypted TM/TC link)
- No Ka ISL relay services
- High performance Feeder Link in Ka EESS bands (26 GHz) with European coverage
- By-passable data encryption for the optical data relay service at 600 Mbps only

EDRS – Data security

The EDRS system offers on board data encryption capabilities

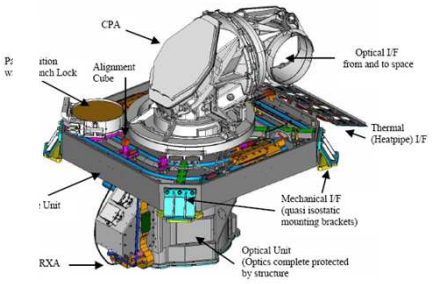
- For customers implementing own data encryption on board their LEO spacecraft it is expected that data encryption by the EDRS system will not be required.
- In any case the encryption function by EDRS can be enabled if required by the customer
- The encryption is performed on board the GEO payload to protect data when transmitted from Space to Ground. Currently only for the data relay service and when operating with the optical ISL at 600 Mbps.
- Rapid tasking service protected through encrypted GEO TM/TC when operating with the optical ISL
- No encryption function available for the data relay nor rapid tasking services when operating with the Ka ISL (encryption assumed at source)

EDRS – ISL terminal on customer side

OPTICAL ISL TERMINAL

From TESAT SpaceCom

- Optical communication @ 1064 nm
- LCT at LEO and GEO end
- Mass ~ 60 kg / 160W DC
- LEO to LEO version already flying and validated on NFIRE and TerraSAR-X



Ka ISL Terminal targeted at 30kg / 100W DC / 80 cm antenna size (TBC)

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EDRS programme status

Authorisation to Proceed signed in March 2011

Contract signature end of Q2 2011

EDRS system operation nominally starting end of 2013 with EDRS-A launch and with redundancy from 2015 with EDRS-C launch, for an initial operational life time up to 2030

Synchronised with Sentinel satellites launches

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EDRS Service offer

A commercial offer

The PPP construction results in the private entity (ASV) owning the system and being solely responsible for commercialisation and operation of the service

According to an agreed Service Level Agreement

Between ASV and the customer defining conditions for service provision, monitoring and prices

The discussion with the Astrium Services must be sufficiently anticipated to allow embarkation of EDRS terminal on board the customer satellite.
Schedule in the order to 18 months for supplying such terminal

The price will be competitive with the traditional cost of X band downlink. The financial engineering of the offer is under discussion

Conclusion

EDRS offers many benefits:

Better Reactivity

Increased Data transmission

Improved Concept of Operations

Improved system reliability by providing an alternative means of data transmission

Cost Efficient Solution for EO operators

Solves security and Sovereignty issues (EO data does not pass through foreign territory)

=> Transition from Mapping to re-active Surveillance
=> EO satellites will create a flood of Data.
=> Data Relay enables this new paradigm change in the EO business

Conclusion

- **EDRS in first stage of implementation phase**
- **The initial EDRS system capabilities will be consolidated in the next few months**
- **ESA is preparing for the next ministerial council end of 2012 with the intention of proposing EDRS extension providing more coverage and more services**

=> ESA IS KEEN TO RECEIVE YOUR FEEDBACK