Direct Broadcast Network (DBNet) for Near Real-Time Relay of LEO Satellite Data

Jérôme Lafeuille and Mikael Rattenborg

WMO Space Programme

WMO, Geneva

ITSC-20, Lake Geneva, WI, 29 October 2015

Acknowledgements

- Nigel Atkinson, Anders Soerensen, Simon Elliott, Mitch Goldberg, Liam Gumley, Anthony Rea, Pascal Brunel, Hidehiko Murata…

- The whole DBNet Coordination group

- All RARS and DBRTN station operators

Weather • Climate • Water

Background : WMO RARS

Regional ATOVS Retransmission Service

- ATOVS data received by globally distributed Direct Broadcast stations
- L1 data consistency ensured by use of common software (AAPP), standardized coding and file naming, and quality monitoring
- Near-real time dissemination via GTS or otherwise (e.g. EUMETCast)
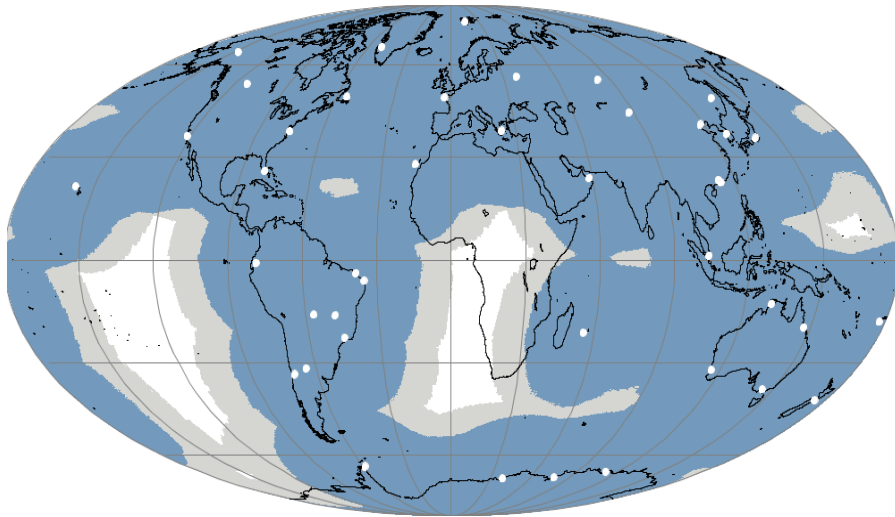
- Initial goal:
  NOAA and Metop ATOVS (L1b) available on the GTS in 30 min from 90% of the globe

- Actual status:
  NOAA and/or Metop ATOVS (L1b) available on the GTS in 20-30 min from 39 stations / 80% of the globe
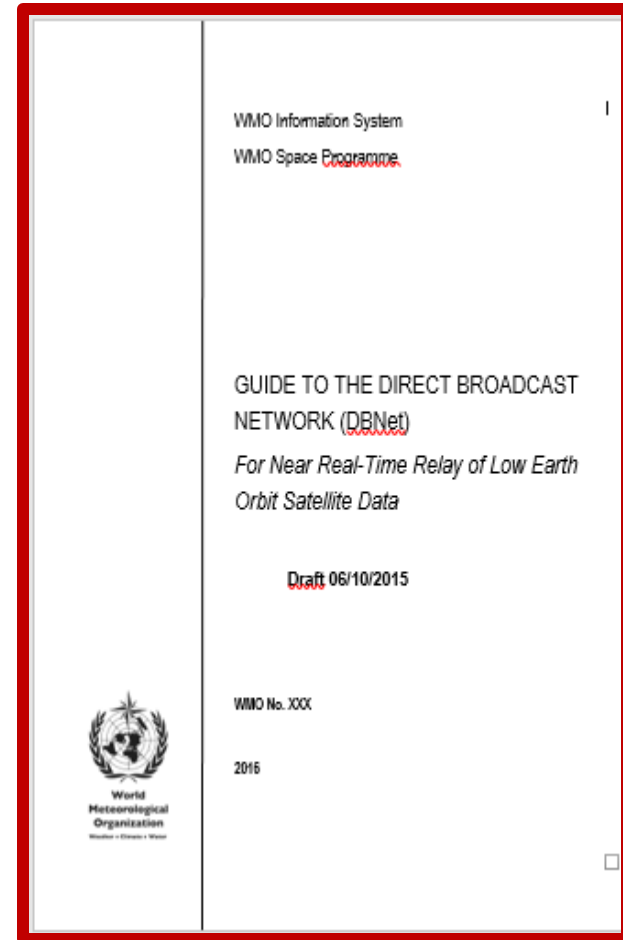
Consensus on the need to evolve from RARS

- ITSC-18 RARS Technical Sub-group (Toulouse)
- CGMS-41 (Tsukuba)
- ITSC-19 RARS Technical Subgroup (Jeju)
- CGMS-42 (Guangzhou)

➢ Extend RARS to hyperspectral sounders & possibly other sensors

➢ Coordinate RARS, EARS, NOAA DBRTN initiatives with a view to define common technical specifications

➢ Describe these specifications in a WMO Technical Guide

Actions taken up at RARS Coord Meeting (Geneva, March 2015) who adopted the name "DBNet" and agreed
to establish a standing "DBNet Coordination group"

Weather・Climate・Water

Towards a Guide on DBNet

- A Guide to DBNet was drafted to record the DBNet specifications, define standards, best practices and coordination mechanisms: http://www.wmo.int/pages/prog/sat/documents/DBNet_Guide-to-DBNet.pdf

- A reference for DBNet providers and users

- Discussed at APSDEU-NAEDEX, ITSC-20 then WMO IPET-SUP, ET-WISC, then CGMS-44 (June 2016) before submission to WMO CBS (Late 2016)

- Living document. Sections on future services can be added or refined later

WMO Information System
WMO Space Programme

GUIDE TO THE DIRECT BROADCAST NETWORK (DBNet)
For Near Real-Time Relay of Low Earth Orbit Satellite Data

Draft 06/10/2015

WMO No. XXX

2016

World Meteorological Organization

Weather · Climate · Water

DBNet Components

- DBNet is composed of regional networks coordinated by regional or sub-regional nodes and a global DBNet Coordination Group
- Global monitoring of product consistency is performed by the NWPSAF

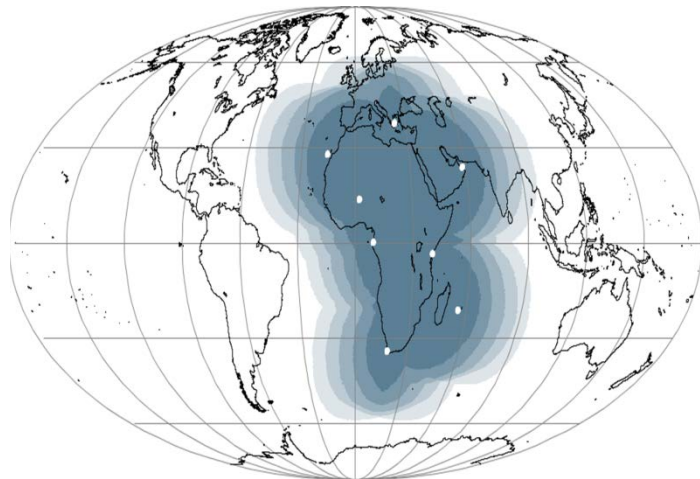| Regional Network	Regional or Sub-regional Node
DBNet - EUMETSAT	EUMETSAT
DBNet - Asia-Pacific	JMA
	BoM
DBNet - South America	INPE
	SMN Argentina / CONAE
DBNet - NOAA	NOAA

Weather • Climate • Water

DBNet (coverage evolution)
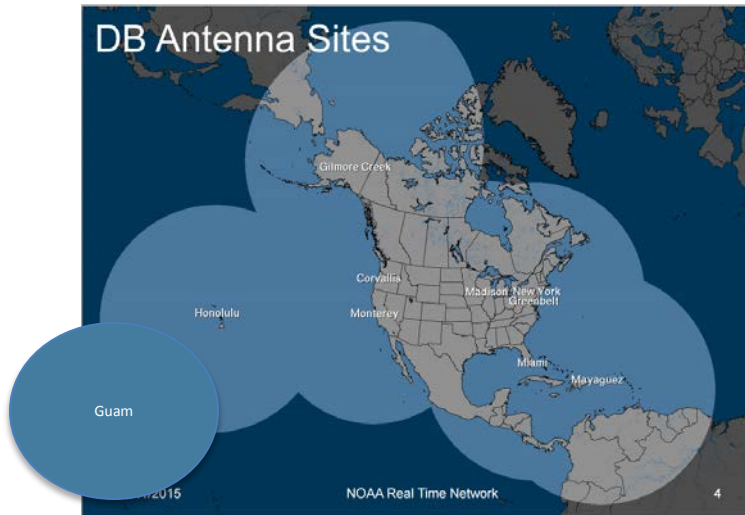
Current network
(ATOVS)
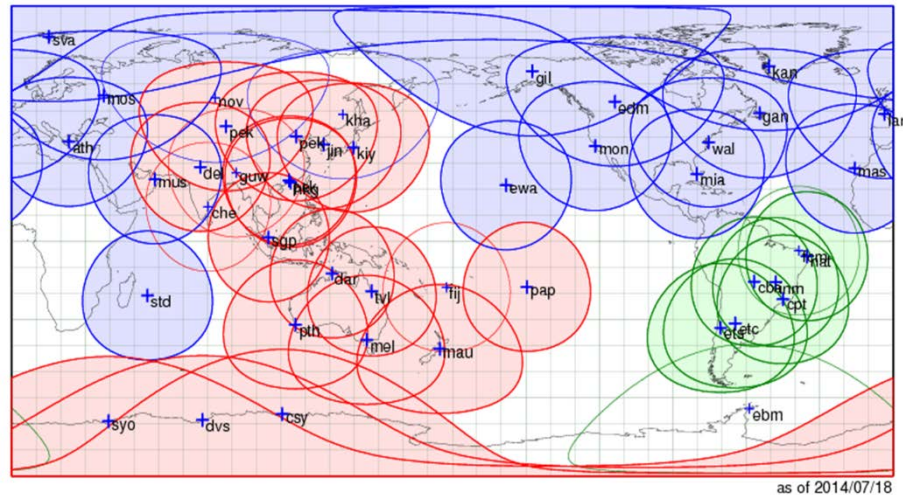
Potential DBnet Africa
(ACMAD project
supported by EC, ATOVS)

New NOAA
Real time
Network
(CrIS, ATMS,
IASI)

Weather · Climate · Water

Current and potential DBNet services

- Each DBNet regional network contributes to one or more "Services"
- A DBNet Service consists of Direct Broadcast acquisition, processing and relay of a category of satellite data
- RARS (ATOVS) will remain, as one of the DBNet Services

Categories of services	Services/Instruments
IR/MW sounding	**RARS** (AMSU-A, MHS, HIRS) ATMS, VASS (MWTS, MWHS, IRAS)
Hyperspectral IR sounding	CrIS, IASI, HIRAS
IR/VIS imaging	VIIRS, AVHRR, MERSI
Scatterometry	ASCAT
MW imagery	MWRI

ITSC-20, Wisconsin, 29 October 2015

Weather • Climate • Water

Draft DBNet High-Level Service Specifications

| Category of Service	Driving Application	Products	Data latency goal/threshold	Availability	Coverage
IR/MW sounding	Global and High-Res NWP	Level 1 brightness temperatures	20 min/ 30 min	95%	90%
IR/VIS imaging	Nowcasting	Level 1 radiance /reflectivity	10 min/ 20 min	95%	30%
Hyperspectral IR sounding	Global and High-Res NWP	Level 1 radiances and PC scores	20 min/ 30 min	95%	60%
Scatterometry	NWP, Nowcasting and Ocean applications	backscatter cross-sections	20 min/ 30 min	95%	50% (of oceanic areas)
MW imagery	NWP, Nowcasting,	Level 1 brightness temperatures	20 min/ 30 min	95%	30%

Weather • Climate • Water

DBNet Areas of harmonisation/standardisation

http://www.wmo.int/pages/prog/sat/documents/DBNet_Guide-to-DBNet.pdf

1. DBNet Network Management
   - Operational monitoring
   - Implementation planning
   - User information

2. Common DBNet Standards and Recommended Practices
   - Acquisition
   - Product Processing (AAPP, CSPP etc.)
   - Product Coding, Format and Distribution
   - DBNet Product Registration and Discovery

3. Specific Standards for Groups of DBNet Services
   - IR/MW sounding
   - IR/VIS imaging
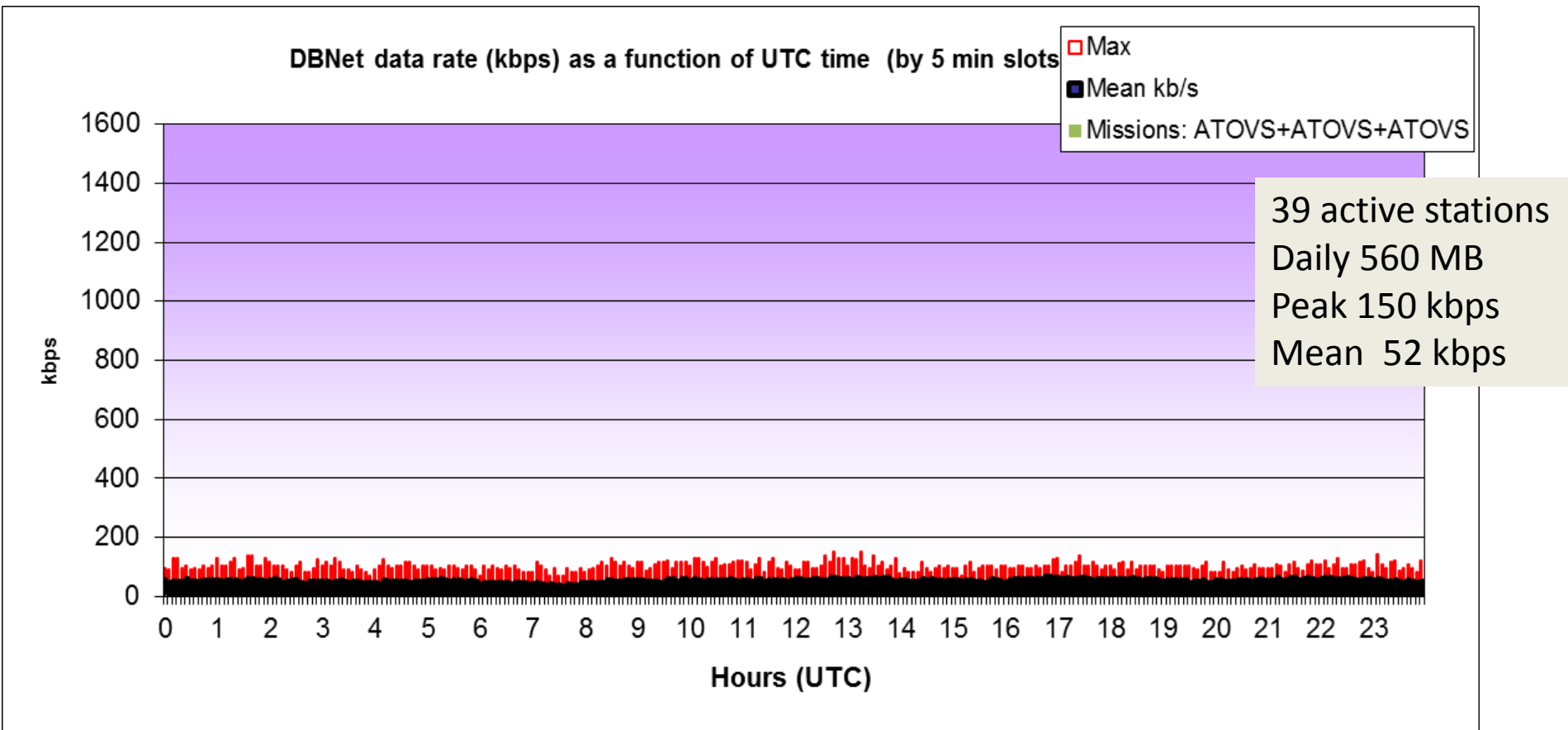   - Hyperspectral IR Sounding
   - Scatterometry

Weather · Climate · Water

Common processing software suite and orbital elements for product consistency
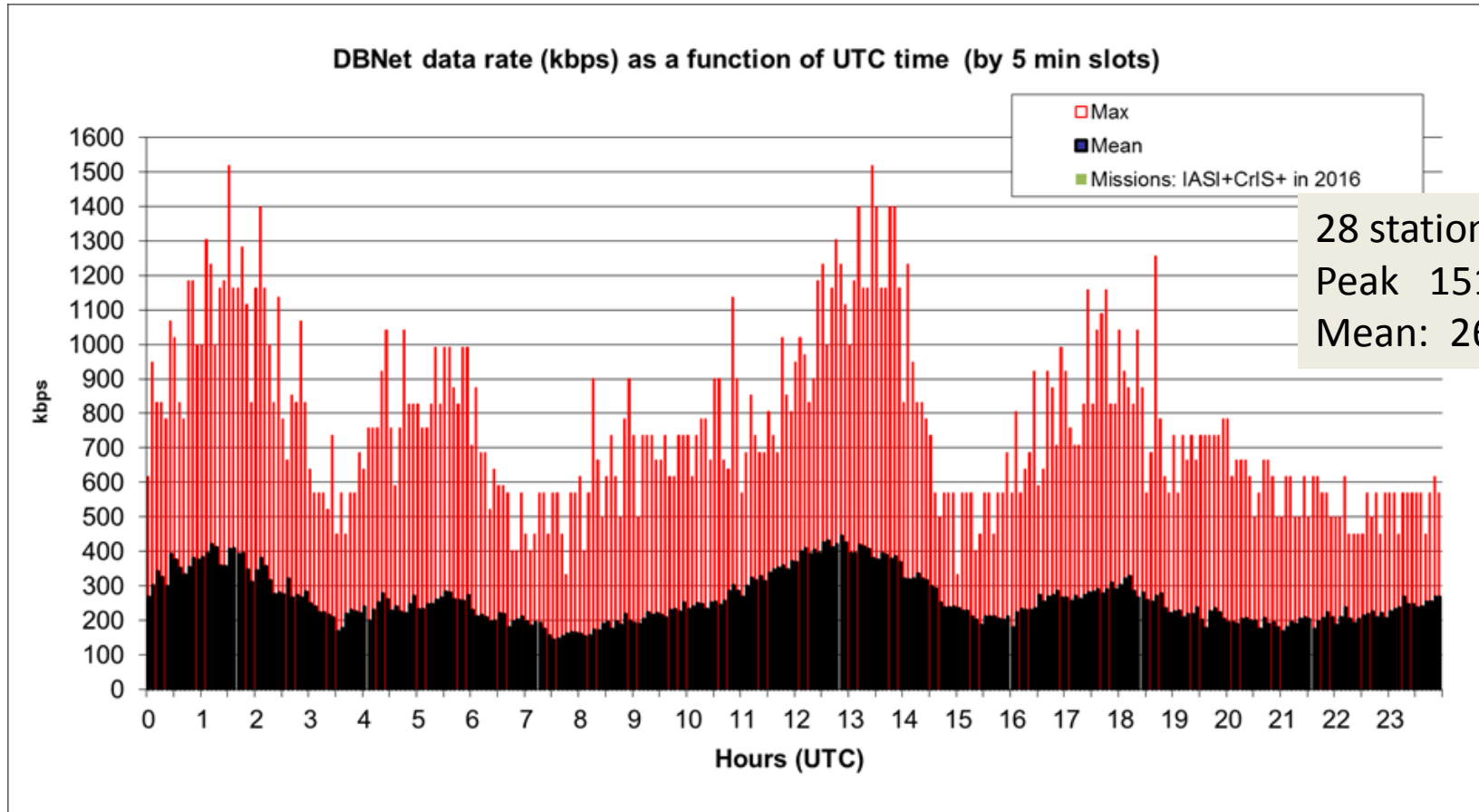
Weather · Climate · Water
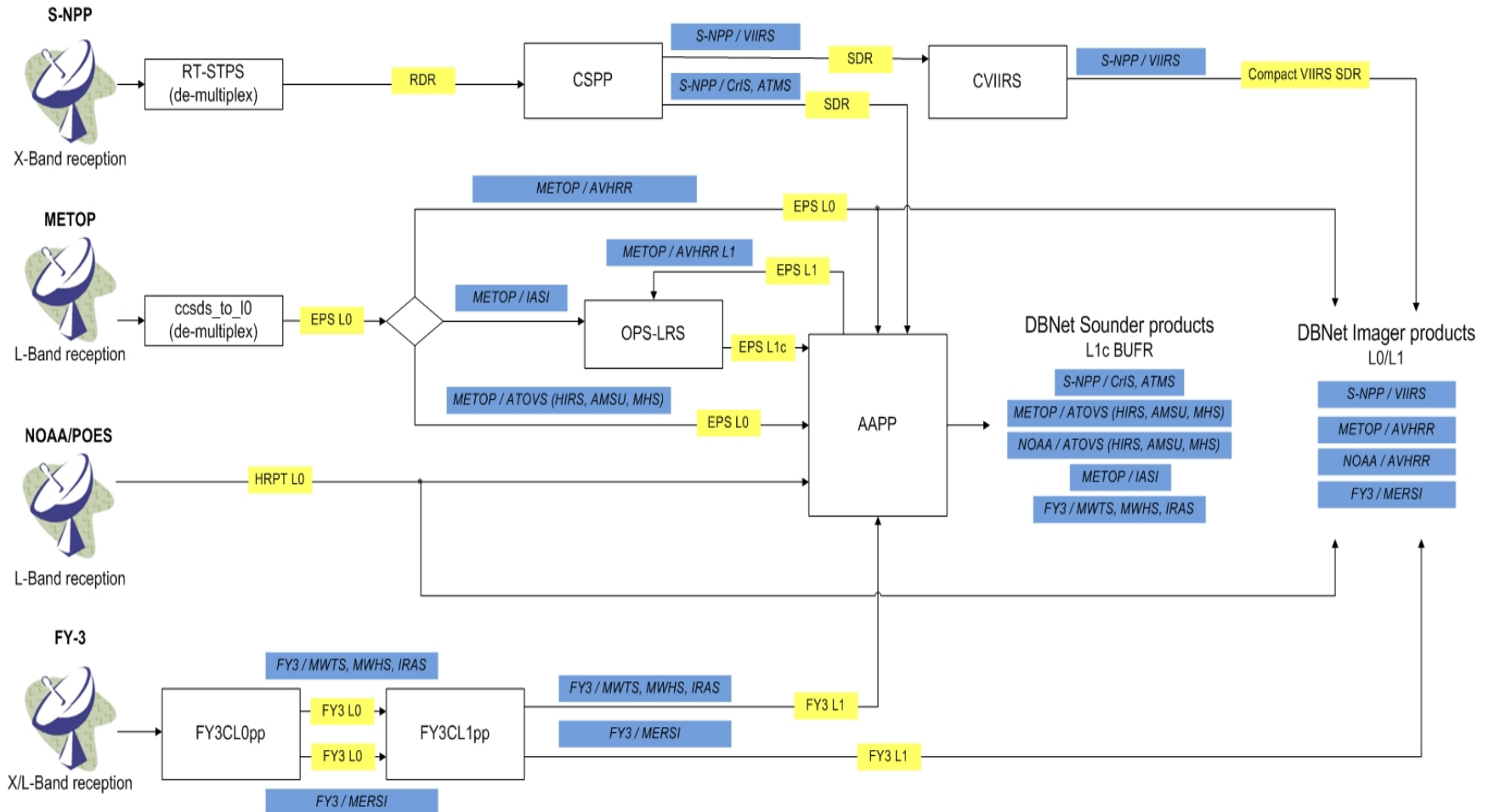
Satellite acquisition priorities (reviewed annually)

Satellite	Orbit and satellite status (D=descending, A=ascending)	Instrument health	Global data availability	Direct broadcast transmission	DBNet priority (H/M/L)
Suomi NPP	NOAA Prime Polar PM 1330A	Good	1 dump per orbit	Good (X-band).	H
Metop-B	Primary AM service. 0930D	Good	Very good: Arctic and Antarctic dumps	Good (L-band)	H
NOAA-19	Prime NOAA PM. Close to S-NPP 1400A/0200D	Good	1 dump per orbit	Good (L-band)	H
NOAA-18	Has drifted to an early morning orbit 1700A/0500D	Good. HIRS degraded	Some blind orbits	Good (L-band)	H
Metop-A	Same orbital plane as Metop-B 0930D	Good	1 dump per orbit	Limited geographically due to radiation issues	M
NOAA-15	Close to NOAA-18 0530D	Poor. AMSU-B and HIRS not working. AMSU-A is still useful.	Some blind orbits. Low priority in NESDIS L1 processing.	Poor signal strength (L-band), can only be received by large dishes	L
FY-3C	1030D	MWTS-2 not working, MWHS-2 OK.	Significant delays	Good (L-band for sounders, X-band for MERSI)	L

DBNet data traffic analysis:
Current data rates from 39 RARS/ ATOVS stations

39 active stations
Daily 560 MB
Peak 150 kbps
Mean 52 kbps

ITSC-20, Wisconsin, 29 October 2015

Weather · Climate · Water

DBNet data traffic projection:
(1) 28 stations   IASI-CrIS

DBNet data rate (kbps) as a function of UTC time (by 5 min slots)

Legend:
- □ Max
- ■ Mean
- ■ Missions: IASI+CrIS+ in 2016

28 stations
Peak   1517 kbps
Mean: 261 kbps

y-axis: kbps
x-axis: Hours (UTC)

Weather • Climate • Water

DBNet data traffic projection:
(2) 47 stations – IASI-CrIS

DBNet data rate (kbps) as a function of UTC time (by 5 min slots)

47 stations
Peak 1517 kbps
Mean: 425 kbps

Weather · Climate · Water
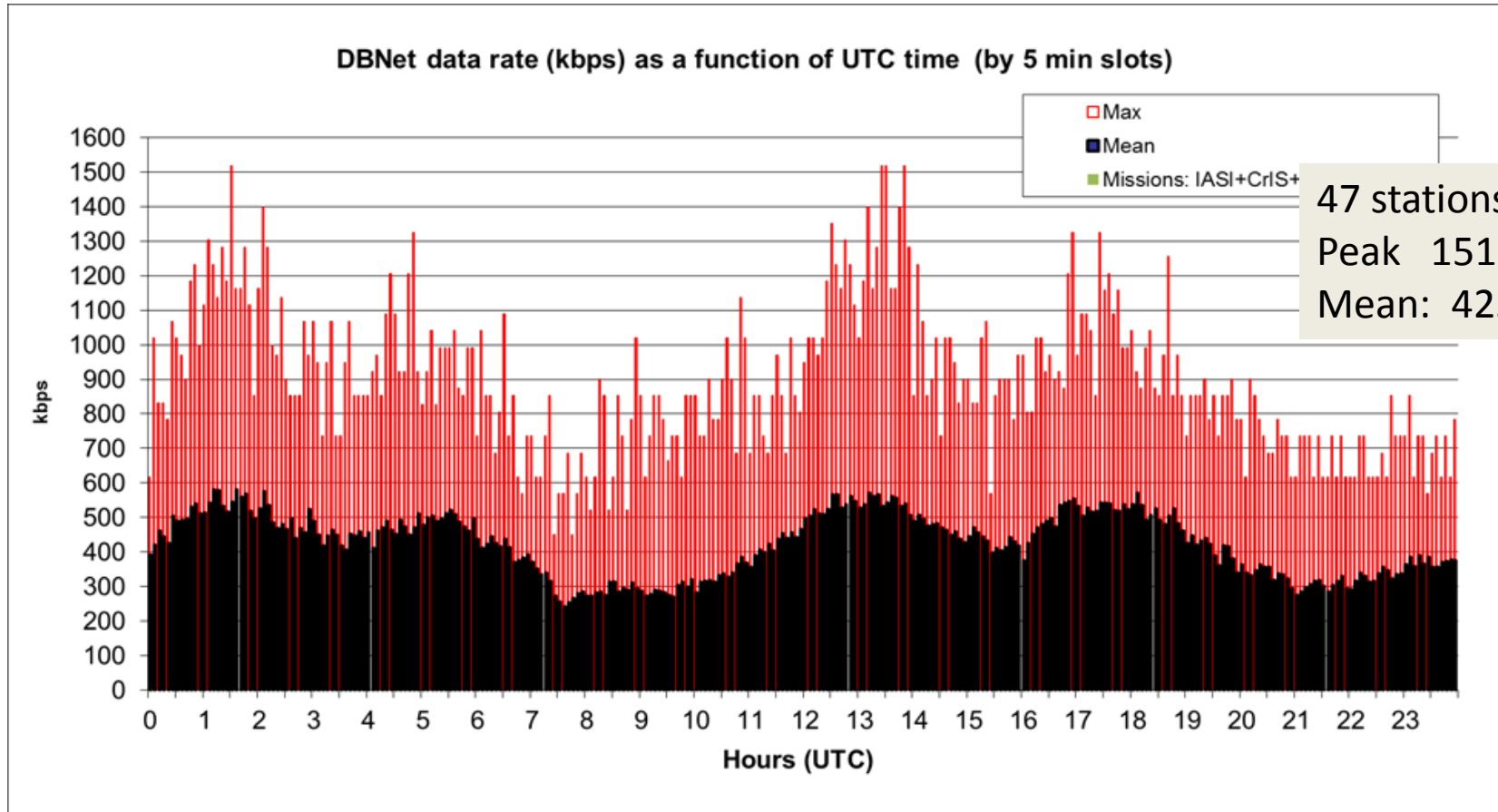
DBNet data traffic projection:
(3) 48 stations – IASI-CrIS-HIRAS

48 stations
Peak   1775 kbps
Mean: 588 kbps

DBNet data rate (kbps) as a function of UTC time (by 5 min slots)

Legend: Max, Mean, Missions: IASI+CrIS+HIRAS in 2020

Weather · Climate · Water
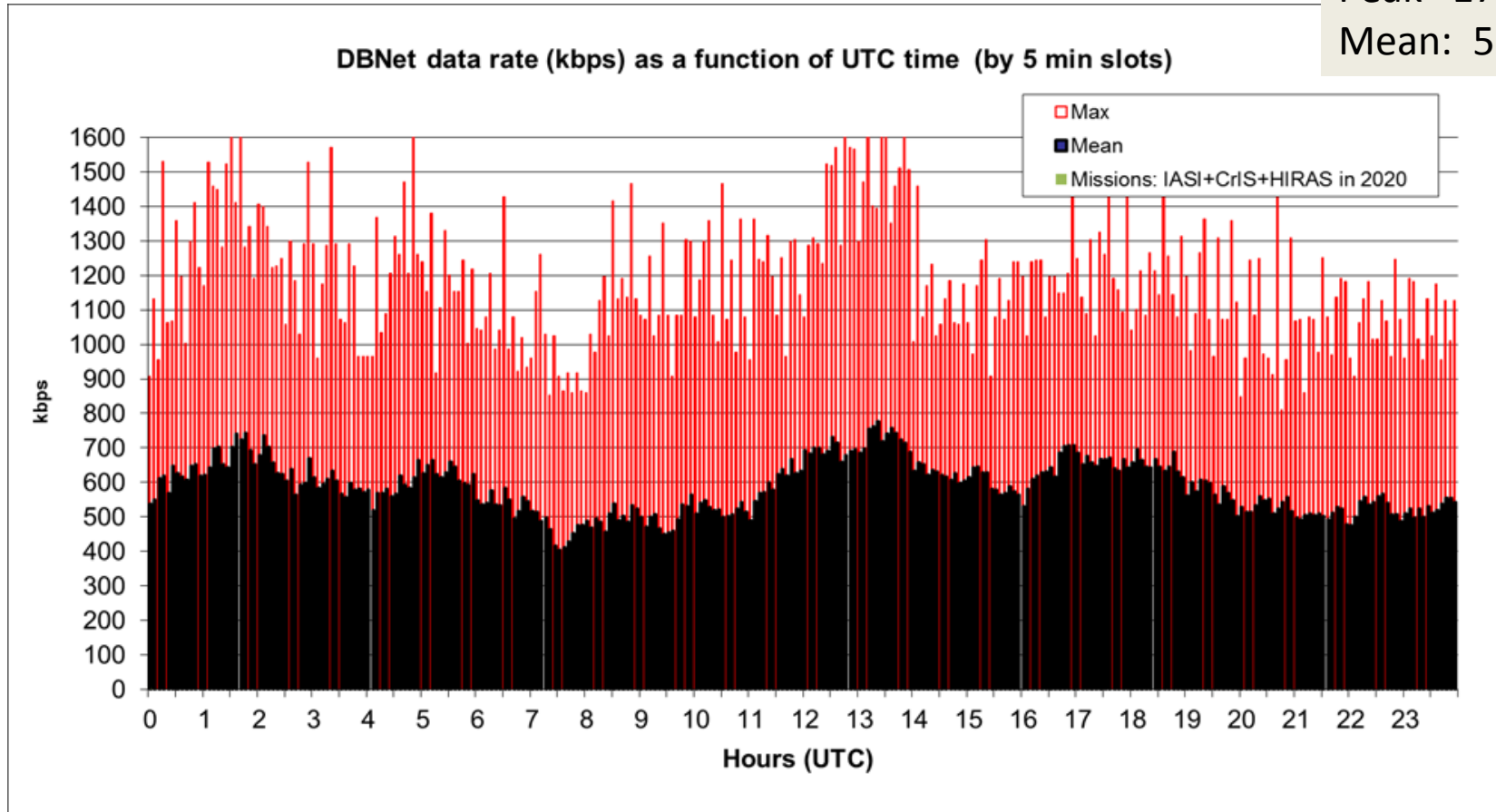
Implementation challenge

- High telecommunication impact
- Requires trade-off and optimization
  - Network design
  - Operating mode
  - Product contents

- DBNet not replacing the global data acquisition, is it?
  - Scope of DBNet is to ensure fast delivery of selected data

Weather • Climate • Water

Issues for consideration by ITSC-20

- ITWG is invited to confirm the overall importance of DBNet
- ITWG, through the RARS/DBNet Technical Sub-group:
  - To review/confirm the high-level DBNet Service Specifications
  - To advise on critical technical specifications
    - Principal components vs channel selection, for hyperspectral sensor
    - Common channel selection for product consistency
    - Network optimization and removal of overlap
    - Satellite priorities list
    - …
  - To advise on priority DBNet Services to be added
- ITWG feedback is essential for the DBNet Coordination Group
- ITWG considered as primary user/provider community

Weather • Climate • Water

Thank you for your attention

Join the RARS/DBNet Technical Sub Group !

ITSC-20, Wisconsin, 29 October 2015

Weather · Climate · Water