Benoît Pirenne, NEPTUNE Canada, UVic, Victoria, BC

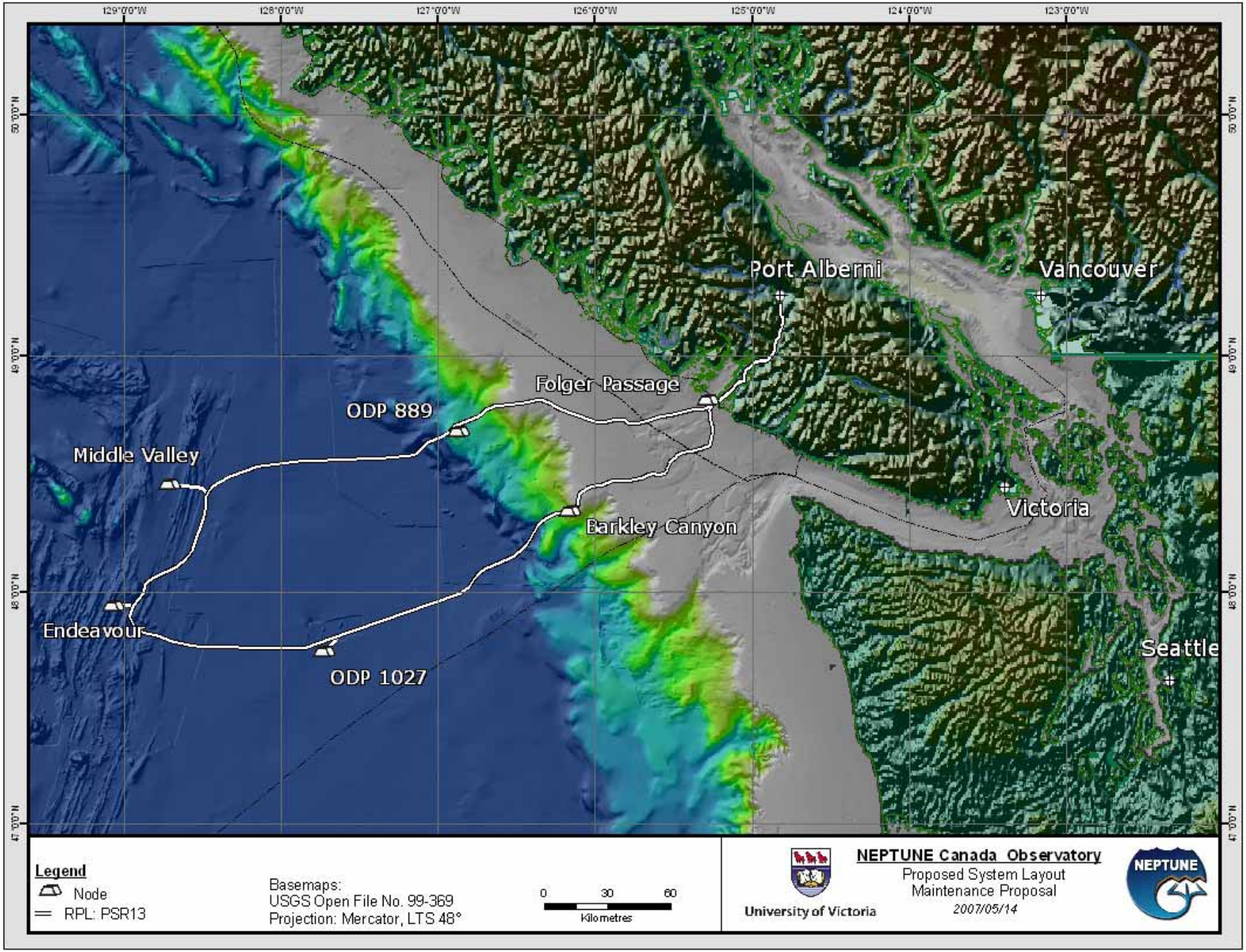
The NEPTUNE Canada Cabled Observatory Data Management System

Capturing and Delivering Terabytes of Data each Day

NEPTUNE Canada Quick Facts

Benoît Pirenne, NEPTUNE Canada, UVic, Victoria, BC

- **NEPTUNE Canada is a regional cabled observatory**
  - 800 km cable loop from Port Alberni (BC)
  - Built and operated by the University of Victoria
  - Represents a total of $82M investment
  - 5 nodes with about 120 instruments, hundreds of sensors
  - Cable Installation in June, nodes and instruments: '08
- **VENUS is a “prototype” for NEPTUNE**
  - 3 km + 30 km lines, ~ 30 instruments, similar concept


129°00'W
128°00'W
127°00'W
126°00'W
125°00'W
124°00'W
123°00'W
50°00'N
49°00'N
48°00'N
47°00'N
Port Alberni
Vancouver
Folger Passage
ODP 889
Middle Valley
Barkley Canyon
Victoria
Endeavour
ODP 1027
Seattle
Legend
Node
RPL: PSR13
Basemaps:
USGS Open File No. 99-369
Projection: Mercator, LTS 48°
0
30
60
Kilometres
University of Victoria
NEPTUNE Canada Observatory
Proposed System Layout
Maintenance Proposal
2007/05/14
NEPTUNE

NEPTUNE Canada Components

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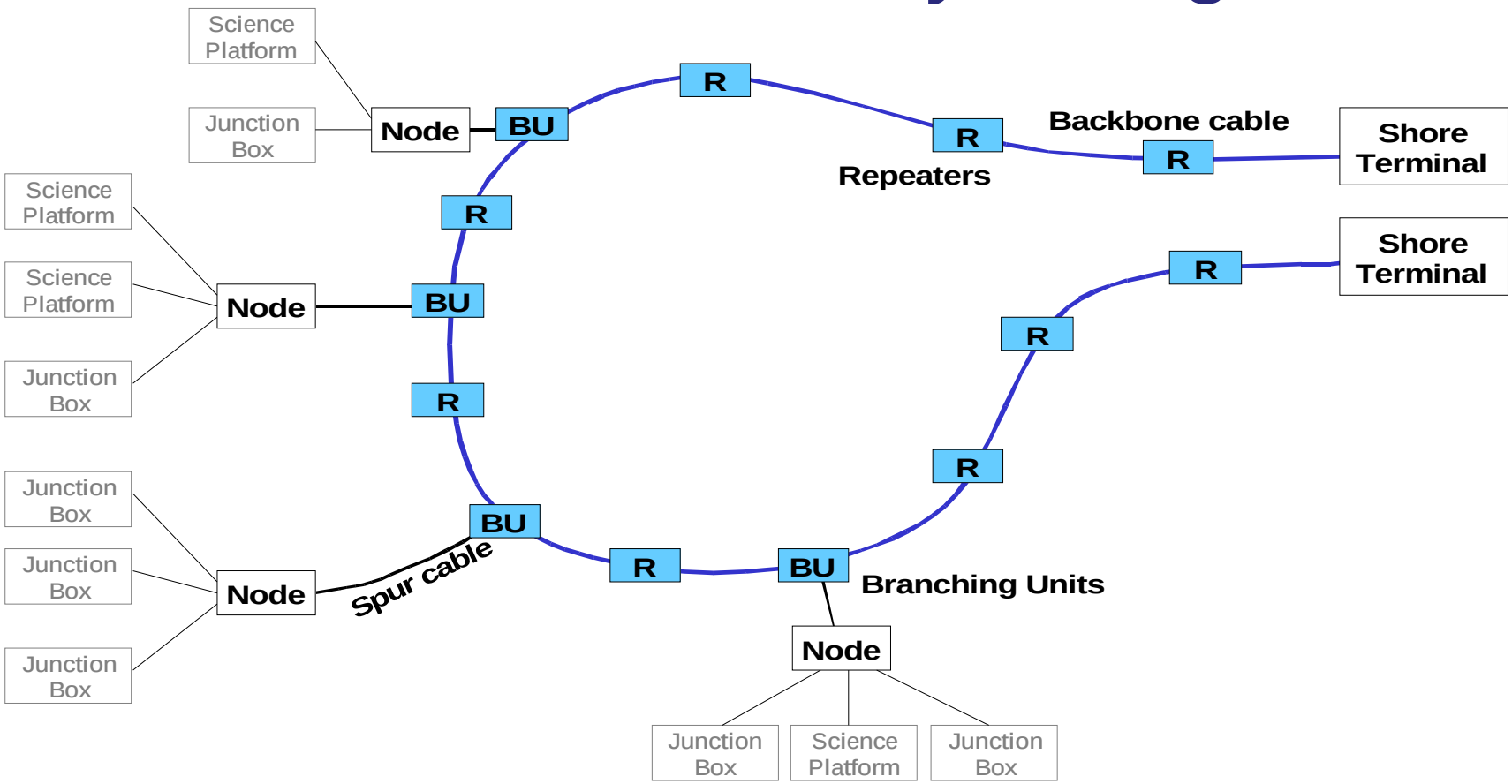
- **Project structure reflects components to be built:**
  - Undersea infrastructure: engineering (Peter Phibbs, Alcatel Submarine Networks)
  - Instrumentation: science (Mairi Best, with PI teams)
  - Software: IT (Benoît Pirenne, in house development)
  - Education & Outreach: unfunded

NEPTUNE Canada: Underwater plant

Benoît Pirenne, NEPTUNE Canada, UVic, Victoria, BC

Generalized Observatory Configuration



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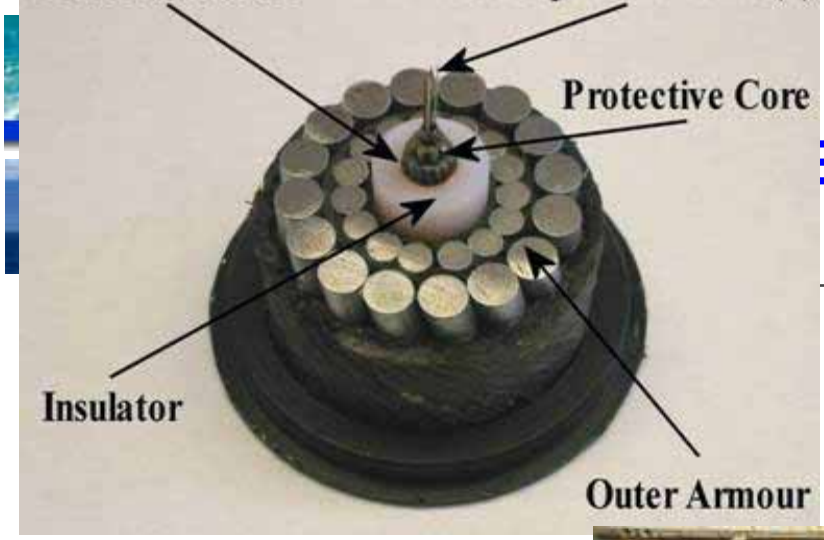

EPTUNE Canada: underwater plant

Benoît Pirenne, NEPTUNE Canada, UVic, Victoria, BC

NEPTUNE Canada: Underwater Plant

- # Instruments
  - VENUS 3 nodes, ~30 instruments, ~120 sensors
  - NEPTUNE: 5 nodes, ~120 instruments, ~400 sensors

Observatory: NEPTUNE

Station | Data Centre | Region, Location and Site | Device

Display: ○ Current ◉ All

Device Id	Device Name	Device Type	Owner
11009	360 camera 1	360 Camera	NEPTUNE
11010	360 camera 2	360 Camera	NEPTUNE
11011	360 camera 3	360 Camera	NEPTUNE
11206	ADCP	RDI Acoustic Doppler Current Profiler	NEPTUNE
20001	ADCP (1200 kHz Upward Looking) FP	ADCP 1200 kHz	NEPTUNE
20002	ADCP (2 MHz Downward Looking) FP	ADCP 2 MHz	NEPTUNE
20003	ADCP (300 kHz) FP	ADCP 600 kHz	NEPTUNE
21620	BB Seismometer ODP1027	Broadband Seismometer	NEPTUNE
10010	BC Crawler SJB	Secondary Junction Box	NEPTUNE
10003	BC Head PJB	Primary Junction Box	NEPTUNE
10002	BC Mid-Canyon PJB	Primary Junction Box	NEPTUNE
10011	BC Pod #1 Axis	Secondary Junction Box	NEPTUNE
10018	BC Pod #2 Metaxas	Secondary Junction Box	NEPTUNE
10012	BC Pod #3 Snelgrove	Secondary Junction Box	NEPTUNE
10013	BC Pod #4 Archambaul	Secondary Junction Box	NEPTUNE
10014	BC Pod #5 ? Hydrates	Secondary Junction Box	NEPTUNE
10017	BC Profiler Base	Secondary Junction Box	NEPTUNE
10001	Barkley Canyon Node	Alcatel Node	NEPTUNE
11004	Benthic flow simulation Chamber	Benthic flow simulation Chamber	NEPTUNE
12501	Bottom Pressure Recorder BC	High-res pressure sensor (device)	NEPTUNE
11501	Bottom Pressure Recorder END	High-res pressure sensor (device)	NEPTUNE
20501	Bottom Pressure Recorder FP	High-res pressure sensor (device)	NEPTUNE
21501	Bottom Pressure Recorder ODP1027 NE	High-res pressure sensor (device)	NEPTUNE
21502	Bottom Pressure Recorder ODP1027 NW	High-res pressure sensor (device)	NEPTUNE
21503	Bottom Pressure Recorder ODP1027 S	High-res pressure sensor (device)	NEPTUNE
22503	Bottom Pressure Recorder ODP889	High-res pressure sensor (device)	NEPTUNE
22057	Broadband Seismometer ODP889	Broadband Seismometer	NEPTUNE
11057	Broadband seismometer END	Broadband Seismometer	NEPTUNE
21301	CORK - Pressure Sensor ODP1027 1026	Pressure Sensor (Device)	NEPTUNE
21304	CORK - Temperature Sensor ODP1027 1026	CORK Temperature Sensor	NEPTUNE
21011	CTD ODP1027 NW	Generic, non-pumped CTD	NEPTUNE
12110	CTD / Oxygen	Seabird CTD-43 /Oxygen	NEPTUNE
13101	CTD END MOOR	Generic, non-pumped CTD	NEPTUNE
13110	CTD END MOOR 10	Generic, non-pumped CTD	NEPTUNE
13111	CTD END MOOR 11	Generic, non-pumped CTD	NEPTUNE
13112	CTD END MOOR 12	Generic, non-pumped CTD	NEPTUNE
13113	CTD END MOOR 13	Generic, non-pumped CTD	NEPTUNE
13114	CTD END MOOR 14	Generic, non-pumped CTD	NEPTUNE
13115	CTD END MOOR 15	Generic, non-pumped CTD	NEPTUNE

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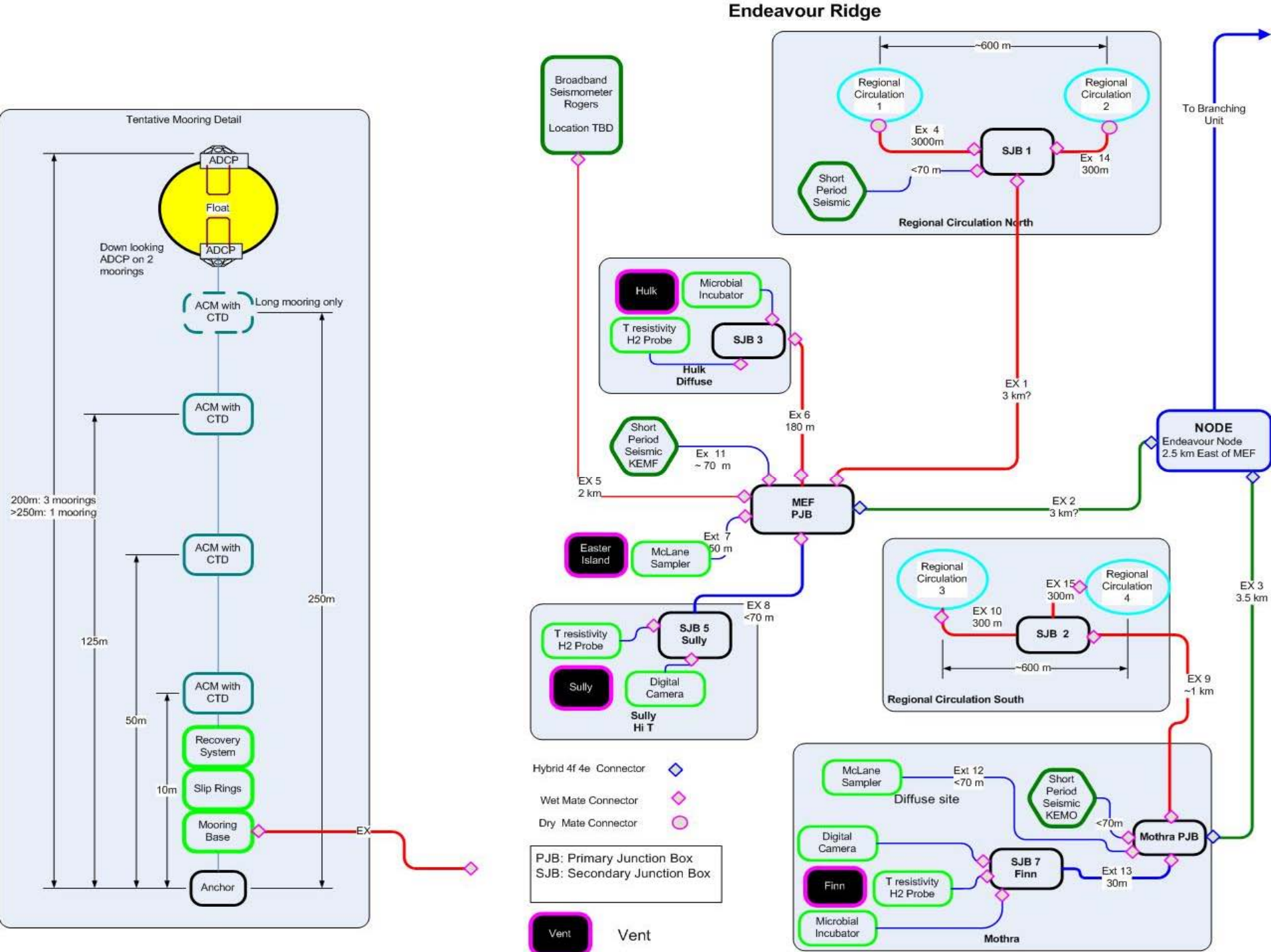
Endeavour Ridge
Tentative Mooring Detail
ADCP
Float
ADCP
Down looking ADCP on 2 moorings
ACM with CTD
Long mooring only
ACM with CTD
200m: 3 moorings
>250m: 1 mooring
ACM with CTD
125m
250m
ACM with CTD
50m
10m
Recovery System
Slip Rings
Mooring Base
EX
Anchor
Broadband Seismometer Rogers
Location TBD
~600 m
Regional Circulation 1
Regional Circulation 2
Ex 4
3000m
SJB 1
Ex 14
300m
Short Period Seismic
<70 m
Regional Circulation North
To Branching Unit
Hulk
Microbial Incubator
T resistivity H2 Probe
SJB 3
Hulk Diffuse
EX 1
3 km?
Ex 6
180 m
Short Period Seismic KEMF
Ex 11
~ 70 m
NODE
Endeavour Node
2.5 km East of MEF
EX 5
2 km
MEF PJB
EX 2
3 km?
Ext 7
50 m
Easter Island
McLane Sampler
EX 8
<70 m
T resistivity H2 Probe
SJB 5 Sully
Sully
Digital Camera
Sully Hi T
Regional Circulation 3
EX 15
300m
Regional Circulation 4
EX 10
300 m
SJB 2
~600 m
Regional Circulation South
EX 3
3.5 km
EX 9
~1 km
Hybrid 4f 4e Connector
Wet Mate Connector
Dry Mate Connector
PJB: Primary Junction Box
SJB: Secondary Junction Box
Vent
Vent
McLane Sampler
Ext 12
<70 m
Diffuse site
Short Period Seismic KEMO
<70m
Mothra PJB
Digital Camera
SJB 7 Finn
Ext 13
30m
Finn
T resistivity H2 Probe
Microbial Incubator
Mothra

NEPTUNE Canada Software

Benoît Pirenne, NEPTUNE Canada, UVic, Victoria, BC

- **Data Management and Archiving System (DMAS)**
  - Three components:
    - Data acquisition & storage
    - Data access
    - Instrument and Infrastructure control and monitoring
  - Features:
    - Very fast data delivery to users
    - Real-time event detection capabilities
    - Event reaction capabilities
    - Fast access to the archive

NEPTUNE Canada Data Acquisition

Benoît Pirenne, NEPTUNE Canada, UVic, Victoria, BC

- **Challenges:**
  - Large variety of instruments
  - Three types of data flows
    - Scalar (temperature, pressure, amplitude, ...)
    - Multi-dimentional (ADCP matrices, images, ...)
    - Uninterrupted streams (acoustic data from hydrophones, video)
  - Wide variety of data formats, instrument protocols
    - ASCII, binary, push, pull, ...
  - Enormous differences in data rates
    - CTD: bits/sec <---> HDTV camera: Gbps

NEPTUNE Canada Data Acquisition

Benoît Pirenne, NEPTUNE Canada, UVic, Victoria, BC

- **Challenges:**
  - Event detection
    - “if $sensor > threshold then do this”
    - “if {starfish} in $cam-video-stream then $take-cam-hires-still”
    - “if $hydrophone-stream contains whale with probability > 80%
      - Then ...”
  - Policies for event reaction
    - Reaction can be email
    - Reaction can be use of shared instrument
    - Must have ranking/priority per user on the use of shared instruments

NEPTUNE Canada Data Acquisition

Benoît Pirenne, NEPTUNE Canada, UVic, Victoria, BC

- **Challenges:**
  - Storage and data compression choices
    - Current estimates for data flow:
      - dominated by HDTV (~1 Gbps native)
      - 1 HDTV at Folger Passage at 8 hrs/day ==> ~25TB/day!
    - Can we afford to store that?
    - Will anybody need it later?
    - How much will we loose if we compress?
    - Compression methods are many and improving. Hoping to decrease volume by a factor 100
  - Metadata collection/value-added to data through pre-processing

Hydrophone

Date: Submit

Access

, Victoria, BC

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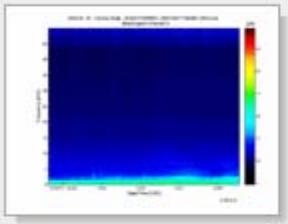

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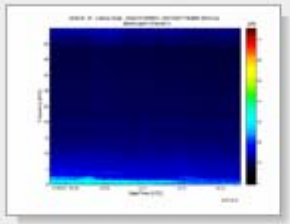

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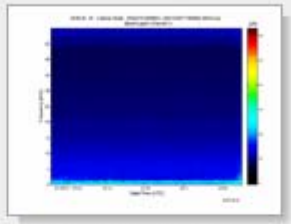

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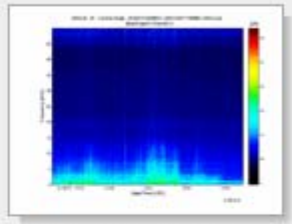

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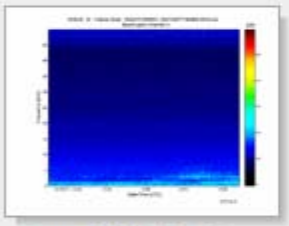

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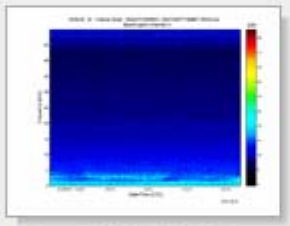

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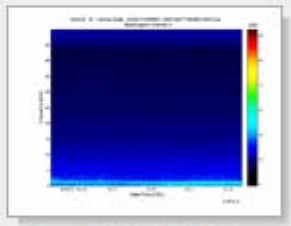

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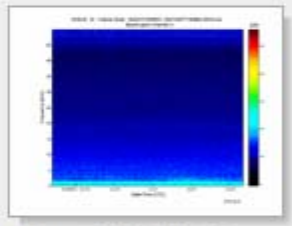

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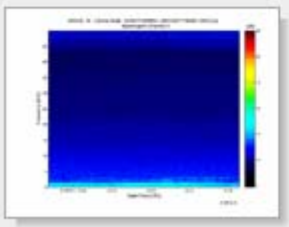

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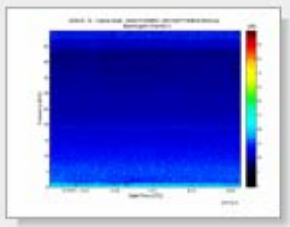

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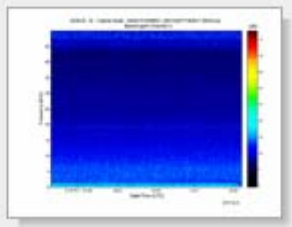

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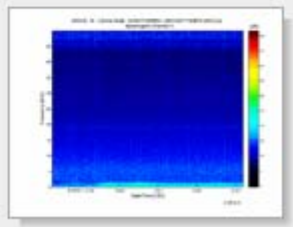

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Camera

Date: Submit

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NEPTUNE Canada Data Acquisition

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- **Expectations:**
  - Current estimates (with compression) call for about 47 TB/year
  - + at least one safe copy elsewhere
  - ==> ~100TB/year for the first 3 years or so.
  - Technology available today, but total cost of ownership must be controlled to limit operations costs
  - Local copy? Outsourced storage to Amazon, Google, UCSD?
- **Data distribution:**
  - Download volumes by users unknown
  - Looking at limiting downloads and providing data centre-based pre-processing, visualization.

Data Acquisition

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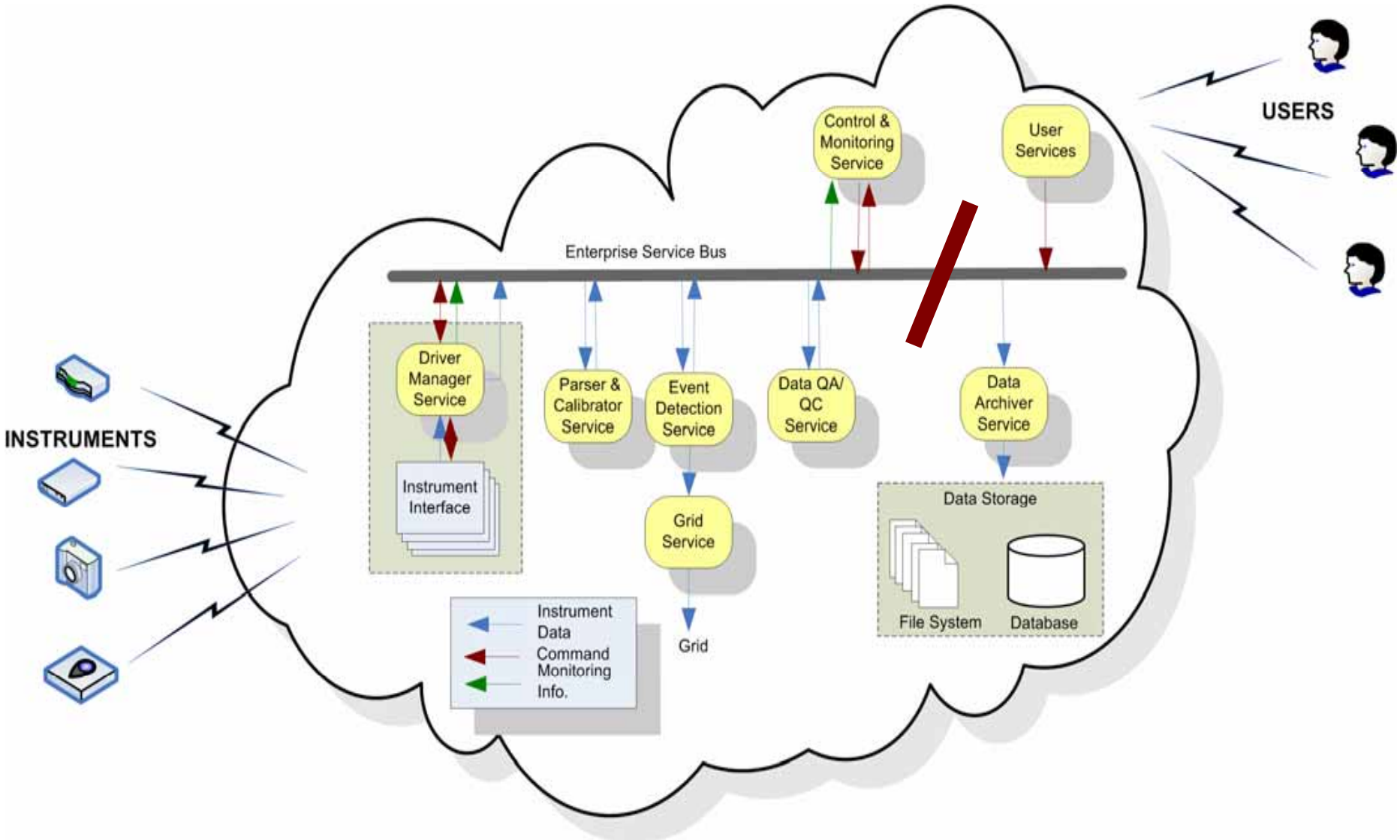

Data Access

Benoît Pirenne, NEPTUNE Canada, UVic, Victoria, BC

- **Data Access Methods**
  - Interactive (web search forms)
  - Computer-to-computer access (web services)
  - Possibility for PIs to host event detection modules at the shore station, data centre or at home
  - Future: social network with many web-based data processing and visualization functions
- **Data Formats**
  - Scalar sensors: we'll offer what users want. So far for VENUS: CSV, Matlab. Coming up: NetCDF.
  - Other complex data: JPG, mp3, ...
  - Tried xml with ADCP data: got in trouble with users...

Conclusions

Benoît Pirenne, NEPTUNE Canada, UVic, Victoria, BC

- **NEPTUNE data are coming!**
- **VENUS has been an invaluable learning tool for us**
- **Prospects of real-time data management are exciting (event detection and reaction)**
- **Challenges of the exploitation of so much good data coming so fast to everyone are going to be:**
  - exciting scientists
  - will quickly generate new needs on the supporting software systems