

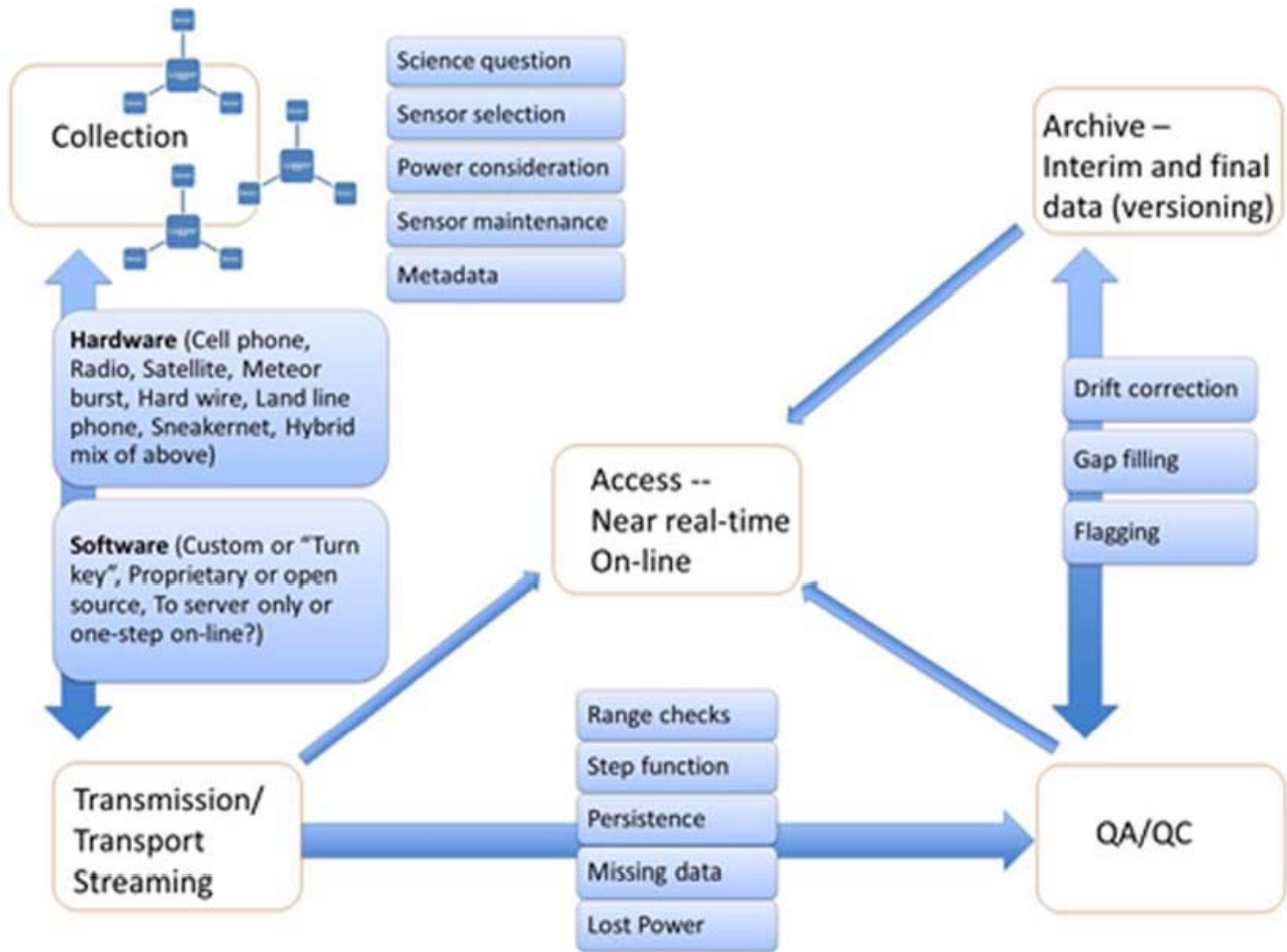
COMMON THEMES FROM PARTICIPATING SITES

JOINT NERC ENVIRONMENTAL SENSOR NETWORK/SENSOR NIS WORKSHOP,
HUBBARD BROOK EXPERIMENTAL FOREST, NH, OCTOBER 25-27TH, 2011

○ Greatest Needs

- Middleware between sensor/data logger and database/applications
- Programming support
- Training workshops to disseminate knowledge & solutions
- Ways to share experiences with software and tools that are useful
 - Clearinghouse for sharing code and solutions
- Knowledge Base (web page) organized by topics
(http://wiki.esipfed.org/index.php/EnviroSensing_Cluster)

Software Tools for Sensor Networks, April 23-26, 2013



ESIP EnviroSensing Cluster:

Building a sensor network resource guide through community participation

○ Online resource guide outline

- Sensor, site, and platform selection
- Data acquisition and transmission
- Sensor management, tracking, documentation
- Streaming data management middleware
- Sensor data quality assurance/quality control (QA/QC)
- Sensor data archiving



Sensor, site, and platform selection

○ Problem statement

- Vast array of possible sensor/hardware packages for multiple science applications
- Communication among PI's, techs, and specialists
 - work together in considering options and planning
- Deployment may be based on interacting factors
 - e.g., permitting, geography, access
- Considerations:
 - seasonal weather patterns, power sources, communications options, land ownership, distance from managing institution, available personnel/expertise, and potential expansion/future-proofing



Data acquisition and transmission



Problem statement

- Manual downloads of environmental sensor data may not be sufficient to assure data security or data integrity, or allow direct control of devices
- Considerations:
 - need for immediate access
 - need for one- or two-way transmission methods
 - bandwidth requirements to transfer the data
 - need for line-of-site communication or repeaters
 - hardware and network protocols
 - power consumption of the system components
 - physical and network security requirements

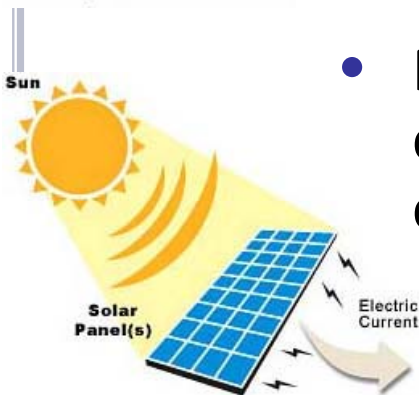
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Sensor management, tracking, and documentation

Problem statement

- Documentation of field procedures need to be sufficient to withstand personnel changes over time
- Noted sensor issues and problems need to be quickly communicated among field technicians, lead investigators and data managers
- Sensor histories are typically tracked in field notebooks or field check sheets and are essential for internal review of data streams, but are often inaccessible to data handlers
- Noted field problems may provide insight into quality control issues and data behavior and should be captured in data qualifier flags



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Sensor data quality assurance and quality control (QA/QC)

- Preventative QA measures in the field are desirable
- Automated QC is necessary for
 - near real-time use of data
 - efficient processing of high volume data streams
- Manual methods are unavoidable
 - a hybrid QC system will include subsequent manual inspection and additional QC checking
- QC system must
 - provide qualifier flags to sensor data
 - accommodate feedback to policies and procedures
 - assure that all QC workflows are documented



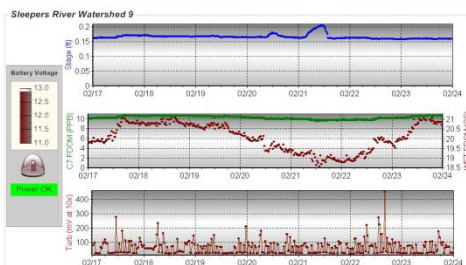
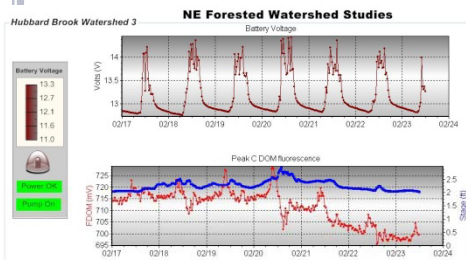
SENSOR DATA ARCHIVING

- Archiving strategies
 - create well documented data snapshots
 - assign unique, persistent identifiers
 - maintain data and metadata versioning
 - store data in text-based formats
- Partner with community supported archives
 - E.g., the LTER NIS, or federated archive initiatives such as DataONE
- Best practices
 - develop an archival data management plan
 - implement a sound data backup plan
 - archive raw data (but they do not need to be online)
 - make data publicly available that have appropriate QA/QC procedures applied
 - assign QC level to published data sets

Streaming data management middleware

○ Definition/Purpose

- “Middleware” in conjunction with sensor networks is computer software that enables communication and management of data from field sensors to a client such as a database or a website
- Purpose of middleware includes the collection, analysis, and visualization of data
- Middleware is chained together into a scientific workflow



Examples:

- Read, reformat, export of different data types or structures (input/output)
- Automated QA/QC on data streams
- Integration of field notes and documentation with the data
- Archiving

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