Support of Asynchrony in Sensor Web

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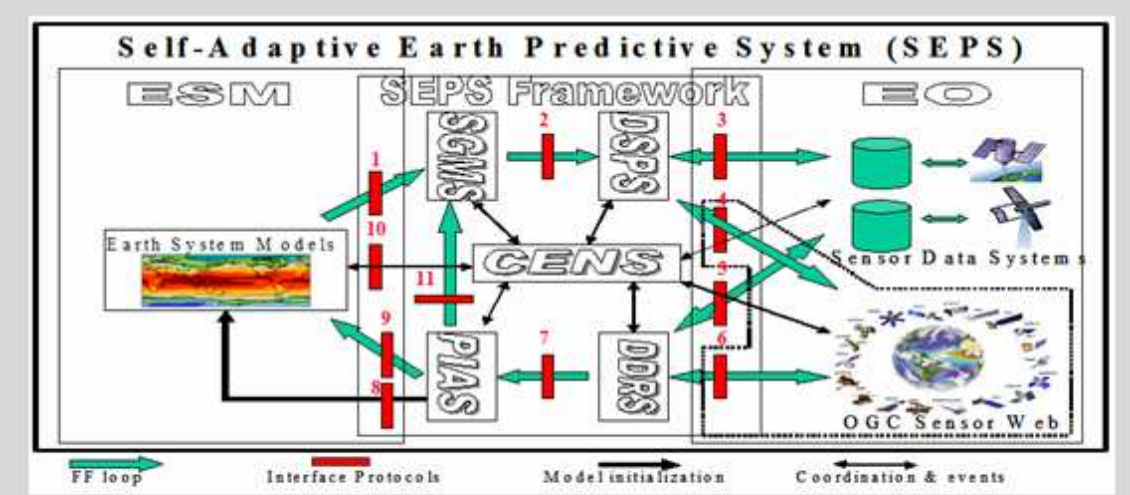
Outline

- Asynchrony
- Asynchronous technologies
  - Standards & specifications
  - Geospatial
- Asynchrony for Sensor Web
  - CENS
- Case studies
  - Order-based
  - OWS-5
- Conclusions

Asynchrony & Sensor Web

- Asynchrony
- “A sensor web is a group of interoperable web services which all comply with a specific set of sensor behaviors and interfaces specifications” – Liping Di



Overall architecture of the SEPS (Di 2007)

Requirements of asynchrony in Sensor Web

- Observations
  - Future
- Sensors
  - Hibernation
- Virtual sensors
  - Processing

Asynchrony in Web Services

- Asynchrony at the transport level
- Standards/protocols
- Web Service
- REST

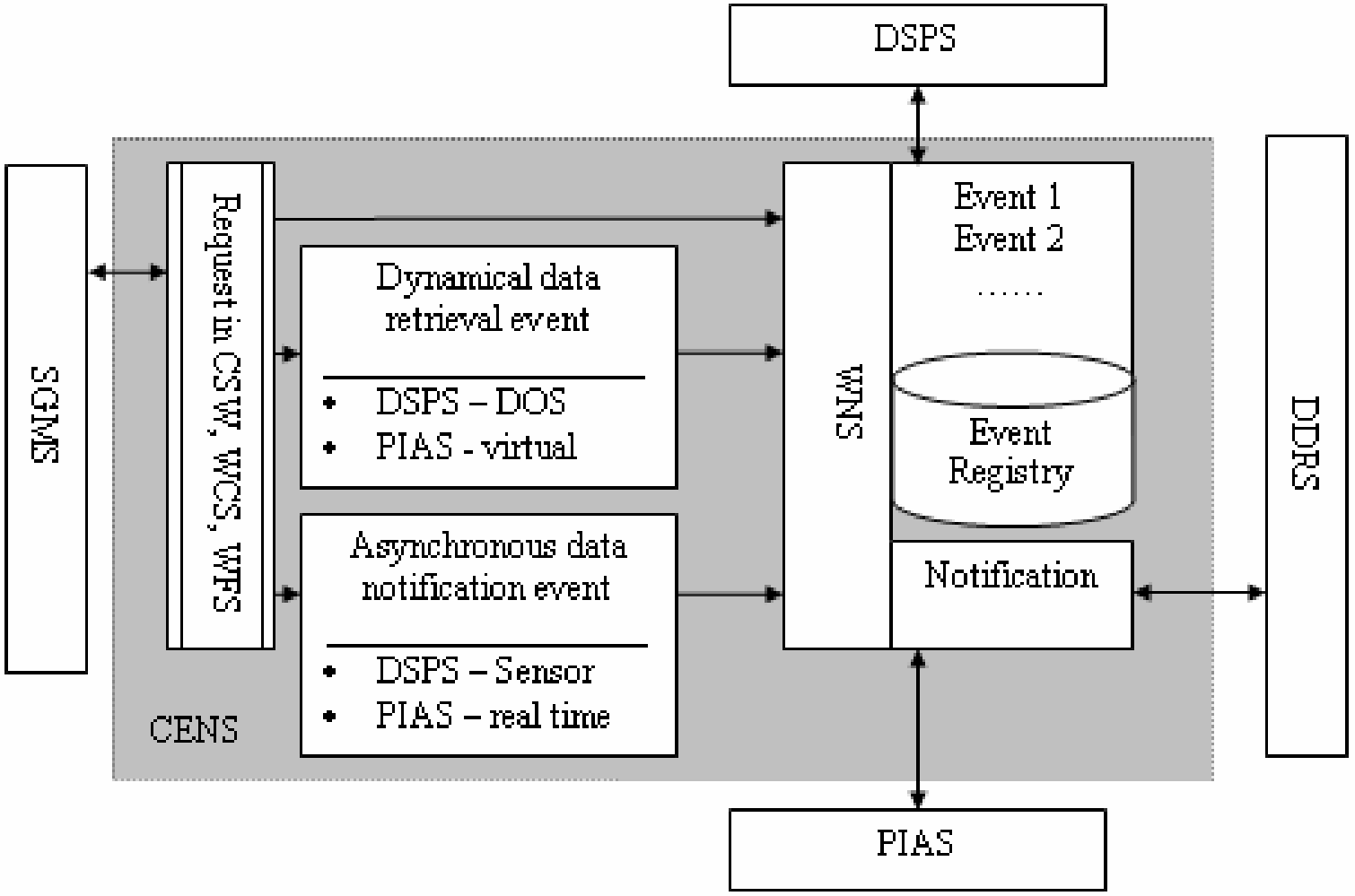
Asynchrony Patterns

- Asynchronies
  - client-side
    - Non-blocking API
    - Transport level
  - server-side
    - WS-Addressing
- Client asynchrony patterns
  - Callback pattern
  - Publish/subscribe pattern
  - Polling pattern
  - Callback Factory Pattern
  - Publish/Subscribe Factory Pattern
- Callback pattern
  - free the client from heavy network traffic of polling between client proxy and server
  - the most widely supported pattern by industrial protocols
    - RossettaNet, xCBL, ebXML, IHE, and OGSA
    - ASAP supports Callback factory pattern only
    - WS-Addressing for SOAP
    - Publish/subscribe pattern by ebXML and OGSA
      - Extensible Messaging and Presence Protocol (XMPP)

Asynchrony in Geospatial Web Services

- OGC SWE
  - Observations & Measurements (O&M)
  - Sensor Model Language (SensorML)
  - Tranducer Model Language (TransducerML)
  - Sensor Observations Service (SOS)
  - Sensor Planning Service (SPS)
  - Sensor Alert Service (SAS)
  - Web Notification Service (WNS)
- Asynchrony
  - Specifications: SAS and WNS
  - SAS
    - XMPP channel publication (from provider) and subscription (from client)
  - WNS
    - alerts/notifications from SAS and SPS

CENS (1)


DSPS
SGMS
Request in CSW, WCS, WFS
Dynamical data retrieval event
DSPS – DOS
PIAS - virtual
Asynchronous data notification event
DSPS – Sensor
PIAS – real time
CENS
WNS
Event 1
Event 2
.....
Event Registry
Notification
DDRS
PIAS

CENS (2)

- Core specifications
  - WNS
  - SAS
- Message notification approach
  - to keep the final processes synchronized to complete complicated and/or lengthy geospatial processing workflows
  - multiple transport protocols, e.g. HTTP, email, telephone, and fax
  - Coodinae other modules of Self-Adaptive Earth Predictive Systems (SEPS)
    - Data Preprocessing, Integration, and Assimilation Services (PIAS)
    - Data Discovery and Retrieval Services (DDRS)
    - Data and Sensor Planning Services (DSPS)

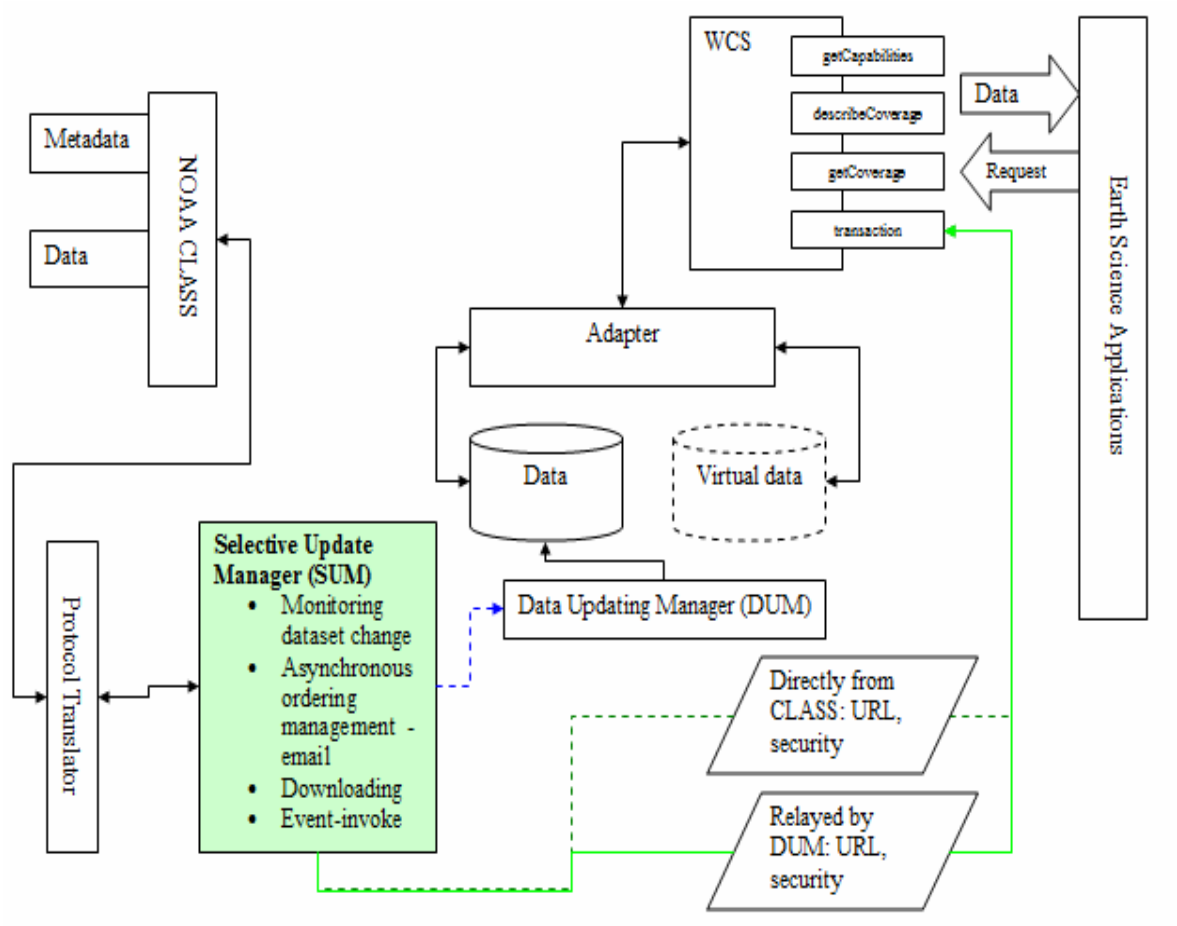
Service Integration

- BPEL
  - Orchestration
- WS-Addressing
  - SOAP message callback pattern
  - Correlation through unique message identification

Case 1 – subscription-base

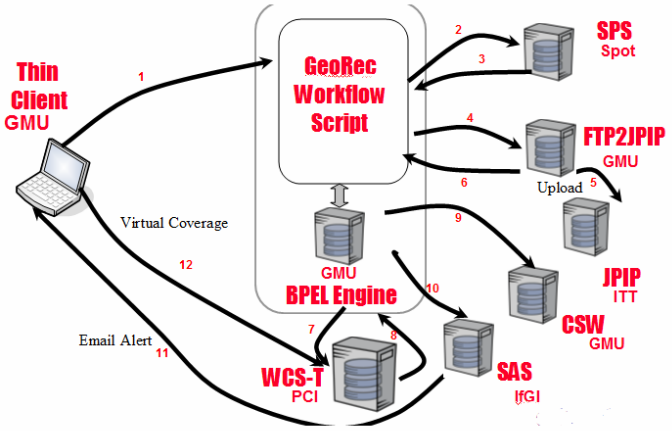
- Asynchronous access to data order system
  - Email notification
  - Quarterly and hours

Architecture



Case 2 – geo-referencing

- Workflow steps
  - planning request to the SPS
    - User as actor
  - email notification
  - Retrieve observation from the SOS
  - Feed the observations into the JPIP server through secured transaction
  - Add the data along with description into WCS through transaction
  - Alert the data availability through SAS to all subscribed users



Geo-referencing workflow

Asynchrony in geo-referencing workflow

- Two types of asynchronies
  - The first step of SPS based on WNS
    - WS-Addressing
    - Callback pattern
  - The final notification of data availability to all subscribed users through SAS
    - XMPP
    - Publish/subscribe pattern

Conclusions

- The asynchronous support in the SEPS
  - CENS – a general framework for relaying message
  - BPEL – a standard script language for workflow
  - BPELPower engine – OGC-specification aware
- Successful applications in two scenarios
  - Order-based system
  - Message-notification
- Findings
  - Inevitability of asynchrony in Sensor Web, due to future observation planning and long processing time
  - Intuitively, proper use of asynchrony reduce the network traffic

Future developments

- Further development and refinement of CENS
- Quantitative evaluation of performance

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