Addressing Quality Requirements in GIS Architectures

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TS14.1 SIM and Quality
From Pharaohs to Geoinformatics, FIG Working Week 2005 and GSDI-8, Cairo, Egypt April 16-21, 2005

High Quality GIS

- Attention is often paid to GIS functionalities
- However, quality aspects are insufficiently addressed. A GIS would be:
  - Ineffective if its processing misses deadlines
  - Unreliable if it is not available when it should be
  - Unusable if it is difficult to understand
- Hence, high quality GIS systems depend on qualities, such as
  - Efficiency
  - Reliability
  - Usability
  - Security

Problems with GIS Quality Requirements

- Complexity and large volume of geographic information
- Often not systematically captured & documented
- Common to find ambiguous statements such as:
  - "*System shall be portable*"
  - "*System shall be highly secured*"
  - "*GIS operations shall be efficient*"
- Hence, no feasible means to assess whether the system has met its quality requirements or not

Solution: Architectural Framework

- Based on two architectural techniques from the **S**oftware **E**ngineering **I**nstitute **(SEI):**
  - Quality Attribute Scenarios
  - Attribute Driven Design Method (ADD)

Quality Attribute Scenarios

- SEI quality attribute scenarios consist of 6 yardsticks:
  1. Source of stimulus
  2. Stimulus
  3. Environment
  4. Artifact
  5. Response
  6. Response measure

Source:	GIS administrator
Stimulus:	The administrator requests to convert the data format of a portion of the GIS data
Artefact:	GIS system (Data source)
Environment:	Runtime
Response:	The required format is converted with no data inconsistency
Response Measure:	Number of elements affected/ programming effort/ data loss

Attribute Driven Design Method

- Attribute Driven Design Method (ADD) is a recursive approach to software architecture design based on the quality attributes the software needs to achieve

1. *Choose one design element*
2. *Choose the architectural drivers i.e. quality requirements*
3. *Choose architectural patterns*
4. *Assign functionality to each of the design elements (resulting from the decomposition)*
5. *Verify that the decomposition has addressed the selected architectural drivers*

Achieving GIS Quality Requirements using ADD

- Quality requirement scenarios addressed:
  - Performance
    - Editing a Geographic Feature
    - Retrieve Data
  - Modifiability
    - Change GIS Data Format
    - Add GIS Component
    - Interface GIS with an External Software System

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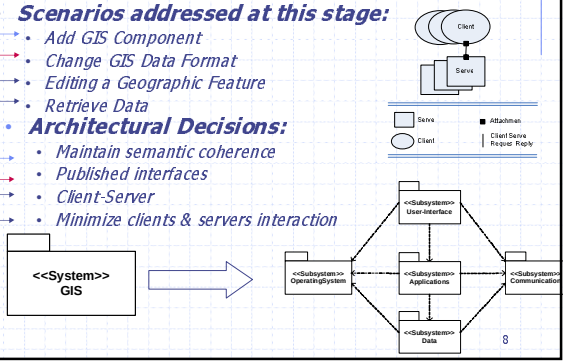
First Level of Decomposition

- ***Scenarios addressed at this stage:***
  - *Add GIS Component*
  - *Change GIS Data Format*
  - *Editing a Geographic Feature*
  - *Retrieve Data*
- ***Architectural Decisions:***
  - *Maintain semantic coherence*
  - *Published interfaces*
  - *Client-Server*
  - *Minimize clients & servers interaction*



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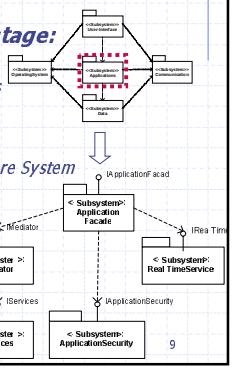
Second Level of Decomposition: Applications Subsystem Decomposition

- ***Scenarios addressed at this stage:***
  - *Mediator design pattern*
  - *Use geographic information standards*
  - *Separation unit operation*
- ***Architectural Decisions:***
  - *Interface GIS with an External Software System*
  - *Change GIS Data Format*
  - *Editing a Geographic Feature*
  - *Retrieve Data*



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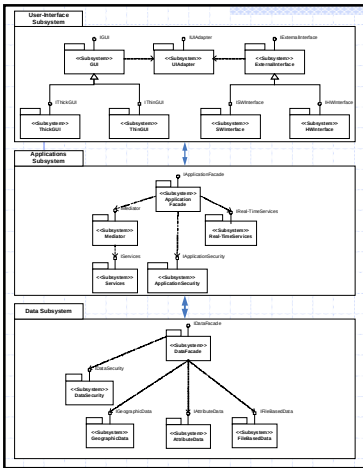

Quality Attribute Scenarios:

- Editing a Geographic Feature
- Retrieve Data
- Change GIS Data Format
- Add GIS Component
- Interface GIS with an External Software System

Architectural Decisions:

1. Maintain semantic coherence
2. Published interfaces
3. Client-Server style
4. Minimize clients & servers interaction
5. Data accessor design pattern
6. Façade design pattern
7. Concurrency
8. Caching
9. Increase hardware resources
10. Mediator design pattern
11. Geographic information standards
12. Separation unit operation
13. Generalization style
14. Adapter (or wrapper) design

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Evaluation: GIS Quality Attribute Scenarios

- **Understandability:** scenarios unambiguously define factors controlling the achievement of quality attributes
- **Precision:** response and response measure offer specific means for assessing GIS architectures
- **Traceability:** decomposing each quality attribute into scenarios enables traceability of how an attribute is addressed during the architectural design and evaluation

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Evaluation: GIS Architecture Design

- **Attribute Driven Design Method:**
  - Simplifies architectural design process
  - Systematic consideration of quality attributes
  - Mapping between quality attribute scenarios & architectural decisions
- **Design Documentation:**
  - Well organized architectural documentation
  - Record of architectural design decisions applied, resultant architectural views and underlying design rationale

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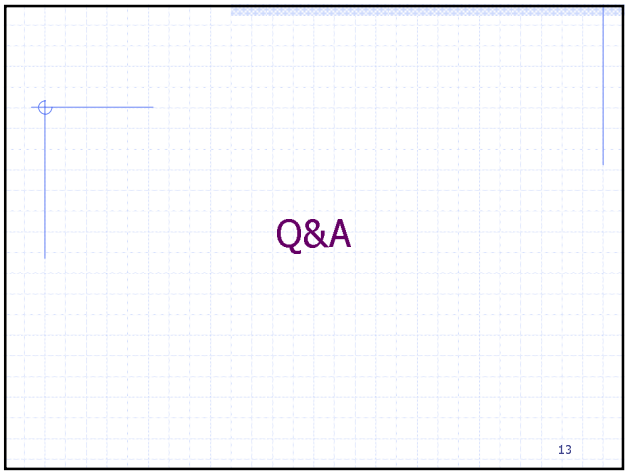
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