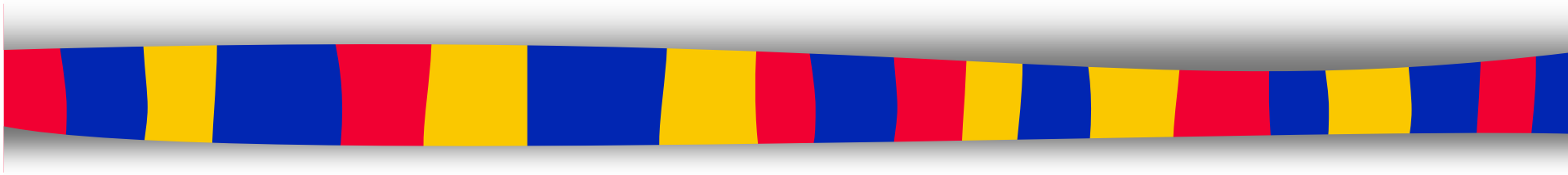
CISC 322

Software Architecture



Lecture 05:

Non Functional Requirements (NFR) – Quality Attributes (2)

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Adapted from Ahmed E. Hassan and Ian Gorton

Last Class - Recap

- Use quality attributes to make NFRs clearer and more precise

- Performance
  - Throughput
  - Response Time
  - Deadlines
- Scalability
  - Request Load
  - Connections
  - Data size
  - Deployment

Today

- Modifiability
- Security
- Availability
- Integration

What is Modifiability?

- Modifiability measures how easy it **MAY** be to change an application

Why Consider Modifiability?

- Software systems are (almost) guaranteed to change
  - New (non-) functional requirements
- Modifiable systems are easier to change/evolve
  - Estimate cost/effort

How to Measure Modifiability?

- Evaluate based on context
  - Research projects vs. Industrial tools
  - Avoid over-engineering!
- Architect asserts likely change scenarios

Modifiability Scenarios

- How hard is it to…..
  - Incorporate new features for **self-service** check-out kiosks.
  - Replace COTS component since **vendor goes out of business**
  - Port application from **Linux** to the **Microsoft Windows** platform.

Modifiability Analysis

- Difficult to quantify impact!

- The best possible is…
  - Convincing **impact analysis**
  - Solution can accommodate modification without *much* change

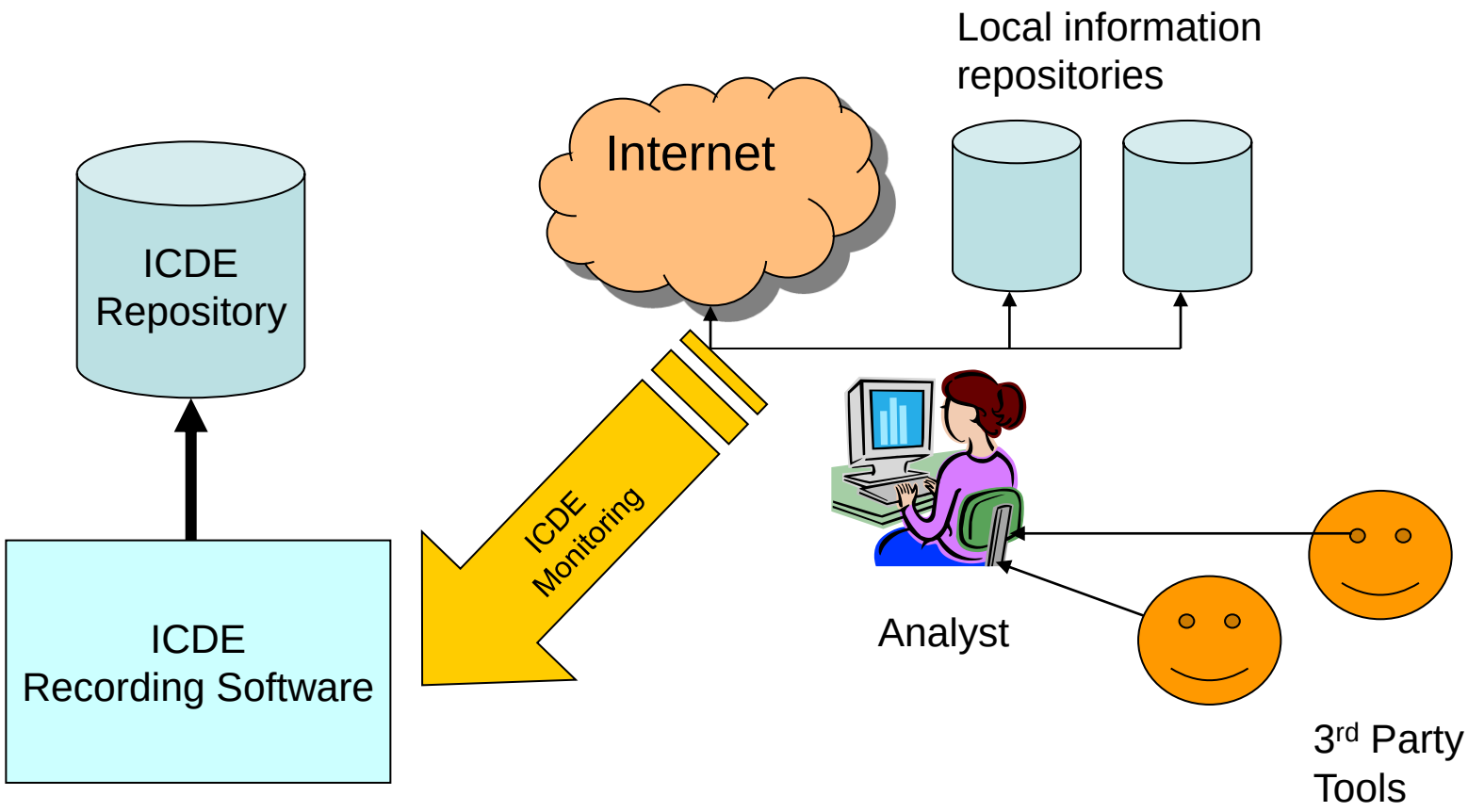
Modifiability General Rules

- Some general rules ….
  - Minimizing dependencies increases modifiability
  - Avoid ripple effects!

Modifiability for ICDE

- The range of events trapped and stored by the ICDE client to be expanded
  - e.g. Different types of search inputs
- Third party tools to communicate new message types

ICDE Schematic



Security

- Specialized quality attribute:
  - Lots of technology available
  - Depends on the application and the context

Security is…

- **Authentication**
  - Verify the identity of users
- **Authorization**
  - Access rights
- **Encryption**
  - Messages sent to/from application are encrypted
- **Integrity**
  - Contents are not altered in transit
- **Many others…**

Security Approaches

- Internet application security (SSL,PKI)
- Authentication and Authorization in Java (JAAS)

ICDE Security Requirements

- Authentication of ICDE users and third party ICDE tools to ICDE server
- Encryption of data to ICDE server from 3rd party tools/users executing remotely over an insecure network

Availability

- The proportion of the required time it is useable
  - Example availability requirements
    - 100% available during business hours
    - No more than 2 hours scheduled downtime per week
    - 24x7x52 (100% availability)
- Related to an application's reliability
  - Unreliable applications suffer poor availability

Measuring Availability

- Period of loss of availability determined by:
  - Time to detect failure +
  - Time to correct failure +
  - Time to restart application

Availability General Rules

- Eliminate single points of failure
- Replication and failover
- Automatic detection and restart
- Recoverability (e.g. Microsoft Word)
  - reestablish performance levels and recover affected data after an application or system failure

Availability for ICDE

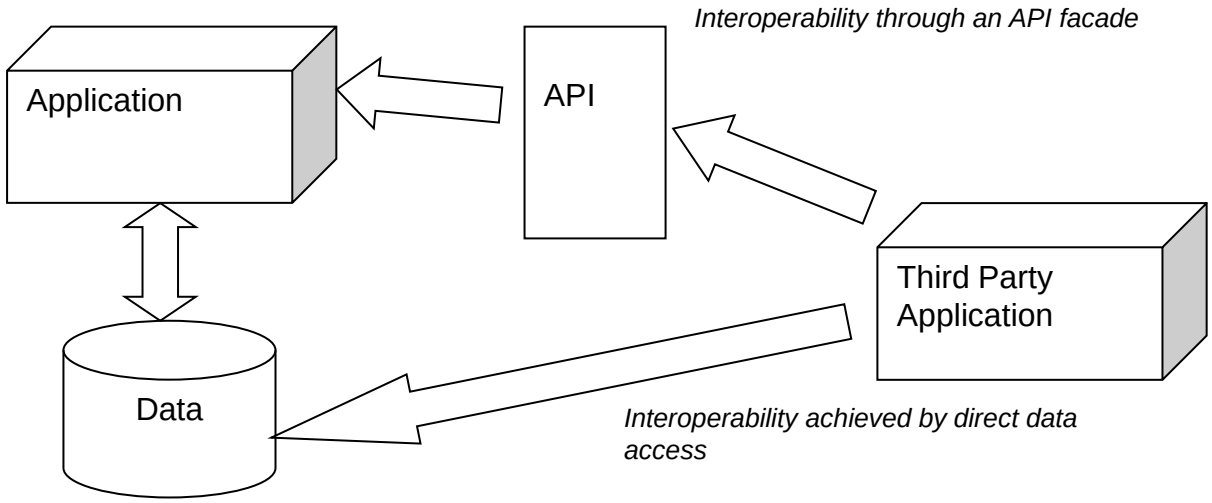
- Achieve 100% availability during business hours
  - Plenty of scope for downtime for system upgrade, backup and maintenance
- Include mechanisms for component replication and failover

Integration

- Ease with which an application can be incorporated into a broader application context

- Typically achieved by:
  - Programmatic APIs
  - Data integration

Integration Strategies



- Data – expose application data for access by other components
- API – offers services to read/write application data through an abstracted interface

ICDE Integration Needs

- Revolve around the need to support third party analysis tools
- Well-defined and understood mechanism for third party tools to access data in the ICDE data store

Misc. Quality Attributes

- Portability
  - Move to new HW/SW platform
- Testability
  - How easy/difficult to test?
  - Consider program complexity
- Supportability
  - How easy to support once deployed?
  - Consider modularity

Design Trade-offs

- QAs are rarely orthogonal
  - highly secure system, difficult to integrate in open environment
  - highly availability, may lead to lower performance
  - high performance, may require being tied to a given platform

NFR – Final Remarks

Importance of NFR

- Functional reqs must be met (ie. mandatory)
- NFRs could be:
  - Mandatory: eg. response time a valve to close
    - The system is unusable
  - Not mandatory: eg. response time for a UI
    - The system is usable but provides a non-optimal experience
- NFRs are very important: 20% of the requirements, hardest to elicit and specify
- NFR: importance increases as market matures

Expressing NFRs

- Functional are usually expressed in Use-Case form
- NFR cannot be expressed in Use-Case form
  - usually do not exhibit externally visible functional behaviour
- Not enough to list NFRs,
  - should be clear, concise, and measurable
- Defining good NFRs requires not only the involvement of the customer but the developers too
  - Ease of maintenance (lower cost) vs. ease of adaptability

The effects of NFRs on high level design and code

- Their implementation does not map usually to a particular subsystem
- Very hard to modify a NFR once you pass the architecture phase:
  - Consider making an already implemented system more secure, more reliable, etc.

Next Class

- Tuesday, Sep. 20
- Architectural Styles

Selected Further Reading

- L. Chung, B. Nixon, E. Yu, J. Mylopoulos, (Editors). Non-Functional Requirements in Software Engineering Series: The Kluwer International Series in Software Engineering. Vol. 5, Kluwer Academic Publishers. 1999.
- J. Ramachandran. Designing Security Architecture Solutions. Wiley & Sons, 2002.
- I.Gorton, L. Zhu. *Tool Support for Just-in-Time Architecture Reconstruction and Evaluation: An Experience Report*. International Conference on Software Engineering (ICSE) 2005, St Loius, USA, ACM Press