

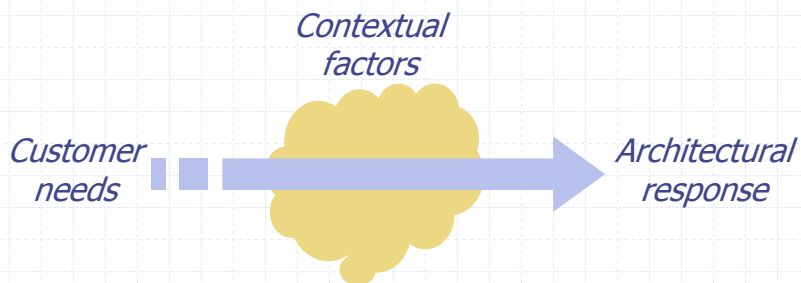
Architectural Analysis

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Wherefore[†] art thou architecture?



Customer needs give rise to
architectural responses,
shaped by contextual factors

[†] **wherefore**
n : the cause or intention underlying an action or situation
<http://www.dictionary.com>

Contextual factors – for houses

- ◆ Climate
- ◆ Available materials
- ◆ Portability
- ◆ Hazards
- ◆ Activities



"Contextual factors"?

Risks

Constraints

Enablers

"OS-Z is not backwards compatible"

"OS-Z improves security"

"OS-Z has no other source"

A factor can have elements of all of these.

Types of contextual factors

◆ *We look for factors in lots of places:*

- *Market/competitive*
- *Organizational*
- *Technological*
- *Policy*

"The development team in Indiana..."

"Lawsuits based on failure of..."

"An updated version of..."

"Standard 3576 requires that we..."

"Our strong Java development capability..."

"Our competitive market window..."

Shapers

- ◆ Change...!
- ◆ Organisational structure
- ◆ Time performance

Usage narratives

- ◆ An informal but useful way to describe system functionality as scenarios
- ◆ Create “characters” and tell a “story”
- ◆ Sometimes seen as a prelude to writing use cases
- ◆ Provide context and add meaning to the requirements

He took his vorpal sword in hand:
Long time the manxome foe he sought
So rested he by the Tumtum tree,
And stood awhile in thought.



An example usage narrative

“Julie is interested in correlating sightings of *Perameles Nasuta* in the Northern beaches area of Sydney with bushfire patterns. She brings up tracking data for the last five years and proceeds to sort the data, and then export it into a form that it can be used by a statistical analysis package.”

“Julie” is a science officer with the National Parks and Wildlife Service.

Functional requirements

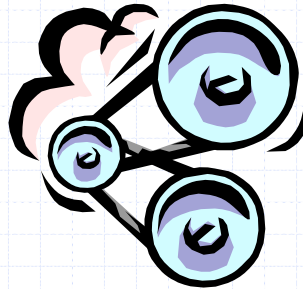
- ◆ Arise from stakeholder needs
- ◆ Express what functions the system provides
- ◆ Varying approaches
 - Structured language (requirements analysis)
 - Use cases
 - Formal models
 - User stories (agile methods, XP)

Non-functional requirements

- ◆ Expressed as quality attributes
- ◆ Determine how the software behaves
- ◆ Architecture deals with identifying, analysing and realising quality attributes
- ◆ Generally must make compromises between the qualities

Runtime qualities

- ◆ Runtime quality attributes emerge from the execution of a deployed system
- ◆ Sometimes referred to as “quality in use”
- ◆ Quality scenarios relate to specific instances of runtime execution



A useful acronym...

performance

Processing speed, resource utilization, response to load

usability

Human factors and impact

reliability

Failure rates, modes, severity, and recovery

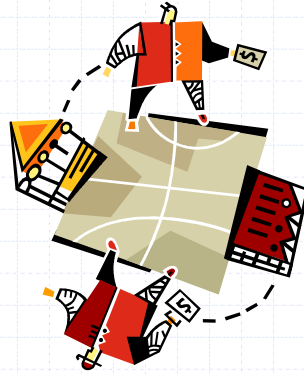
security

Data integrity, confidentiality, resistance to attack

These quality attributes are a useful set of “umbrella” qualities.

Non-runtime qualities

- ◆ Non-runtime qualities relate to the lifetime of a system
- ◆ Quality scenarios are expressed in terms of incidents that occur during system development, deployment, or operation



Acronym time again...

Maintainability

evolvability

testability

reusability

integrity

Configurability

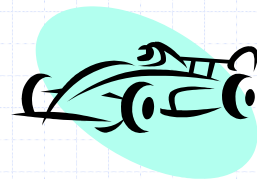
Scalability

Any more quality attributes?

*availability auditability modifiability feasibility
compatibility backwards-compatibility standards-
compliance continuity-of-view friendliness
customizability learnability memorability enjoyability
responsiveness schedulability verifiability
analyzability reparability adaptability integrability
interoperability predictability extensibility
dependability safety portability survivability
expendability expandability extensibility
distributability flexibility*

Performance

- ◆ Performance manifests in many ways:
 - Latency
 - Throughput
 - Response
 - Memory efficiency
- ◆ Different performance metrics may apply to different parts of the system

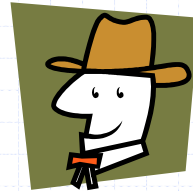


Usability

◆ Usability has many aspects:

- Learnability
- Enjoyability
- Time to complete task
- Error rates

◆ For good results, must be performed with a usability expert



Usability depends on the user

- ◆ To a stockbroker, usability means “do it now”
- ◆ To an unsure new user, usability means “Keep me safe”
- ◆ To a control system operator, usability means “keep me informed and do what I need done”

Reliability

- ◆ A complex field:
 - Hardware/software failures
 - Mean time to failure (MTTF)
 - Mean time to repair (MTTR)
- ◆ Reliability needs often depend on criticality:
 - Inconvenience
 - Loss of income
 - Loss of life
- ◆ Different systems have different concepts of reliability
 - Financial systems can crash, but dare not lose any data
 - Telecommunication systems can lose data but need to recover and restart
 - Control systems must maintain control, come what may
- ◆ Related to Recoverability

$$\text{Availability} = \frac{\text{MTTF}}{\text{MTTF} + \text{MTTR}}$$



Criticality

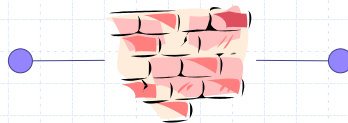
- ◆ Effect of system failure
 - Non-critical
 - ◆ Disrupt work
 - Low
 - ◆ Business loss, but not serious
 - Medium
 - ◆ Long-term damage to business
 - High
 - ◆ Injury, loss of life, etc.

Security

- ◆ Almost any system can be under threat:
 - External attack (network)
 - Policy weakness
 - Data integrity
- ◆ High security is very expensive
- ◆ Secure expert help



Firewalls



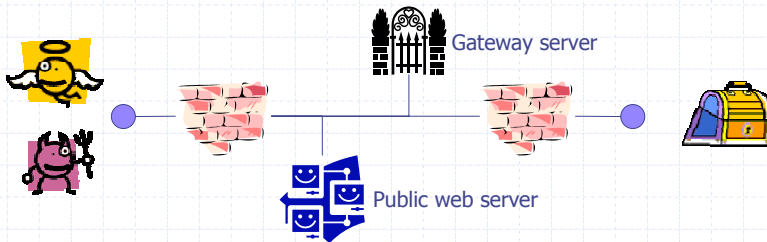
Packet filtering rules specify:

- ✚ Source address (or range)
- ✚ Destination address (or range)
- ✚ Destination port
- ✚ TCP/UDP
- ✚ Application protocol

Packet-filtering firewalls are a common and useful security measure



Demilitarized zone (DMZ)



DMZ:

- ✚ Protects a whole enterprise, while
- ✚ Allowing specific services to be exposed, with
- ✚ Multiple security barriers

Addressing quality attributes

- ◆ Quality narratives (or scenarios) → Coming right up!
- ◆ Behavior → Soon!
- ◆ Patterns → Later!
- ◆ Styles → In module 5
- ◆ Tactics → See supplementary reading...

Quality narratives

- ◆ What do you mean by "fast"?
- ◆ When does it matter and why?
- ◆ A narrative or scenario that highlights a quality attribute need
 - Context
 - Action
 - Response

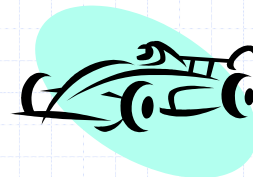
He took his vorpal sword in hand:
24 hours the manxome foe he sought
So rested he by the Tumtum tree,
And stood 5 minutes (mean) in thought.



Measurable if possible!

Performance

"Under load at the peak event rate,
any given event is analyzed and
logged in no more than 200 ms."



Questions

- ◆ Questions
- ◆ Questions
- ◆ Questions

Labs

- ◆ Now you are due to go to the labs located at Building 1 Level 22 Room 14
- ◆ There, you will be told something about the labs, how they work and other logistical stuff
- ◆ There will be a simple exercise in pairs
- ◆ There will be a more complicated, but still relatively small, team exercise