Abstract

Today’s IT capabilities are seemingly limitless. From the point of view of last century we have amazing functionality available to consumers, businesses, governments et cetera. Technology advances have made this possible. At the same time we suffer from unwanted, unexpected incidents, ranging from slow or no response to loss or theft of sensitive data. The growth of systems and its complexity play a role. We will look at the role of the human creators of these systems and the available technology to discuss our concurrent progression and regression, and we will look at the role of the architect in particular.
Functionality is Limitless

consumers

government

financial transactions

financial infrastructure

businesses

financial institutes

anywhere, anytime

Status of IT Architecting: Progression or Regression?

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But Problems seem to be Pervasive

slow response, outages, human-less helpdesks, silly excuses (the computer could not...), identity-theft, lost privacy

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PRSIThell
Do we Gain or do we Lose?

desired properties
functionality
performance

not desired
failures
threats

progression
regression

time

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PRSIITquestion
question
gain or
lose?

role of
architect

example

webshop
application

performance
technology

solution?
reference
architecture

reflection
on size and
complexity

analysis
Example, Case Webshop

Up-to-date information:
Bestsellers
What Other Customers Are Looking At Right Now

catalogue entries
main access through search
personalization
styling: frequently updated, fashion!

standard boilerplate
other advertisements

snapshot of www.amazon.com
### Some Numbers: New Books per Year

#### New books per year

<table>
<thead>
<tr>
<th>Country</th>
<th>New Books per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>206k (2005)</td>
</tr>
<tr>
<td>USA</td>
<td>172k (2005)</td>
</tr>
<tr>
<td>China</td>
<td>101k (1994)</td>
</tr>
<tr>
<td>India</td>
<td>12k (1996)</td>
</tr>
</tbody>
</table>

#### Source:
- [http://en.wikipedia.org/wiki/Books_published_per_country_per_year](http://en.wikipedia.org/wiki/Books_published_per_country_per_year)

![Diagram](http://en.wikipedia.org/wiki/Books_published_per_country_per_year)

#### Notes:
- Selection depends on business life cycle changes determined by business characteristics.
- Product portfolio characteristics.
question gain or lose?

role of architect

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Typical Block Diagram and Typical Resources

- **Data Base Server**
- **Web Server**
- **Network**
- **Presentation**
- **Computation**
- **Communication**
- **Storage**

Legend:
- **Screen**
- **Client**
- **Network**
## Hierarchy of Storage Technology

<table>
<thead>
<tr>
<th>Category</th>
<th>Storage Type</th>
<th>Latency</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor Cache</td>
<td>L1 cache</td>
<td>sub ns</td>
<td>n kB</td>
</tr>
<tr>
<td></td>
<td>L2 cache</td>
<td>ns</td>
<td>n MB</td>
</tr>
<tr>
<td></td>
<td>L3 cache</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast Volatile</td>
<td>Main Memory</td>
<td>tens ns</td>
<td>n GB</td>
</tr>
<tr>
<td>Persistent</td>
<td>Disks</td>
<td>ms</td>
<td>n*100 GB</td>
</tr>
<tr>
<td></td>
<td>Disk Arrays</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disk Farms</td>
<td></td>
<td>n*10 TB</td>
</tr>
<tr>
<td>Archival</td>
<td>Robotized</td>
<td>&gt;s</td>
<td>n PB</td>
</tr>
<tr>
<td></td>
<td>Optical Media</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tape</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Performance as Function of Data Set Size

![Graph showing performance as a function of data set size.]
### Communication Technology: Figures of Merit

<table>
<thead>
<tr>
<th></th>
<th>Latency</th>
<th>Frequency</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>on chip</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>    </td>
<td>connection</td>
<td>sub ns</td>
<td>n GHz</td>
</tr>
<tr>
<td>    </td>
<td>network</td>
<td>n ns</td>
<td>n GHz</td>
</tr>
<tr>
<td><strong>PCB level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>    </td>
<td>connection</td>
<td>tens ns</td>
<td>n 100MHz</td>
</tr>
<tr>
<td><strong>Serial I/O</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>    </td>
<td></td>
<td>n ms</td>
<td>n 100MHz</td>
</tr>
<tr>
<td><strong>network</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>    </td>
<td>LAN</td>
<td>n ms</td>
<td>100MHz</td>
</tr>
<tr>
<td>    </td>
<td>WAN</td>
<td>n 10ms</td>
<td>n GHz</td>
</tr>
</tbody>
</table>
Performance

question gain or lose?
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PRSITlogoPerformance
Example Web Shop

- Screen
  - Client
- Web server
  - Network
- Database server
  - Product descriptions
  - Logistics ERP
  - Financial
  - Customer relations

**Consumer**
- Browse products
- Order
- Pay
- Track

**Enterprise**
- Logistics
- Finance
- Product management
- Customer management

**Exhibit products**
- Sales & order intake
- Order handling
- Stock handling
- Financial bookkeeping

**Customer relation**
- Management
- Update catalogue
- Advertise
- After sales support

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MAFTexampleWebShop
Impact of Picture Cache

- Fast response
- Less load
- Less server costs

Screen
Client
Network
Mid office server
Back office server
Product descriptions
Logistics ERP
Financial
Customer relations
Picture cache
Multiple Layers of Caching

<table>
<thead>
<tr>
<th>Cache Type</th>
<th>Cache Miss Penalty</th>
<th>Cache Hit Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Cache</td>
<td>1 s</td>
<td>10 ms</td>
</tr>
<tr>
<td>Network Layer Cache</td>
<td>100 ms</td>
<td>1 ms</td>
</tr>
<tr>
<td>File Cache</td>
<td>10 ms</td>
<td>10 µs</td>
</tr>
<tr>
<td>Virtual Memory</td>
<td>1 ms</td>
<td>100 ns</td>
</tr>
<tr>
<td>Memory Caches L1, L2, L3</td>
<td>100 ns</td>
<td>1 ns</td>
</tr>
</tbody>
</table>

Typical cache 2 orders of magnitude faster.

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MAFTgenericCaches
Why Caching?

- Project risk
- Performance
- Response time
- Life cycle
- Cost
- Latency penalty once
- Overhead once
- Processing once
- Limit storage needs to fit in fast local storage

- Frequently used subset
- Fast storage
- Local storage
- Design parameters
  - Caching algorithm
  - Storage location
  - Cache size
  - Chunk size
  - Format

- Low latency
- Less communication
- Latency penalty once
- Overhead once
- Processing once
- In (pre)processed format

- Long latency
- Mass storage
- Communication
- Overhead
- Resource intensive
- Processing
- Communication
- Long latency
- Mass storage
- Resource intensive
- Processing
- Communication
Risks of Caching

- Frequently used subset
- Fast storage
- Local storage
- Larger chunks
- In (pre)processed format

Robustness for application changes
Ability to benefit from technology improvements
Robustness for changing context (e.g., scalability)
Robustness for concurrent applications
Failure modes in exceptional user space

Life cycle
cost
effort

Project risk
cost
effort
Performance

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MAFTrisksOfCaching
Size and Complexity

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PRSITlogoSize
Level of Abstraction Single System

static system definition

monodisciplinary

number of details

system requirements

multidisciplinary design

static system definition

monodisciplinary
Product Family in Context

- 10^9
- 10^6
- 10^3
- 10^0
- 10^3
- 10^6
- 10^9

number of details

- enterprise context
- enterprise
- stakeholders
- systems
- multidisciplinary design
- parts, connections, lines of code

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RAPdiabolo
Number of Details in Today’s Services

- society
- enterprises
- enterprise
- stakeholders
- processes
- systems
- multi-disciplinary design
- parts, connections, lines of code
- employees in the field
- enterprise architects
- information architects
- suppliers outsourced

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Reference Architecture as Solution?

Systems, multi-disciplinary design, parts, connections, lines of code, stakeholders, enterprises, society, processes, systems, multi-disciplinary design, parts, connections, lines of code.

Some context details are essential, some technical details are essential.

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PRSITdiaboloRA
1.1 One of several prerequisites for architecture creative synthesis is the definition of **5-7 specific key drivers** that are critical for success, along with the rationale behind the selection of these items.

2.1. The essence of a system can be captured in about **10 models/views**.

2.2. A **diversity** of architecture descriptions and models is needed: languages, schemata and the degree of formalism.

2.3. The level of **formality** increases as we move closer to the implementation level.

from http://www.architectingforum.org/bestpractices.shtml
Possible useful visualizations

actual figures and references to their use at http://www.gaudisite.nl/figures/<name>.html
Ideal Structure does not exist
Synthesis, Integration, Relation oriented

1. Functional Decomposition
2. Construction Decomposition
3. Allocation
4. Infrastructure
5. Choice of integrating concepts

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LWAArchitectureHow

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Checklist for RA content

customer context

- business
- financials
- stakeholders
- benefits, concerns
- concept of operations

technical architecture

- key performance parameters
- product features, functions

relations

guidance

- core technologies
- critical resources
- design issues
- dominant patterns

business architecture

- business model
- life cycle
- stakeholders
- benefits, concerns
question: gain or lose?

role of architect

example:
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- technology

solution?: reference architecture

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Tasks of Architect

- society
- enterprises
- enterprise
- stakeholders
- processes
- systems
- multi-disciplinary design
- parts, connections, lines of code

- select data
- guide sales, deployment
- understand fitness
- overview
- understand design
- select data
- guide realization

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PRSITasksArchitect
Responsibilities

KISS
Elegance
Simple

Integrity

Balance
Consistency

Decomposition
Integration

Overview

satisfied stakeholders
context

system

module
subsystem
system

Requirement
Spec
Design
Realization

modules

Quality
Function

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RSAResponsibilities
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LWAstakeholdersArchitecture
Gain or Lose?

question gain or lose?

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PRSITlogoConclusion
Loss Scenario

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PRSITlossScenario
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PRSITgainScenario
Conclusion

We need to improve architecting skills to gain.

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PRSITconclusion
Read More at the Gaudisite

Reference Architecture Primer

Webshop case is part of System Modeling and Analysis
http://www.gaudisite.nl/SystemModelingAndAnalysisBook.pdf

All about Architecting: System Architecting