Abstract

A Reference Architecture captures the essence of the architecture of a collection of systems. The purpose of a Reference Architecture is to provide guidance for the development of architectures for new versions of the system or extended systems and product families.

We provide guidelines for the content of a Reference Architecture and the process to create and maintain it. A Reference Architecture is created by capturing the essentials of existing architectures and by taking into account future needs and opportunities, ranging from specific technologies, to patterns to business models and market segments.
1. general introduction

2. level of abstraction

3. content

4. summary
Why Reference Architectures?

When to Use Reference Architectures?

What do Reference Architectures contain?

How to use Reference Architectures?

What are inputs of a Reference Architecture?

Criteria for a good Reference Architecture.
Graph of objectives of Reference Architectures

- Increased complexity
- Increased scope
- Increased size

Facilitate
- Multi-site
- Multi-organization
- Multi-vendor
- Multi-*
- System creation and life-cycle support

Effectively create new:
- Products
- Product lines
- Product portfolio

Managing synergy
- Providing guidance, e.g. architecture principles, best practices
- Providing an architecture baseline and an architecture blueprint
- Capturing and sharing (architectural) patterns
- Providing a common lexicon and taxonomy
- Providing a common (architectural) vision
- Providing modularization and the complementary context

Articulation of domain and realization concepts

Achieve interoperability between many different and evolving systems

Explicit modeling of functions and qualities above systems level

Explicit decisions about compatibility, upgrade and interchangeability.
When to Use Reference Architectures

Reference Architectures facilitate the step towards product family architecting and evolvability; this often coincides with multi-* problems.
RA Elaborates Mission, Vision and Strategy

- **Mission**
- **Vision**
- **Strategy**

Multiple organizations

Reference Architecture elaborated in guidance for future
RA = Business Arch. + Technical Arch. + Customer Context

- Customer context
  - Customer enterprise
  - Users
- Technical architecture
  - Requirements
  - Black box view
- Relations
  - Guidance
  - Business model
  - Life cycle
- Design patterns
  - Technology
- Business architecture
Instantiation of a RA in few Transformations

- architect
- reference architecture
- system architecture
- family architecture
- shared asset architecture
- design and engineer
- system A
- system B
- product family
- shared assets
- build and test
- field feedback
- extracting essentials
- constraints and opportunities

reference architecture
architectures
engineering documentation
actual systems
Inputs of a Reference Architecture

- existing architectures
- customer needs, business needs
- product portfolio, future requirements
- essence, architecture patterns
- proven concepts & known problems
- exploration & analysis
- vision

Reference Architecture

guides evolution

triggers new changes
Criteria for a good Reference Architecture

understandable for broad set of stakeholders

accessible and actually read/seen by majority of the organization

addresses the key issues of the specific domain

satisfactory quality

acceptable

up-to-date and maintainable

adds value to the business

customers

product managers

project managers

engineers

...
Challenge: Appropriate Level of Abstraction

Single System
Product Family in Context
Capturing the Essence
Size Considerations:
  What is the appropriate level of abstraction?
  How many details?
Decomposition of Large Documents
Level of Abstraction Single System

- static system definition
- monodisciplinary
- number of details
- system requirements
- multidisciplinary design
- static system definition
- monodisciplinary
Product Family in Context

- $$10^9$$: enterprise context
- $$10^6$$: enterprise
- $$10^3$$: stakeholders
- $$10^0$$: systems
- $$10^3$$: multidisciplinary design
- $$10^6$$: parts, connections, lines of code
- $$10^9$$: number of details
RA: Capturing the Essence

A Reference Architecture Primer
Gerrit Muller

version: 0.6
October 20, 2017
RAPdiaboloRA

some context
details are
essential

some technical
details are
essential

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

number of
details

10^9
10^6
10^3
10^0
10^-3
10^-6
10^-9
RA: level of abstraction, number of details

level of abstraction

10^3

10^6

number of details

market
process flow
key drivers
key performance indicators
information model
decomposition
concurrency & synchronization

compact reference architecture
few diagrams only

high end market
value chain
industry roadmap
key drivers
strategic partners
business models
Cost of Ownership
process flow
interoperability
function flow
process descriptions
standards
map of systems

key performance indicators

decomposition
behavior
exception handling
security
functional models
information model
supplier policy
API's
shared assets

concurrency & synchronization

extensive reference architecture
many documents

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RAPsize Spectrum
Size Considerations

10^3 level of abstraction 10^6 number of details

- **level of abstraction**
  - market
  - process flow
  - key drivers
  - key performance indicators
  - information model
  - decomposition
  - concurrency & synchronization

- **number of details**
  - high end market
  - value chain
  - industry roadmap
  - key drivers
  - strategy
  - partner
  - business models
  - process flow
  - interoperability
  - function flow
  - standards
  - map of systems
  - key performance indicators
  - functional models
  - behavior
  - exception handling
  - security
  - safety
  - information model
  - concurrency & synchronization
  - API's
  - shared assets
  - cache design

**compact reference architecture**
- few diagrams only
- low effort to create
- limited guidance
- anchor value
- easy to share
- read

**extensive reference architecture**
- many documents
- significant effort to create
- great guidance
- anchor value
- difficult to share
- read
Decomposition of Large Documents

- **document structure**
- **overview**
- **compound document**

**Frontpage**
- title
- identification
- author
- distribution
- status
- review

**History**
- changes

**Diagrams**
- contents
- tables

**Contents max 2 pages**

**Contents 2..18 pages**

**Atomic document**

1. aap
2. noot
3. mies

Lists and ca 50% text
What should be in Reference Architectures?

Guidance from Best Practices

Visualizations

Structure

What content should be in Reference Architectures?
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
1. Functional Decomposition

2. Construction Decomposition

3. Allocation

4. Infrastructure

5. Choice of integrating concepts
Checklist for RA content

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

technical architecture
- key performance parameters
- product features, functions
- core technologies
- critical resources
- design issues
- dominant patterns

business architecture
- business model
- life cycle
- stakeholders
- benefits, concerns

relations
- guidance