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
General Introduction to Reference Architectures

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

Facilitate multi-site, multi-organization, multi-vendor, multi-* system creation and life-cycle support

Increased complexity, scope, size

Effectively create new: products, product lines, product portfolio

Achieve interoperability between many different and evolving systems

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

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

A Reference Architecture Primer

Gerrit Muller

version: 0.6
March 6, 2013
SAFRAstrategy

mission

vision

strategy

multiple organizations

Reference Architecture

guidance for future

elaborated in
RA = Business Arch. + Technical Arch. + Customer Context

customer context

requirements
black box view

technical architecture

design patterns
technology

relations
guidance

business model
life cycle

business architecture
Instantiation of a RA in few Transformations

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

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SAFRAinstantiation
Inputs of a Reference Architecture

- existing architectures
- customer needs
- business needs
- product portfolio
- future requirements

Reference Architecture

- essence
- architecture patterns
- proven concepts & known problems
- exploration & analysis
- vision

guides evolution

triggers new changes

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SAFRAflow
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
- Multi-disciplinary design
- System requirements
- Monodisciplinary
Product Family in Context

- $10^9$
  - parts, connections, lines of code
- $10^6$
  - multidisciplinary design
- $10^3$
  - systems
- $10^0$
  - stakeholders
- $10^{-3}$
  - enterprise
- $10^{-6}$
  - enterprise context

number of details
**RA: Capturing the Essence**

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RAPdiaboloRA

A diagram showing a pyramid with layers labeled as follows:

- **Enterprise Context**: $10^9$
- **Enterprise**: $10^6$
- **Stakeholders**: $10^3$
- **Systems**: $10^0$
- **Multidisciplinary Design**: $10^3$
- **Parts, Connections, Lines of Code**: $10^6$

The diagram illustrates the number of details increasing from bottom to top, with some context details and some technical details being essential at different levels.
RA: level of abstraction, number of details

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

compact reference architecture
few diagrams only

extensive reference architecture
many documents

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

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

decomposition
behavior
resource management
exception handling
security
supplier policy
API’s
shared assets

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RAPsizeSpectrum
Size Considerations

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

Compact reference architecture
few diagrams only

Extensive reference architecture
many documents

Low effort to create
maintain
read
easy to share

Significant effort to create
maintain
read
difficult to share

Limited guidance
anchor value

Great guidance
anchor value

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RAPsizeConsiderations
Decomposition of Large Documents

overview

compound document

document
structure

recursion

atomic document

compound document

compound document

compound document

frontpage

title

identification

author

distribution

status

review

history

changes

diagrams

tables

meta information

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

relations
guidance

business model
life cycle
stakeholders
benefits, concerns

business architecture
Summary of the role of Reference Architectures

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

**Reference Architecture**

- **Customers**
- **Market**

- **Existing architectures**
- **Multiple organizations**

- **Technology**
  - **Needs**
  - **Opportunities**

- **Guidance**
  - **Knowledge**

- **New or evolved architectures**