FROM KNOWN KNOWNS TO UNKNOWN UNKNOWNS

MODPROD Linköping 2017-02-08

Pär Hammarström
SAAB Aeronautics

MODELLING A FIGHTER AS SERVICES AND FEATURES

Pär Hammarström
System Architect Gripen E
Saab Aeronautics

A (micro)services oriented architecture, in order to enable effective and efficient variant handling and long term evolution of a complex system.

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- Introduction & Background
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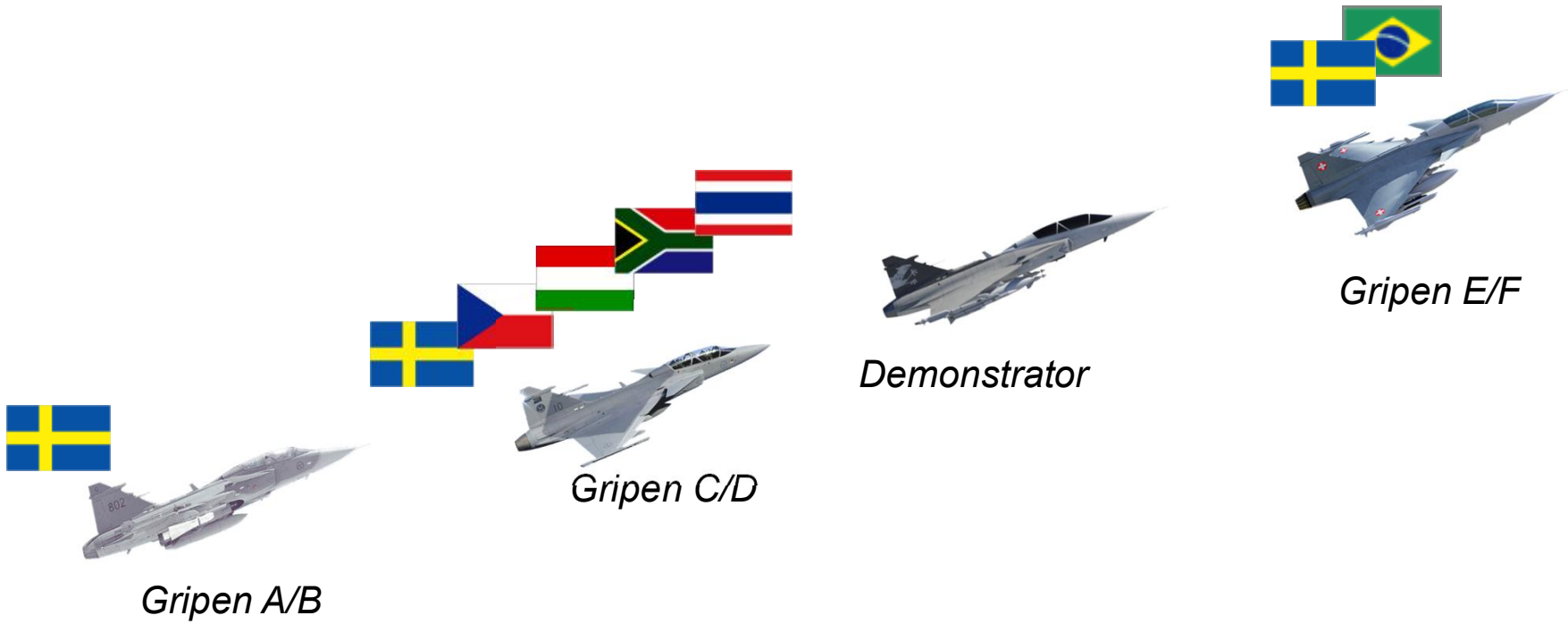
GRIPEN EVOLUTION

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A CONSTANTLY CHANGING ENVIRONMENT

Gripen A/B

National Defence

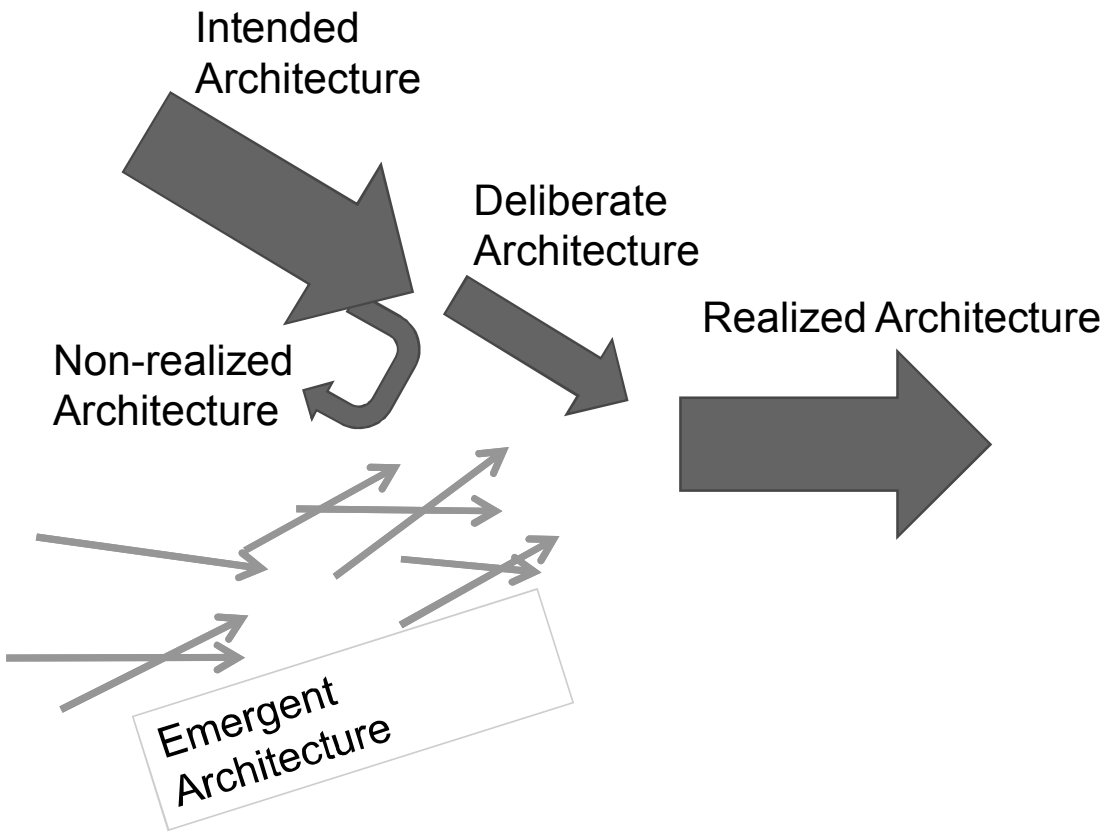
Gripen C/D

International Missions
Export

Gripen E/F

National Defence
International Missions
Export

ARCHITECTURE: PLAN, PATTERN AND PERSPECTIVE



Architecture as a Process

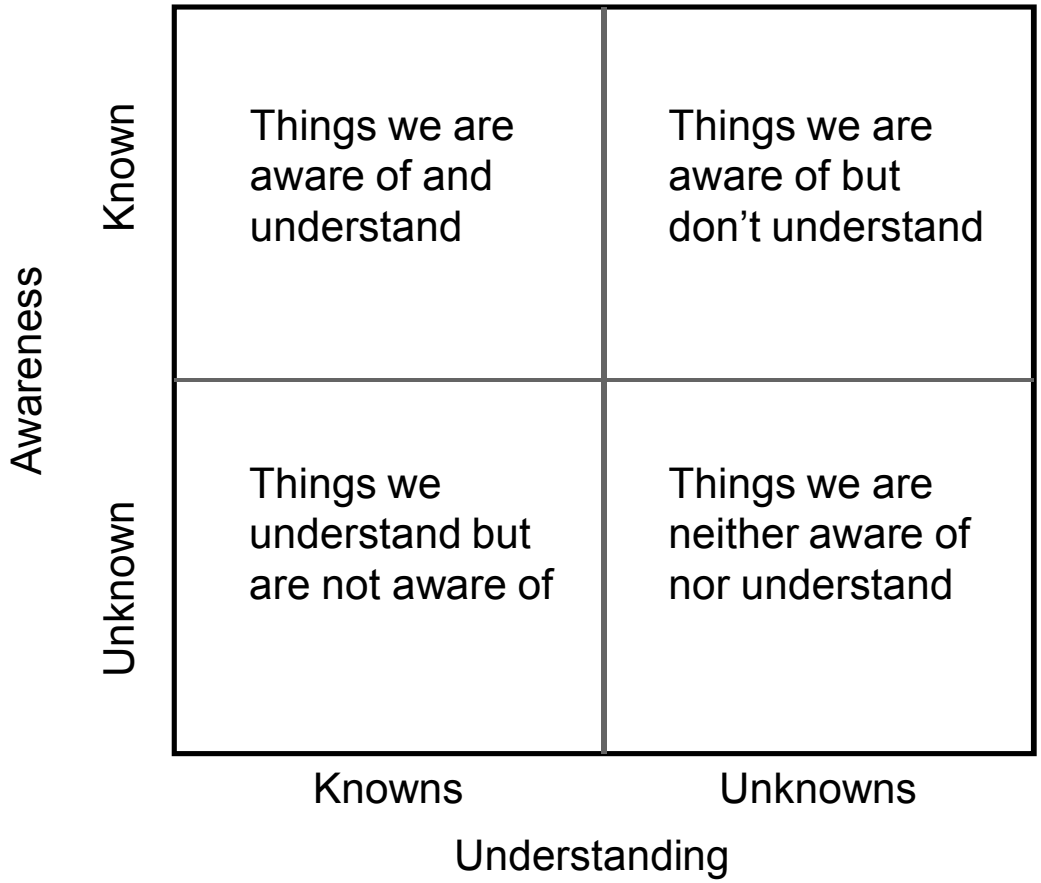
Paraphrazed from Mintzberg H., 1994, The Rise and Fall of Strategic Planning

PARTLY DESIGNED, PARTLY EVOLVED

"… But there are also unknown unknowns – the ones we don't know we don't know. And if one looks throughout the history of our country and other free countries, it is the latter category that tend to be the difficult ones."

- US Secretary of Defence, Donald Rumsfeldt

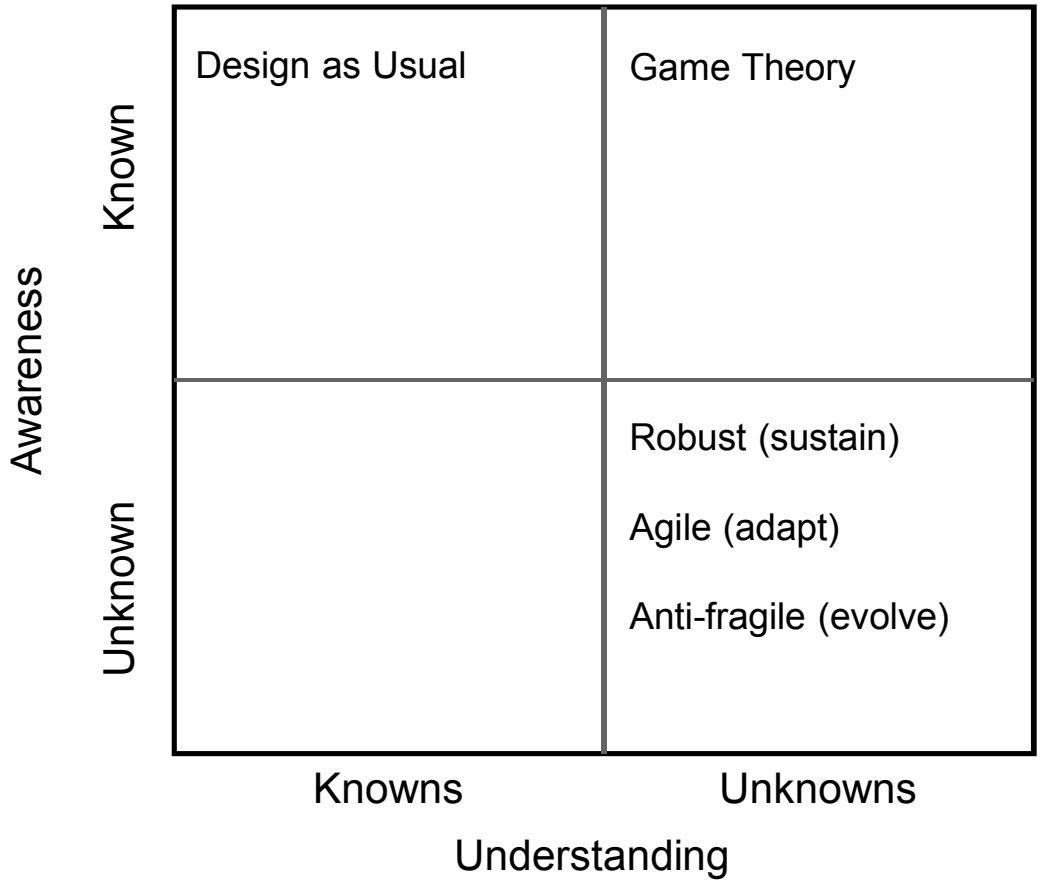
WHAT DO YOU KNOW?



WAKE UP AND SMELL THE COFFEE

“we didn’t do anything wrong, but somehow, we lost”
- Nokia CEO Steve Elop

HOW DO YOU PREDICT THE UNPREDICTABLE?

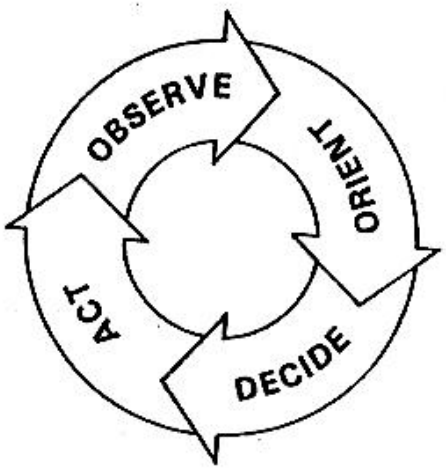


- **KEY PRINCIPLES**
- Prevent ripple effect
- Allow diversity and redundancy
- Defer decisions
- Fight complexity

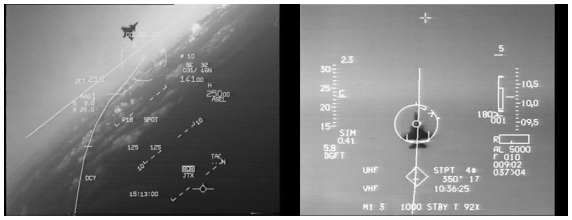

SAAB
GRIPEN E

COMPETITIVE ADVANTAGE

- Conflict, in its most basic form, is a contest between decision making loops. The side with the FASTER and BETTER decision making loop wins any conflict
- It's all about getting inside the enemy's OODA-loop

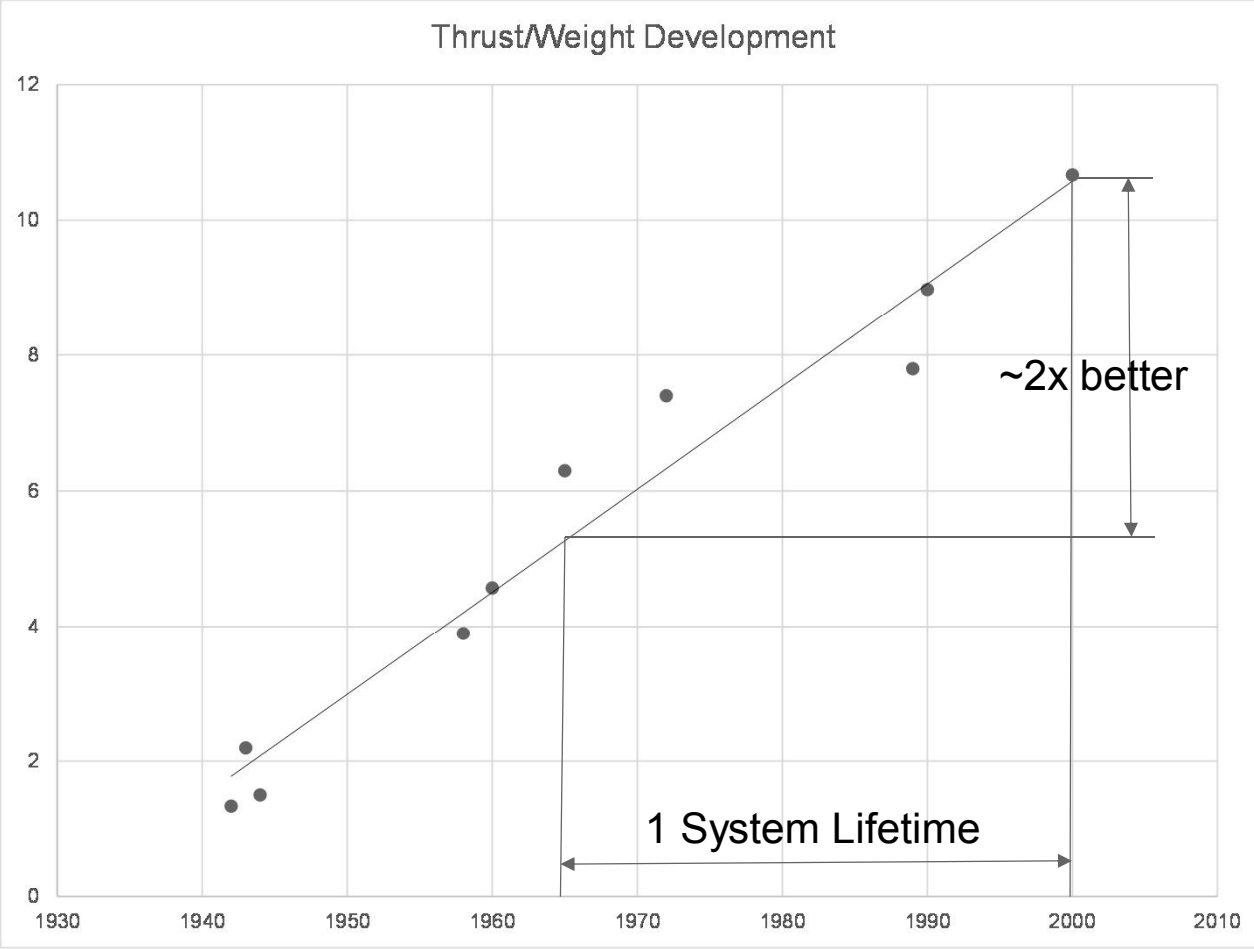


Short Loop



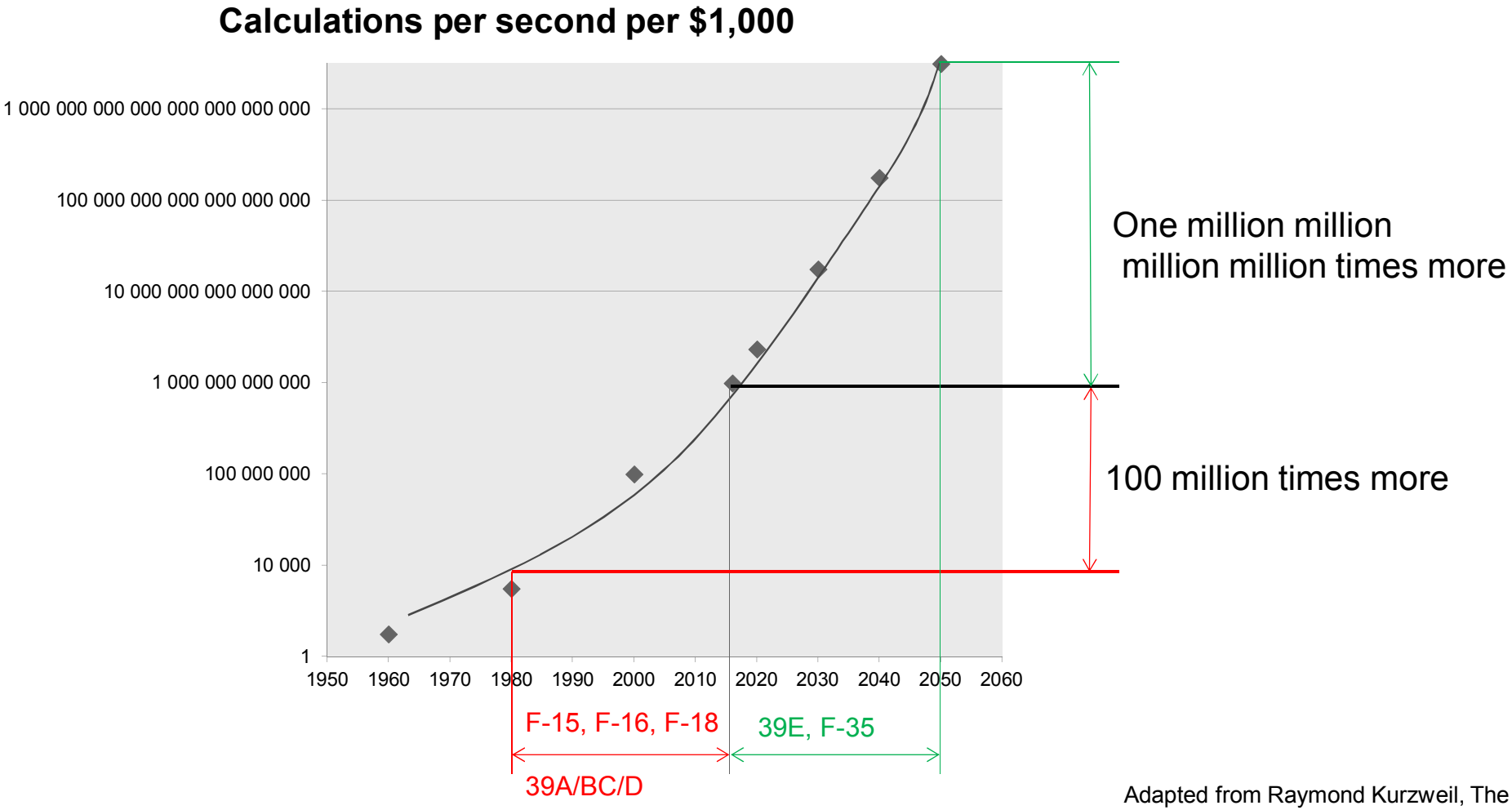
Long Loop

PACE OF CHANGE



Pratt&Whitney Engine Data

PACE OF CHANGE

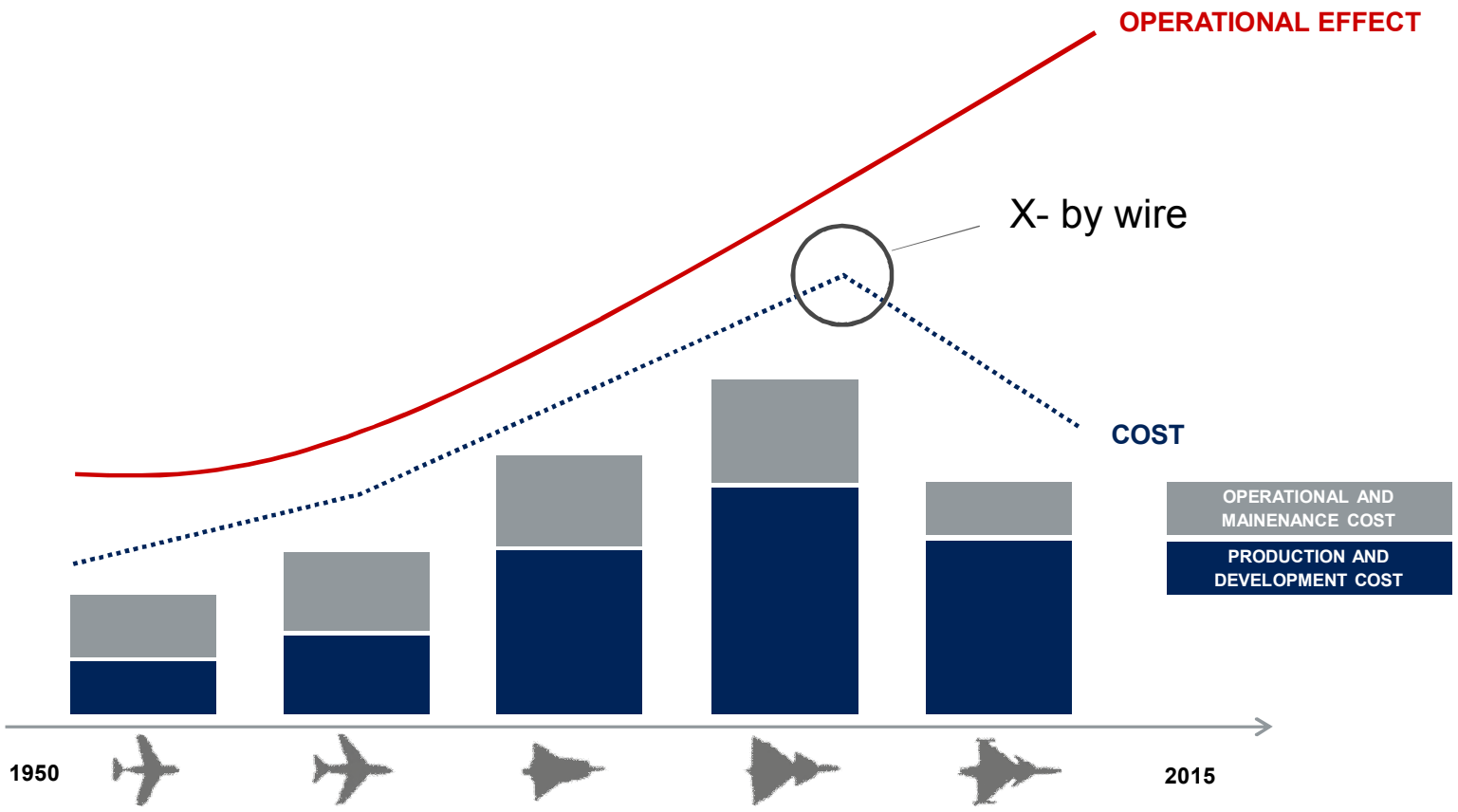


Adapted from Raymond Kurzweil, The Age of Spiritual Machines

BREAKING THE **COST CURVE**

Cost-efficient products…

… and **value for money**



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“In the future, all companies will be software companies”
George F. Colony (CEO Forrester Research)

MOVING AT THE PACE OF CHANGE

Pär's first mobile

1983

1992

1998

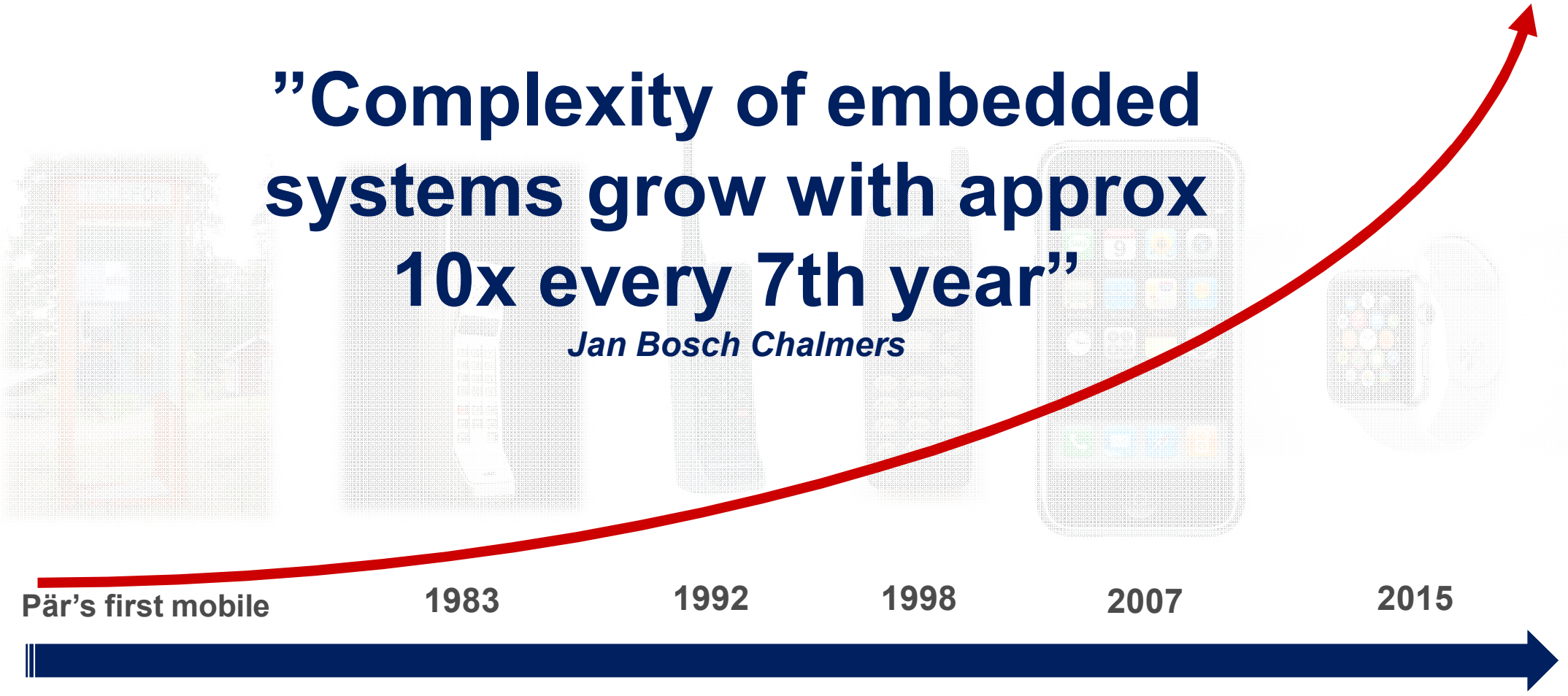
2007

2015

MOVING AT THE PACE OF CHANGE

”Complexity of embedded systems grow with approx 10x every 7th year”

Jan Bosch Chalmers



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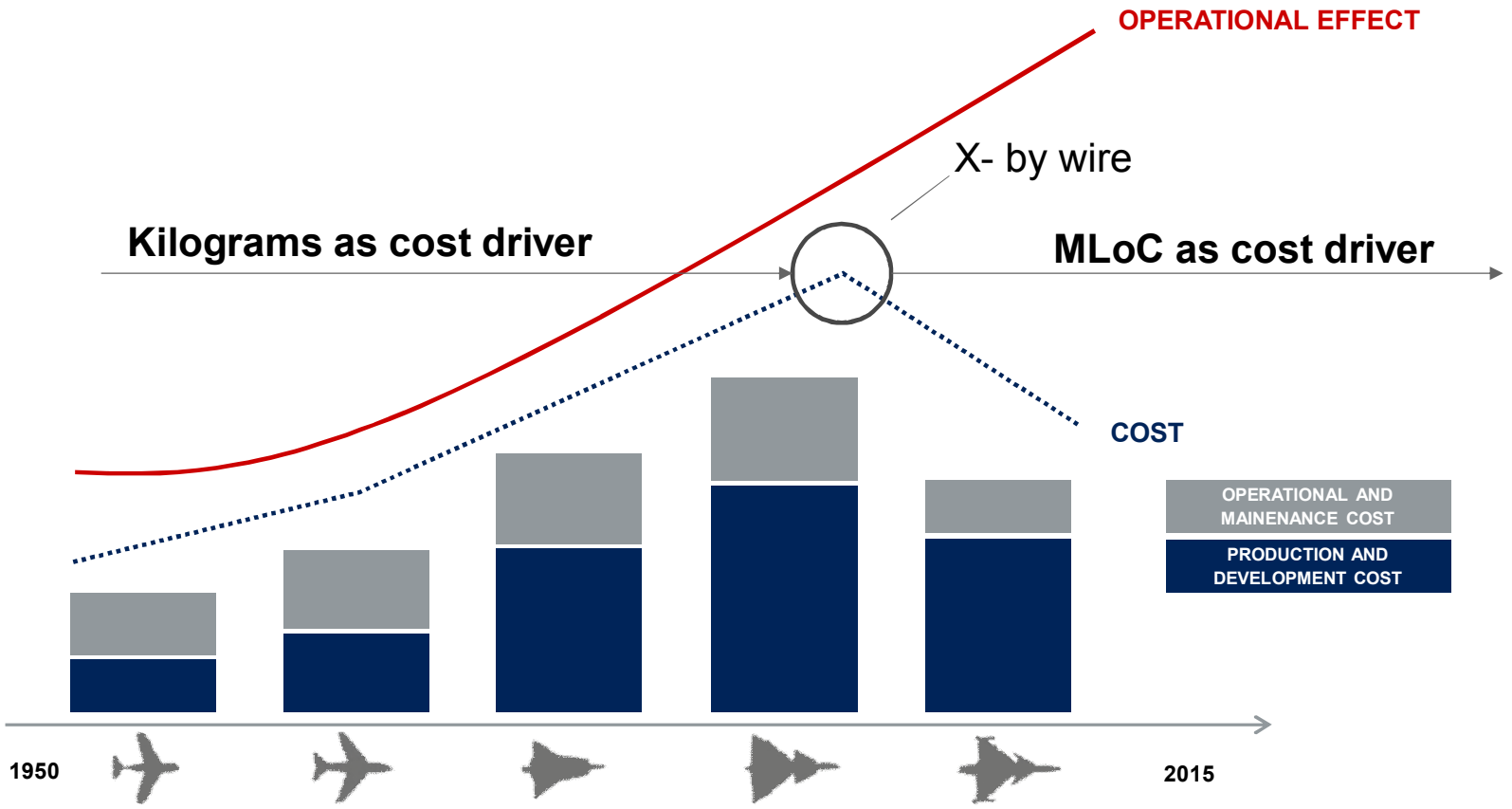

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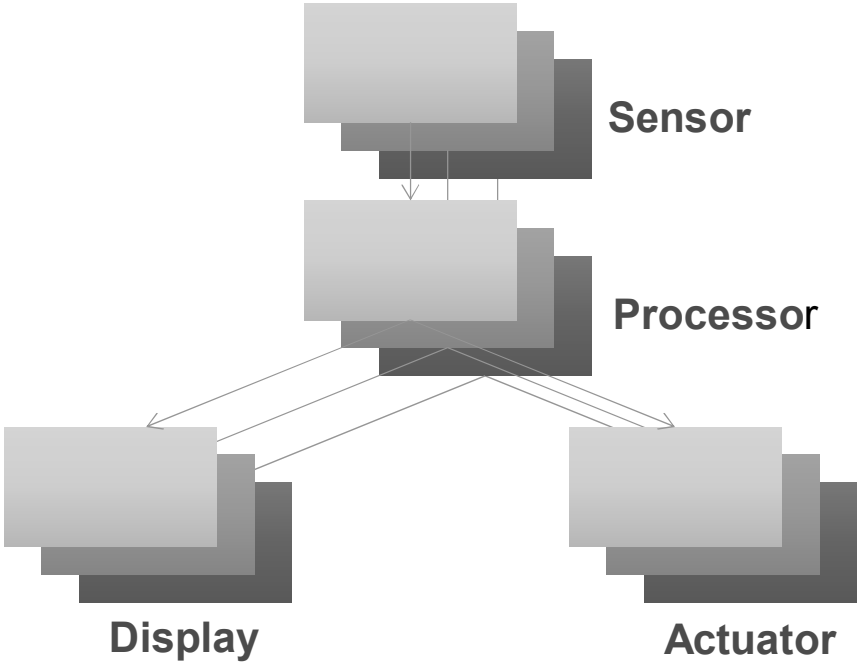
THE CLASSIC DESIGN - FEDERATED SYSTEM



- Separate HW for each function
- ”Hard wired”
- Limited Integration and Synergy

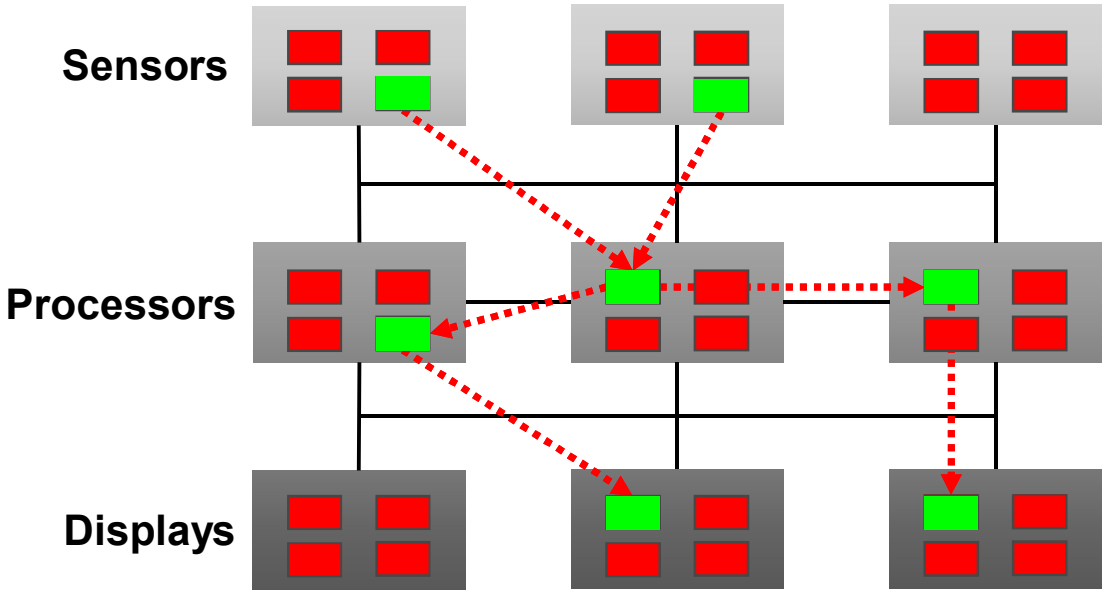
+ ”Simple” integration and verification

THE CLASSIC DESIGN – FEDERATED SYSTEM

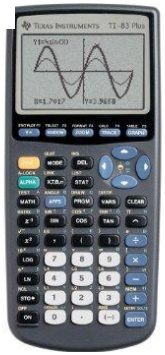
DIGITALIZATION - INTEGRATED MODULAR AVIONICS

+ Generic HW
+ ”Software defined”
+ Composability

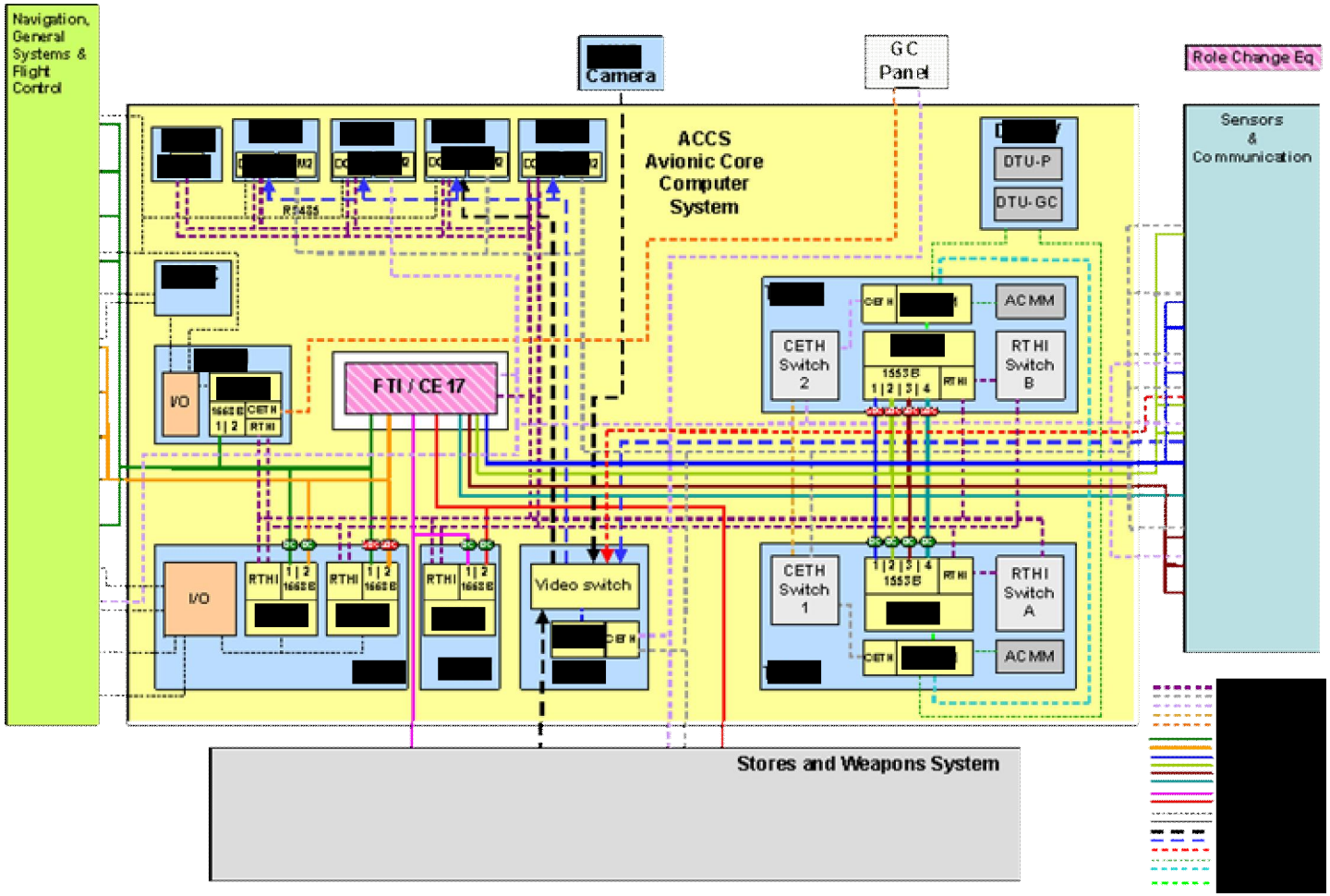
– Complex framework for integration and verification



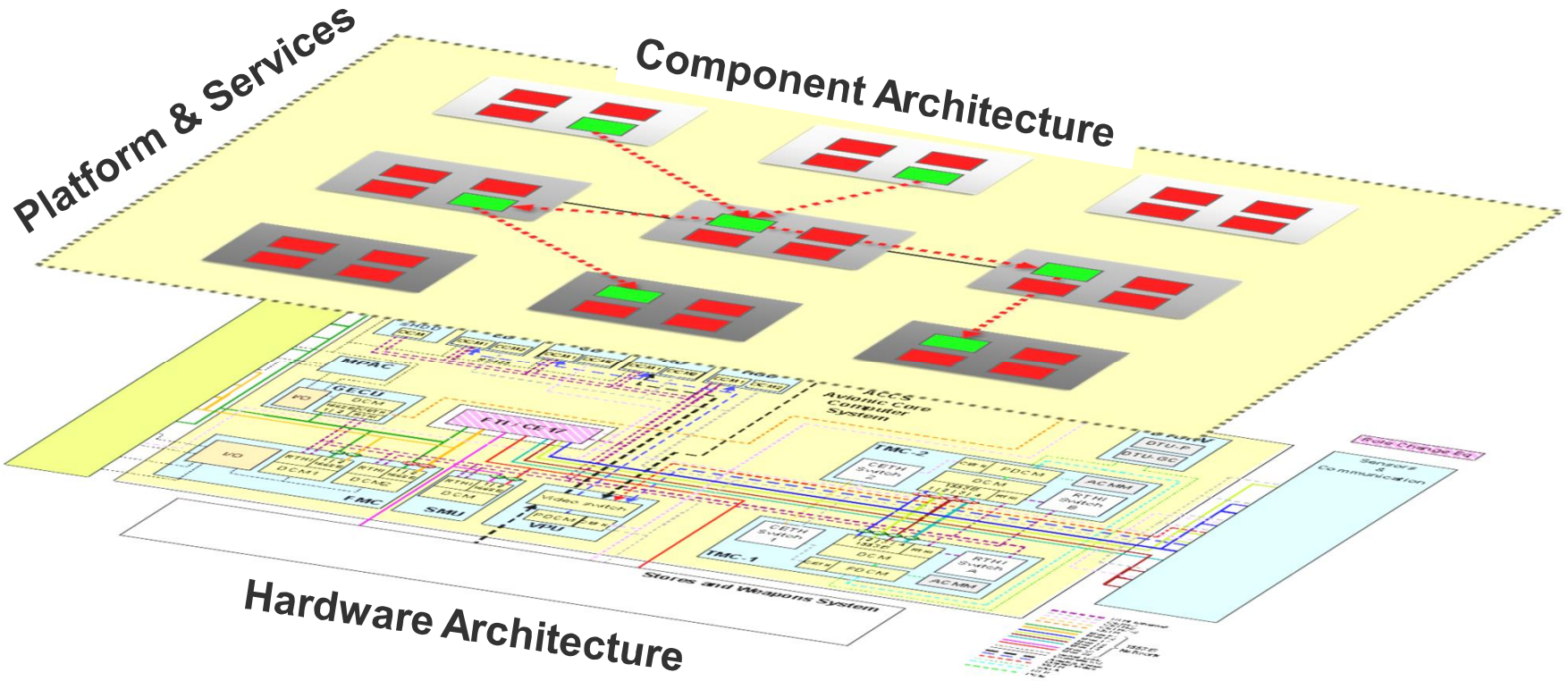
DIGITALIZATION - INTEGRATED MODULAR AVIONICS



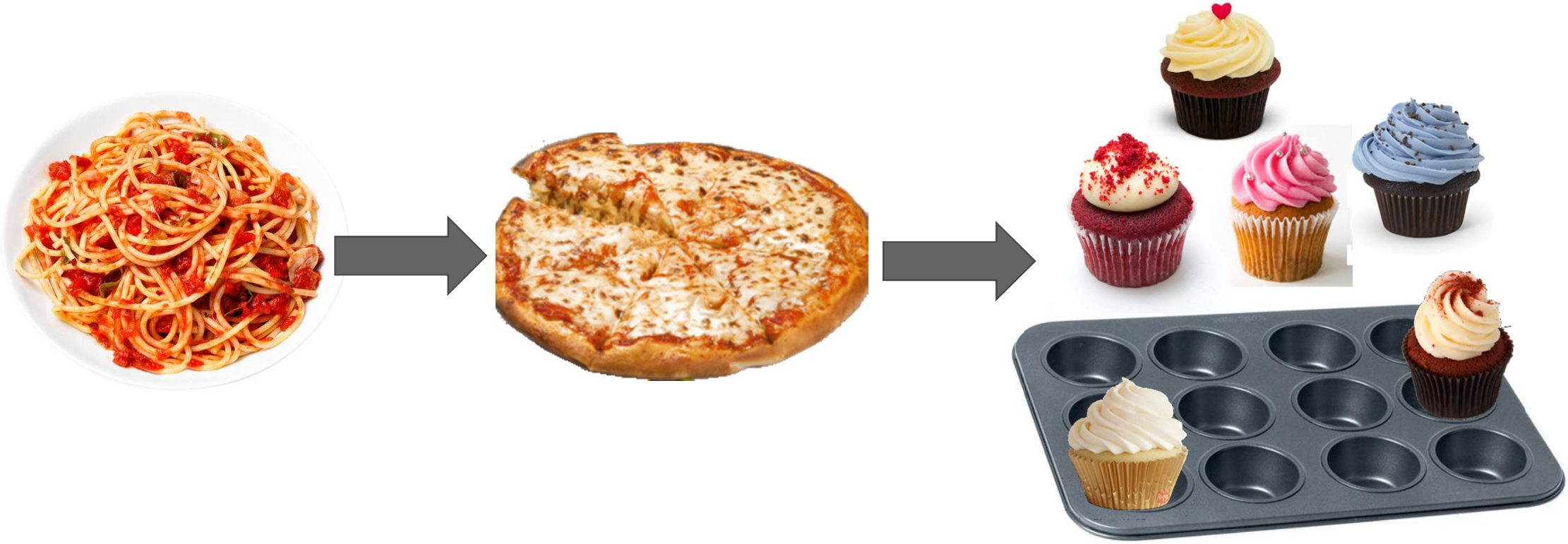
HARDWARE ARCHITECTURE



THE INVISIBLE MACHINE



A FOOD ANALOGY



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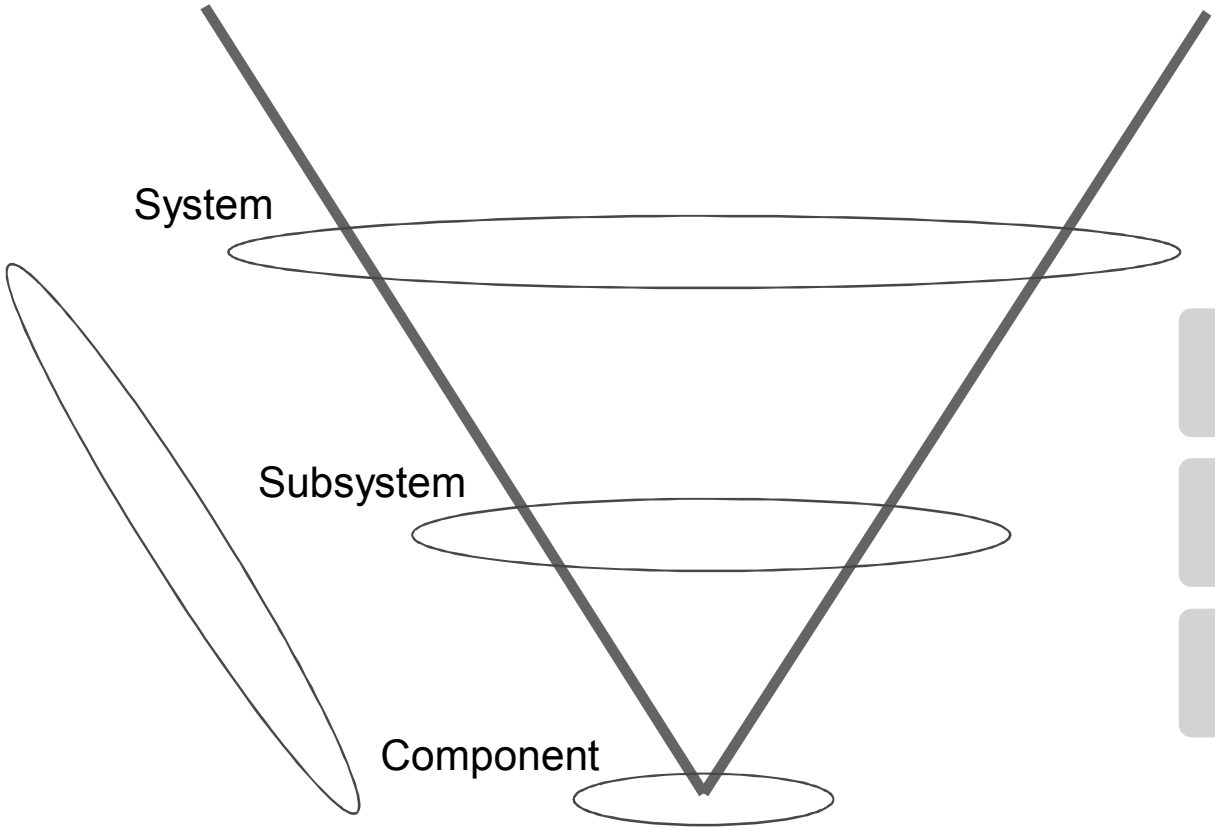
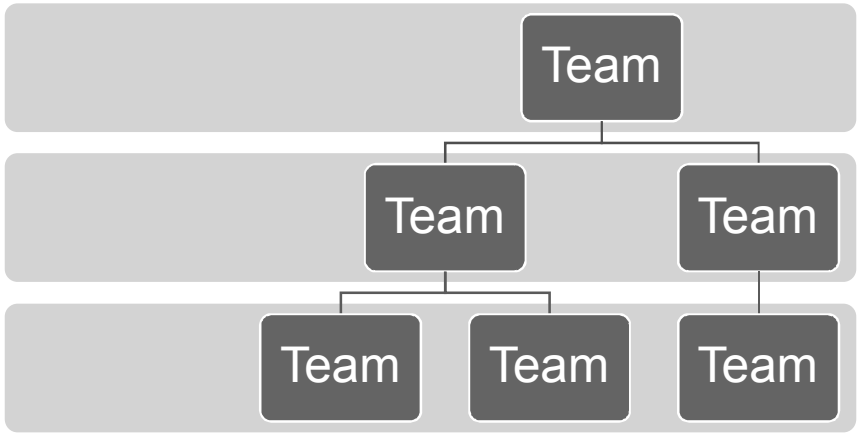
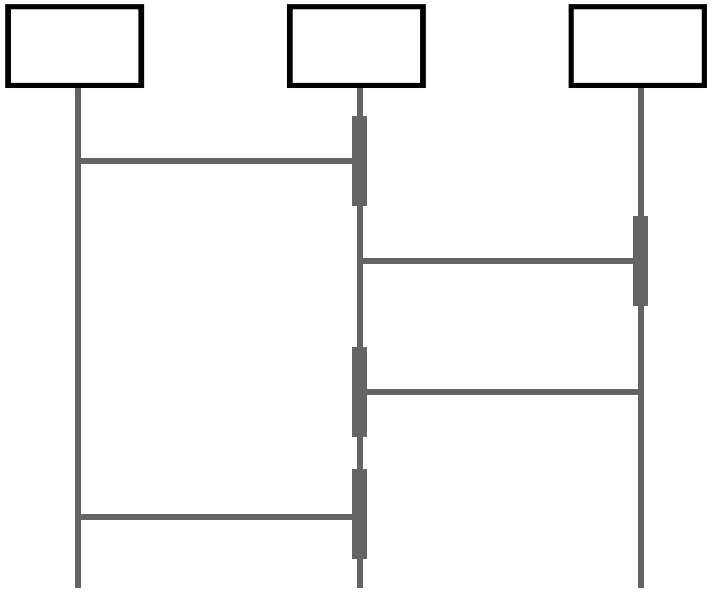
SYSTEMS, ENGINERING AND SYSTEMS ENGINERING





SUCCESS CRITERIA



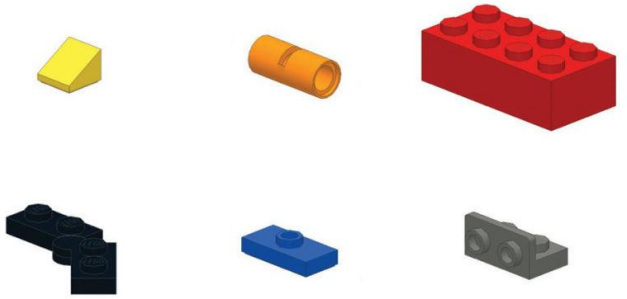
The greatest leverage in system architecting is at the interfaces.

The greatest dangers are also at the interfaces.

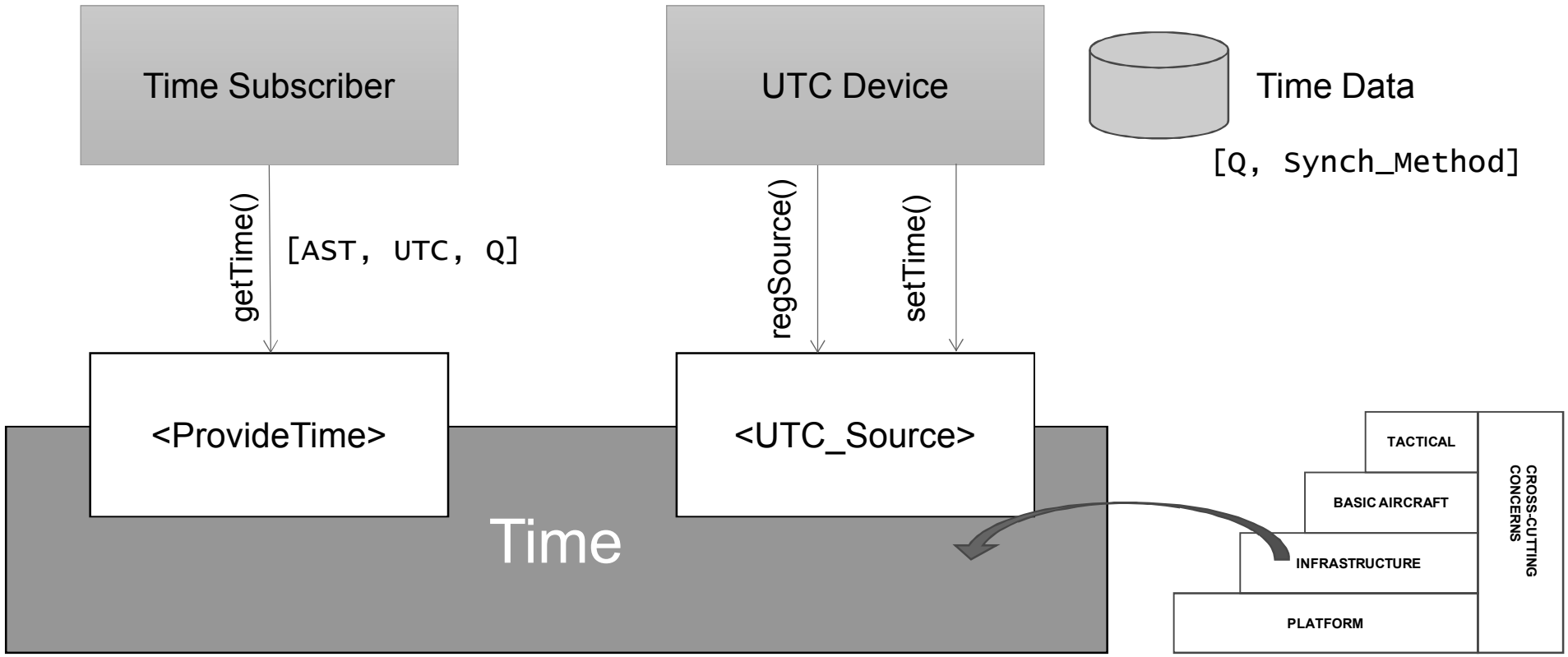
- Rechtin & Maier, 2000, The Art of Systems Architecting

A LEGO ANALOGY

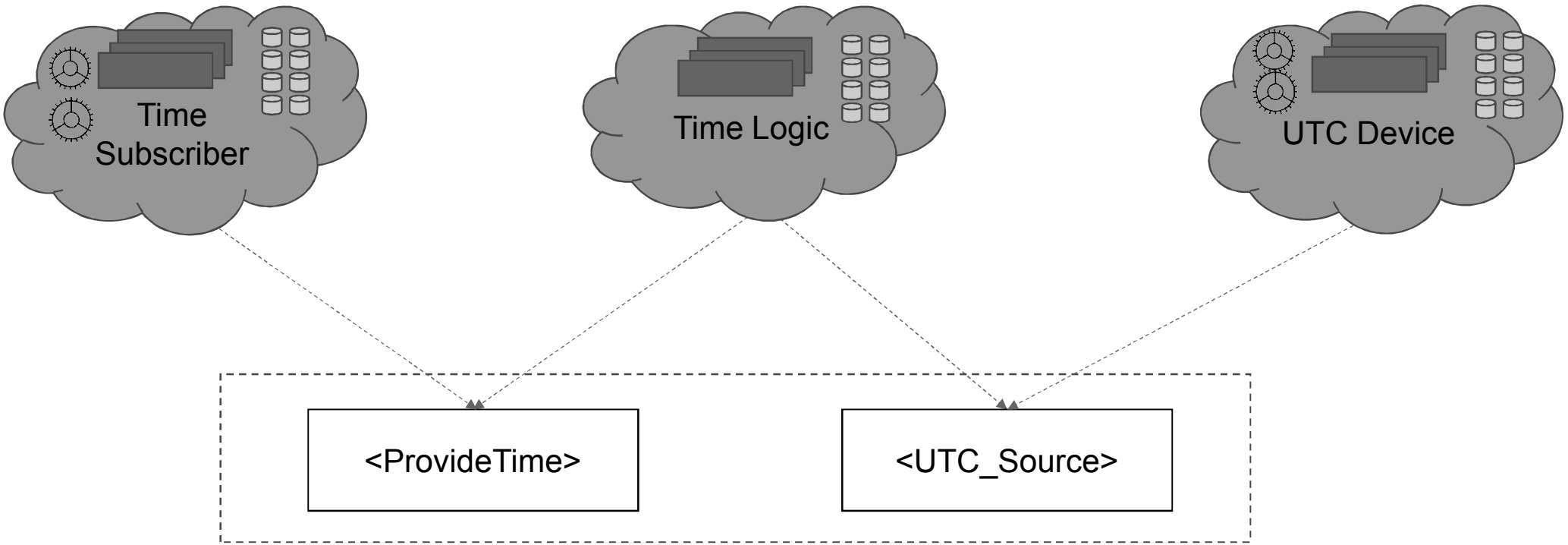
VS



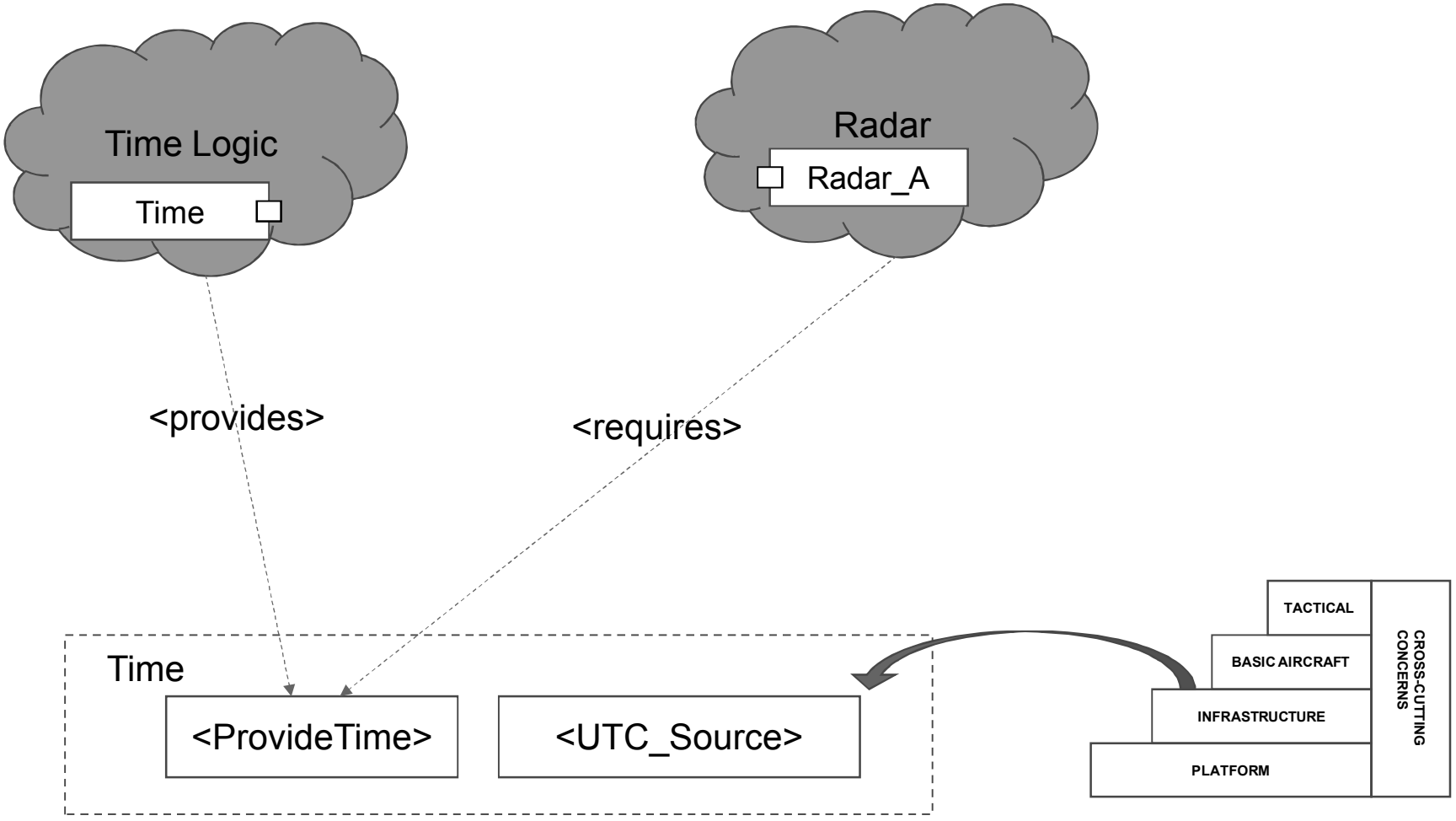
EXAMPLE: TIME



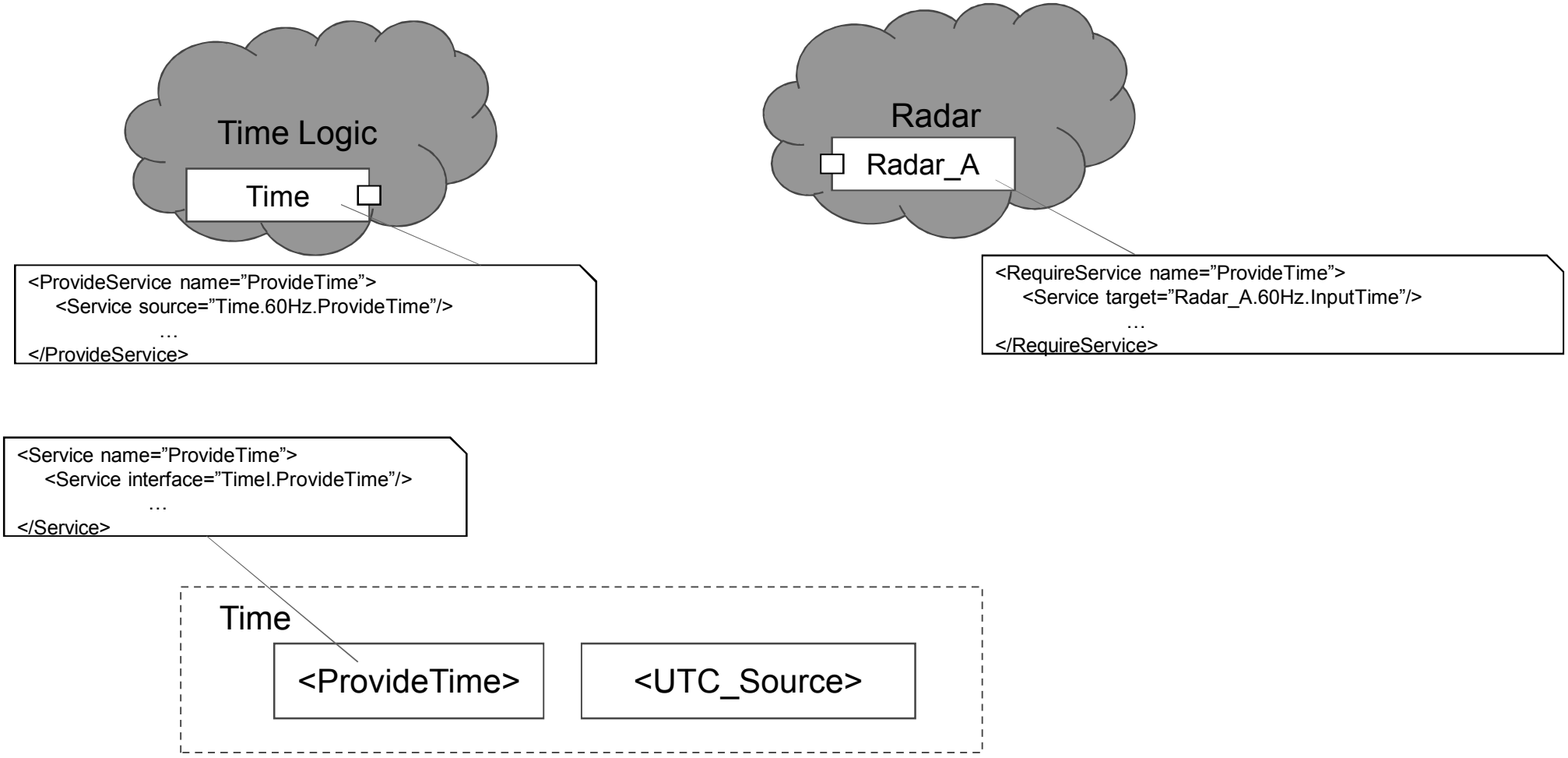
DECOUPLING THROUGH INFORMATION HIDING



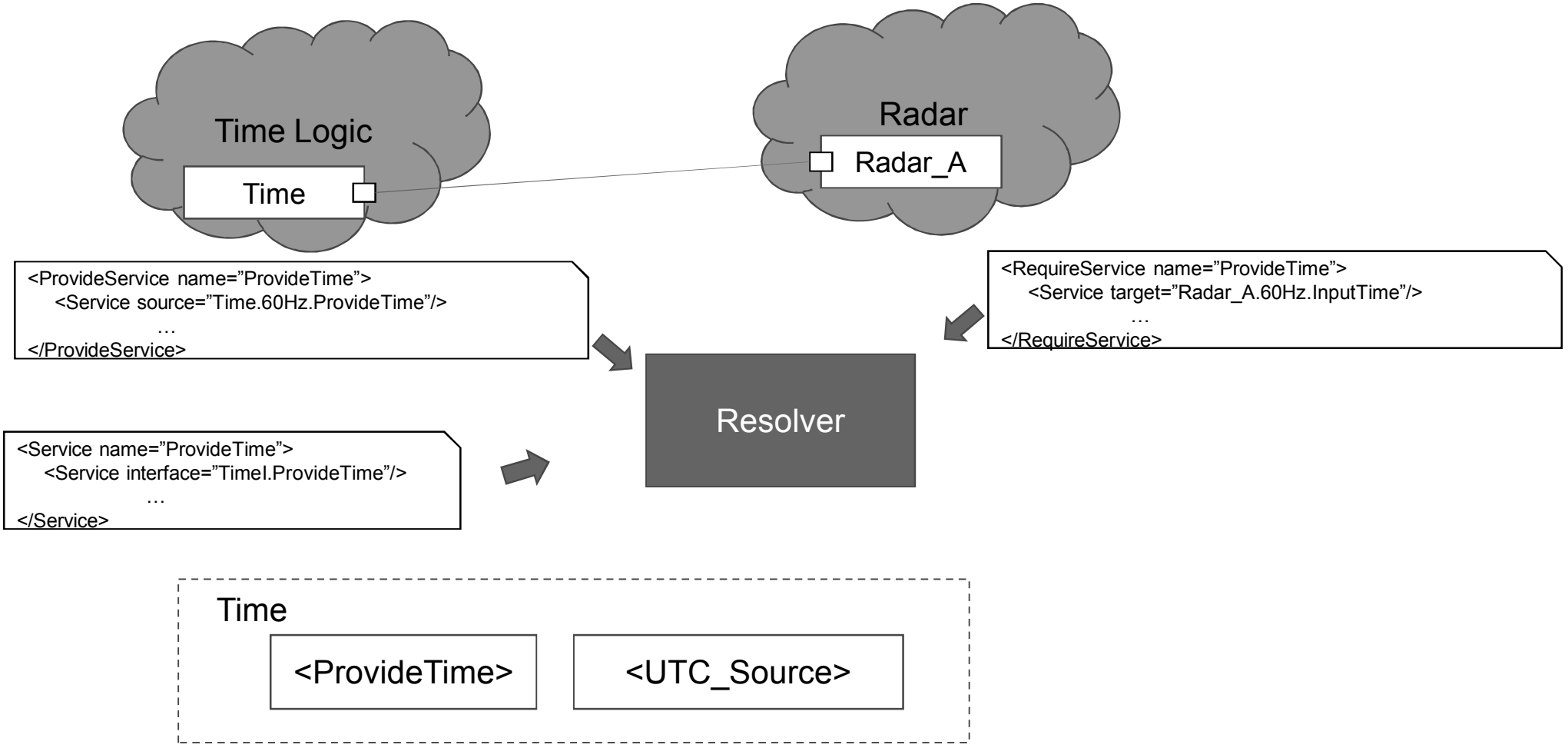
DEPENDENCY INVERSION



SERVICE DEFINITION



SERVICE LOCATOR



SERVICE GUARANTEED

Option A,

<ProvideTime> Required Interface AST, UTC, Q

Define Q as a Configuration parameter
Each UTC Device Feature Package has to declare nominal Q
Each Time subscriber needs to state a minumum Q for guaranteed capability

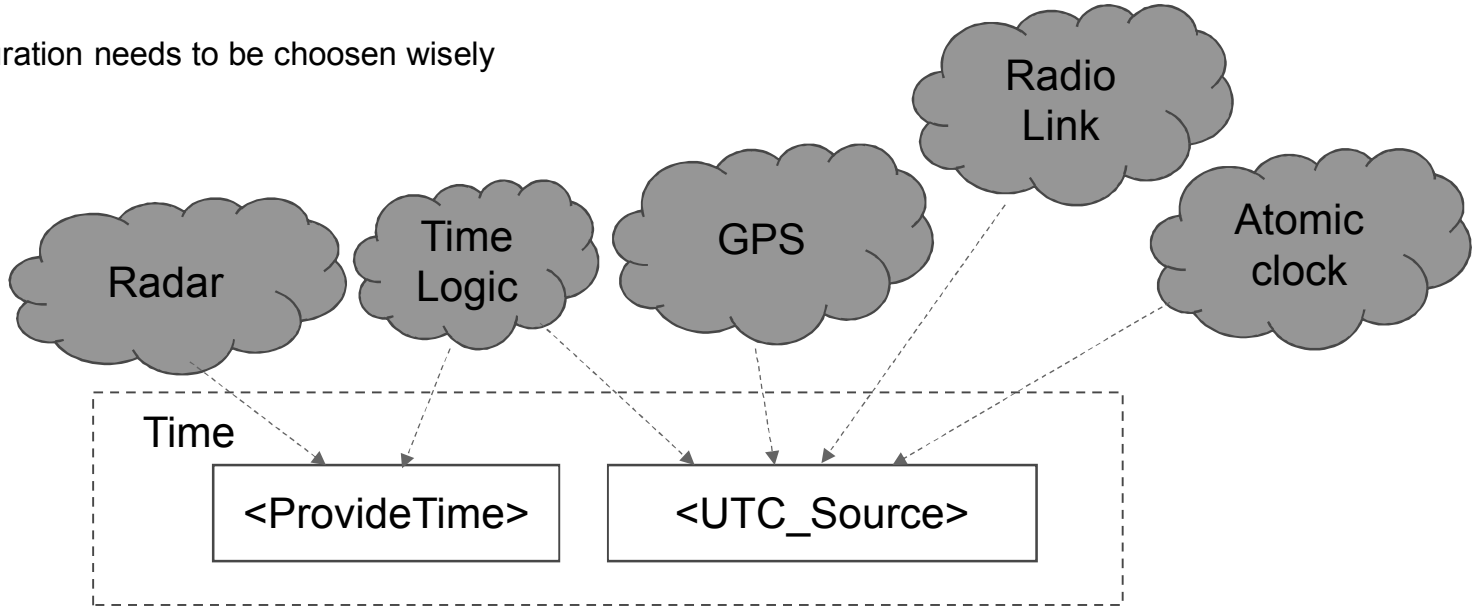
Configuration needs to be choosen wisely

Option B,

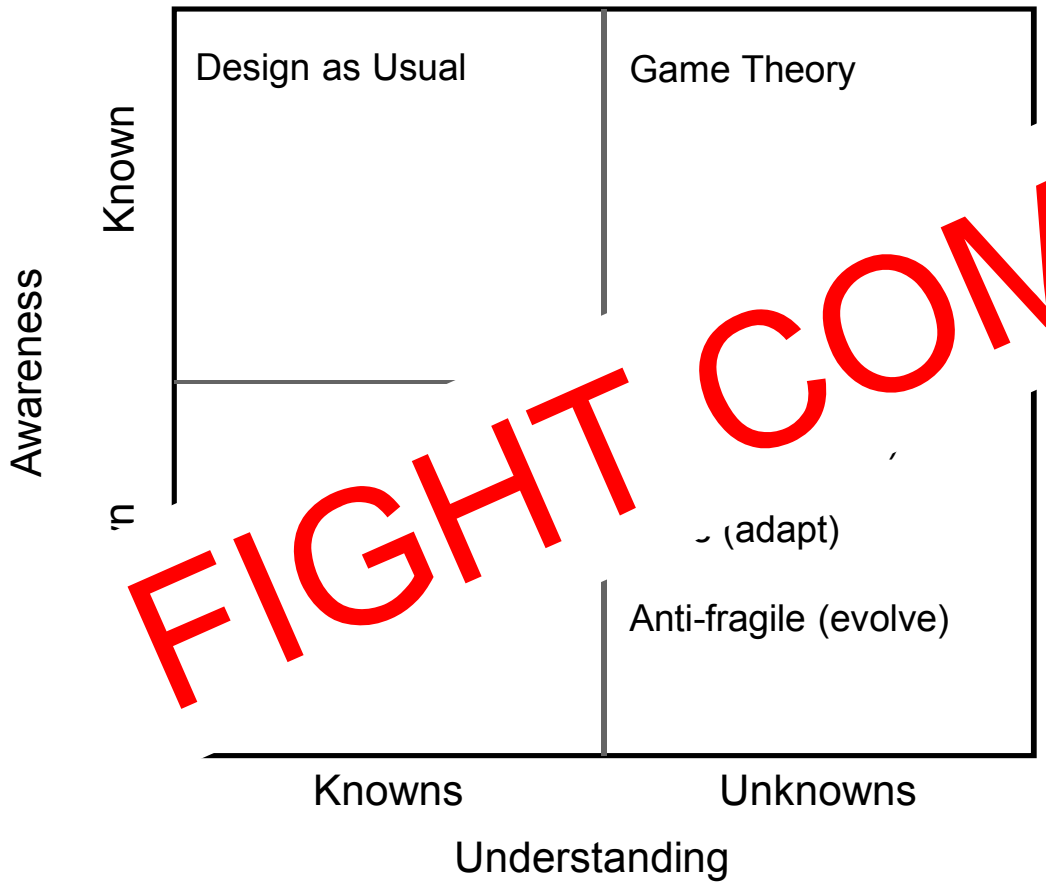
<ProvideTime> Required Interface AST, UTC, Q

Service Package declares Q (nominal)

UTC providers (devices) needs to be choosen wisely



SUMMARY



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  - irect
  - ency Inversion
  - elf-containment
  - Information Hiding
- Allow diversity and redundancy
  - Competing Solutions
  - Autonomous Teams
- Defer decisions
  - Utilize Abstractions

FIGHT COMPLEXITY

THANK YOU!

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Modelling a Fighter as Features and Services

MODPROD 2017 Linköping

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