



Software Architecture to Everything

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**Brunel Software Engineering Lab (BSEL) seminar
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About Me...

- Senior Lecturer in Computer Science- Brunel University London.
- Principal Lecturer in Software Engineering- University of Brighton.
- Research fellow at Lero-The Irish Software Engineering Research Centre
- PhD from Universidad Politecnica de Valencia-Spain
 - ❑ Ambient-PRISMA: Mobile Ambients in Aspect-Oriented Software Architecture
- Bsc in Computer Science from Bir-Zeit University Palestine.

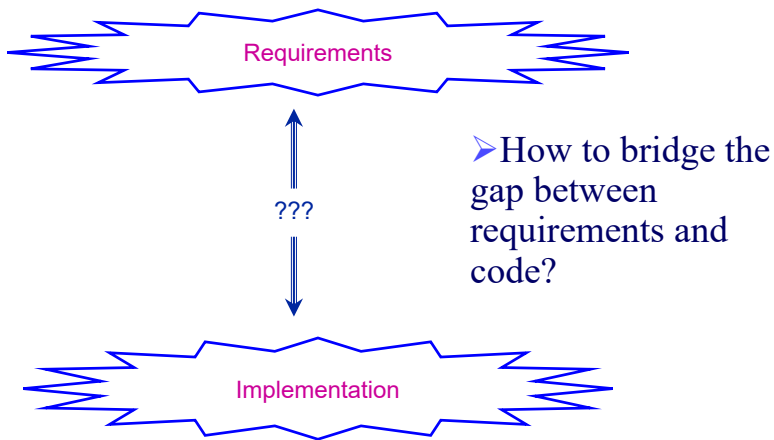
Contents

- Introduction
- Just-In-Time Architecture Recovery and Consistency
- Micro-Service Architecture Recovery
- Ambients in Software Architecture
- Conclusions

Architecture



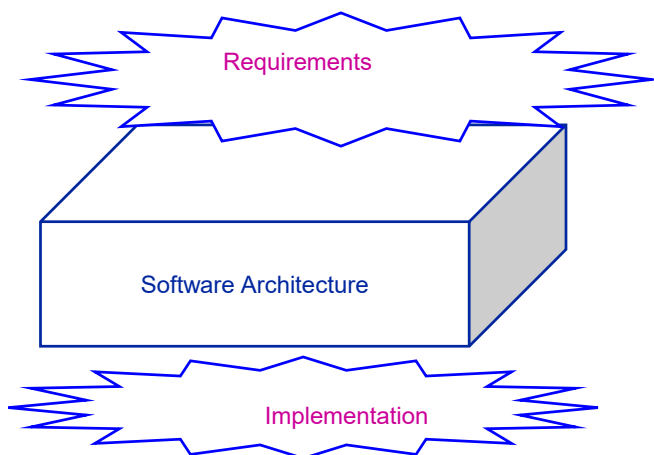
The Problem



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The Role of Software Architecture



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Software Architecture Definition

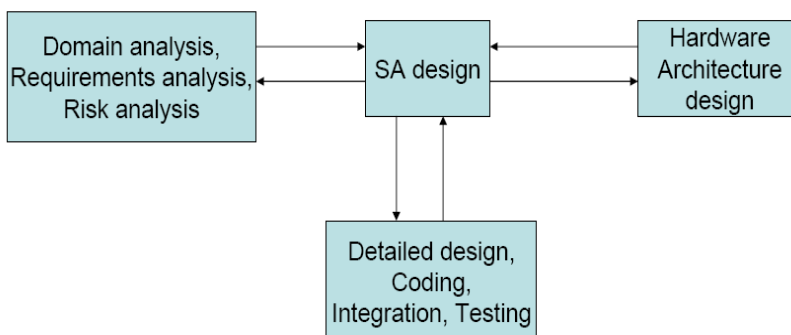
“The software architecture of a program or computing system is the **structure or structures** of the system, which comprise **software elements**, the externally **visible properties** of those elements, and the **relationships** among them.”

➤ [L.Bass, P.Clements, R.Kazman, *Software Architecture in Practice (2nd edition)*, Addison-Wesley 2003]

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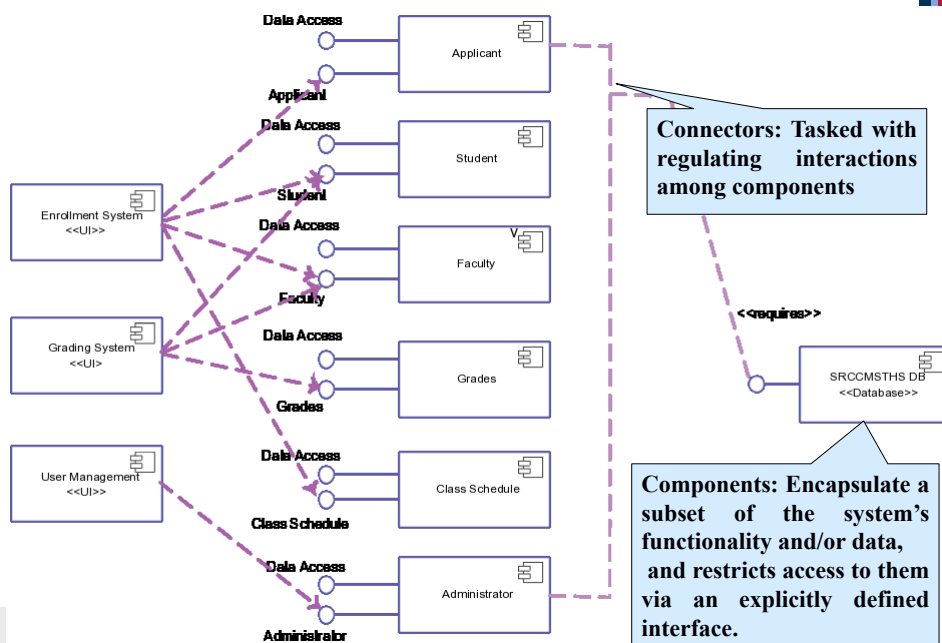
Software Architecture as a Design Plan



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Example of A SOFTWARE ARCHITECTURE

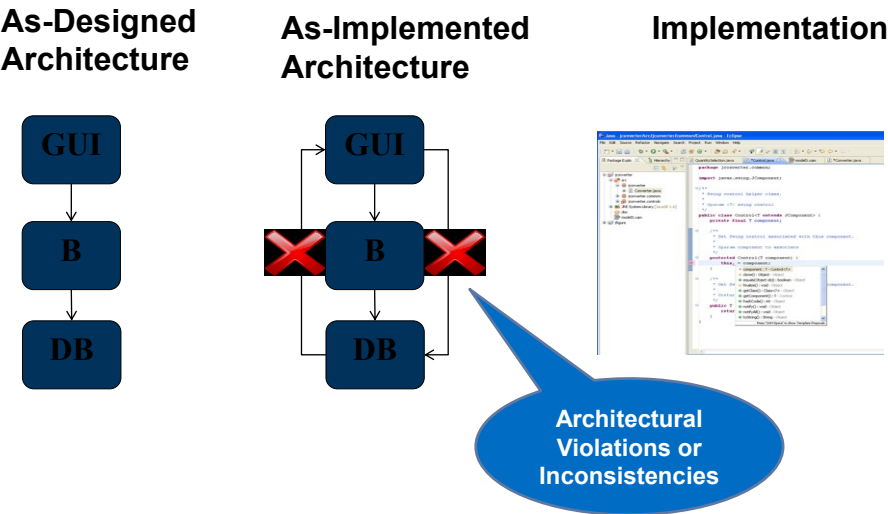


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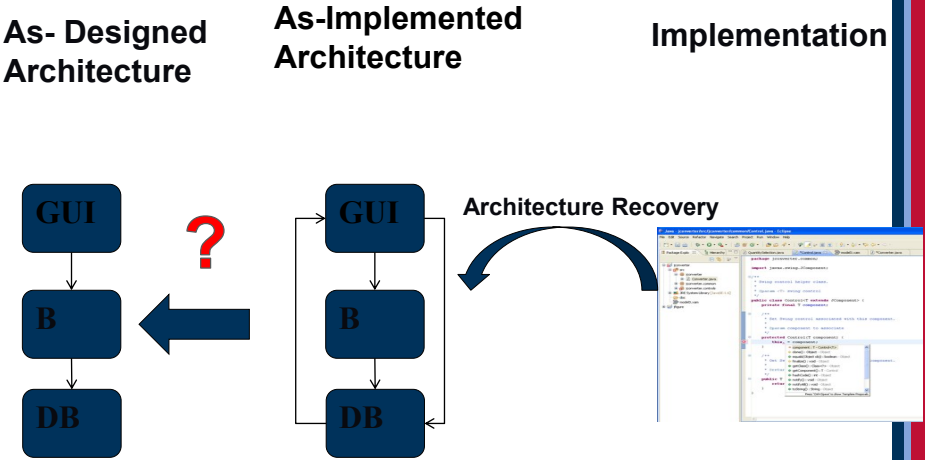
Architectural Consistency Motivation



Architectural Drift



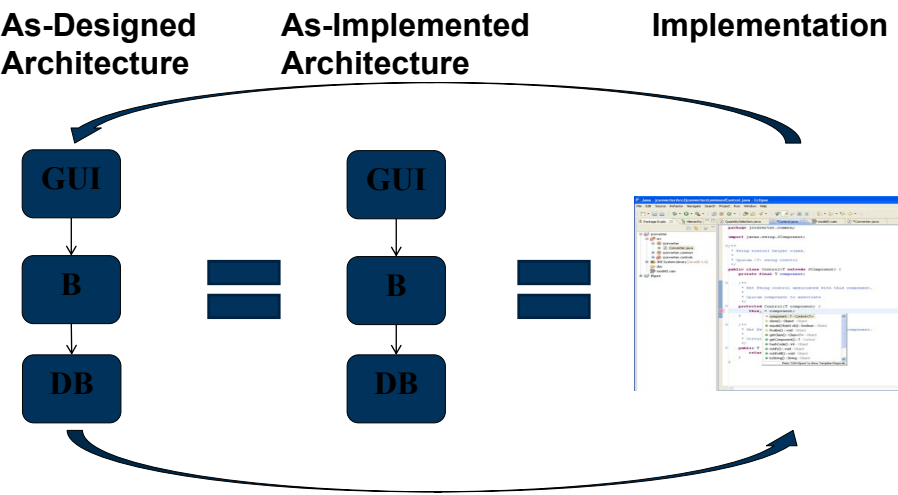
Architecture Recovery and Consistency



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JIT Architectural Consistency



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DEMO JITTAC

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Real World Usage

	Java Files	Packages	Project	LOC	Age	Deployment	No of Developers
SA	173	25	1	38,582	1.25 years	5 months	6
SB	239	124	2	75,556	2 years	18 months	11
SC	7300	1105	1	2223872	>10 years	>120 months	>30

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Usefulness of the tool

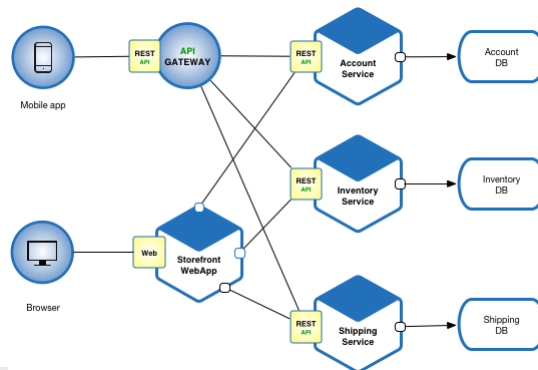
- “It gives us a very sense of what has actually happened. It has always been very difficult to visualize or internalize this. This has been enormously interesting, it is always impossible to get this kind of metrics which we are getting here.”
(PC)
- “The tool is useful in terms that an arrow and screen is easy to visualize and understand the code”- (PA)
- “I think that the results were instant, that when you dragged your package or class it showed inconsistencies straight away ”- (PB)

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Microservice Architecture

- The Microservice architectural style is an approach to developing a single application as a suite of small services, each running in its own process and communicating with lightweight mechanisms.



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Research Problem

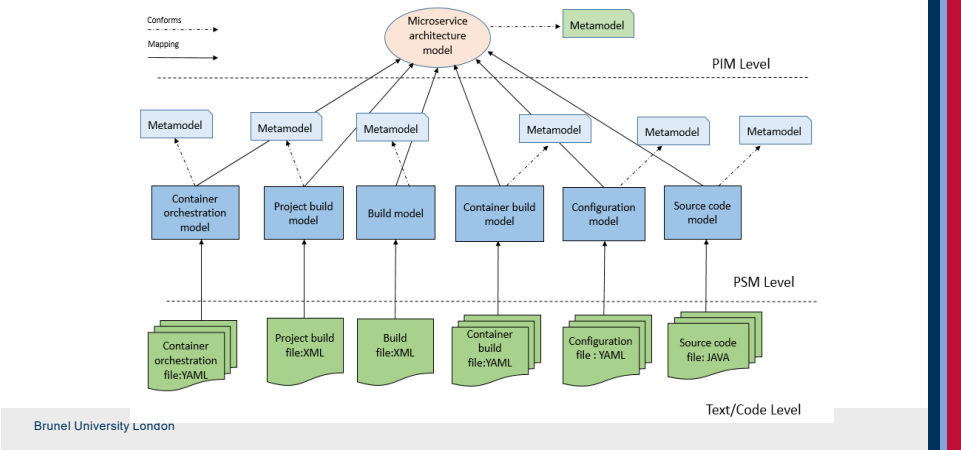
- Microservice architectures (MSA) introduce a level of complexity into applications.
 - ❑ Developed with many technologies
- MSA are very dynamic which allow for distributed micro services to have a myriad of dependencies.
 - ❑ Developers may not have a full picture of the architecture.
- The architecture can be lost and problematic to manage.

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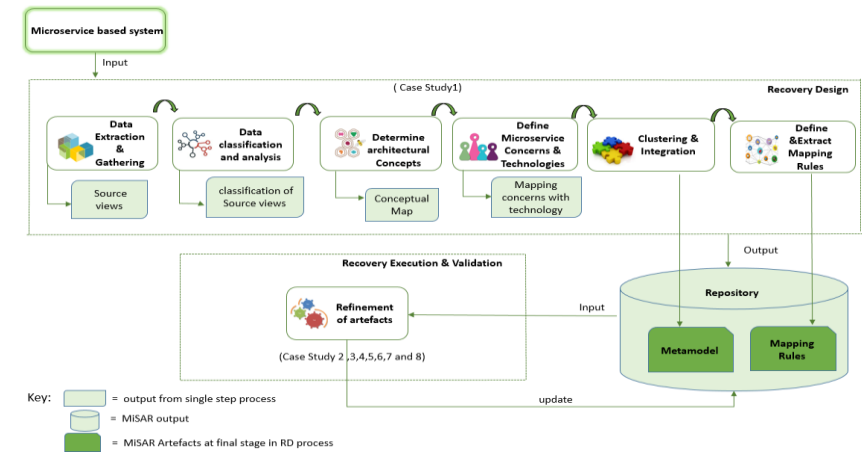
Micro Service Architecture Recovery Approach (MiSAR)

➤ MiSAR: An approach that aims to recover the architecture of micro service based systems by following the Model Driven Engineering (MDE) approach.



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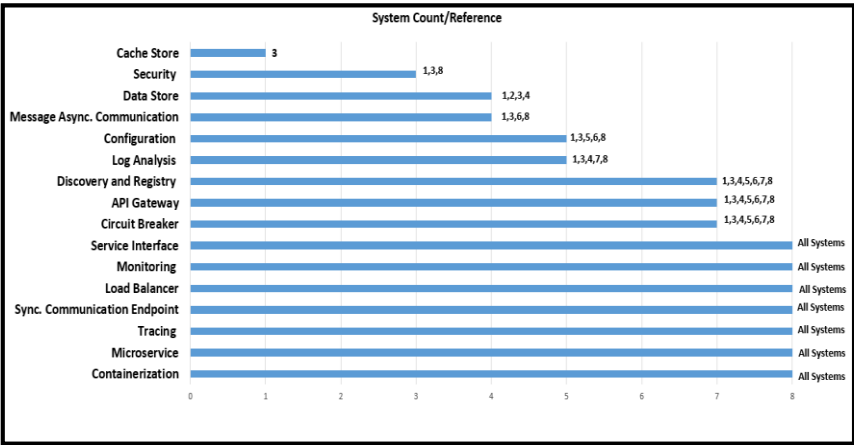
Microservice Architecture Recovery Process



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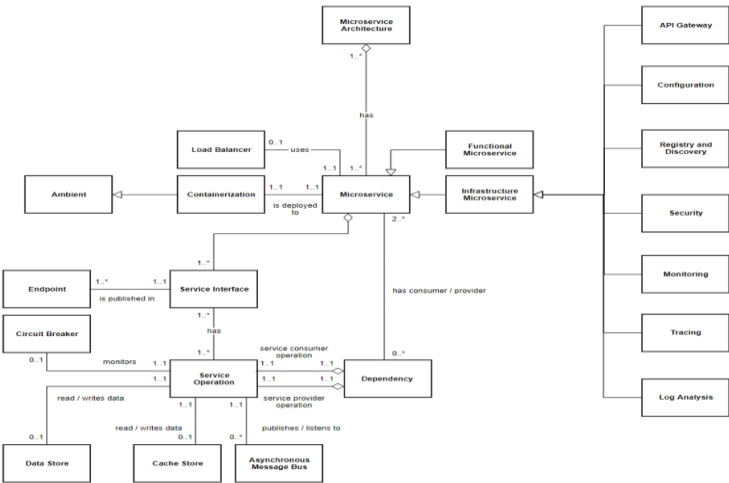
RESULTS: Microservice Metamodel



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Microservice architecture metamodel at PIM-level

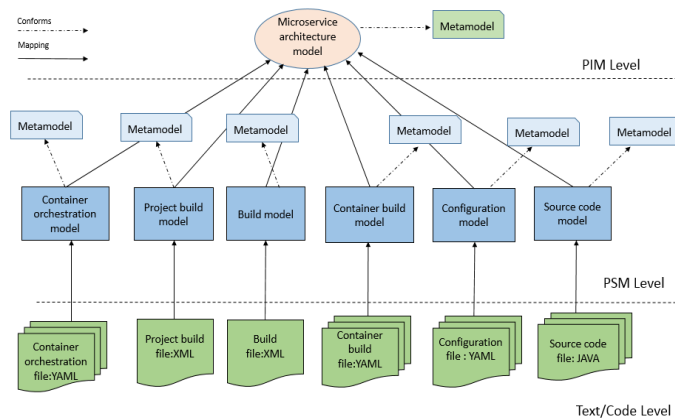


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RESULTS: Mapping Rules

➤ 211 mapping rules.



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- Summary

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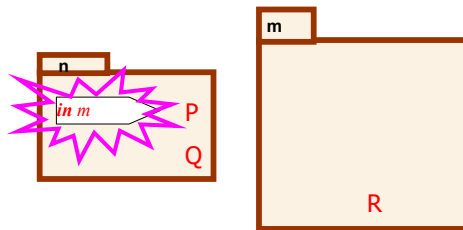
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Ambient Calculus

Cardelli and Gordon, 1998

- An *ambient* is a place, delimited by a boundary, where computation happens.
- Examples of ambients are:
 - ⊗ Devices such as laptops, servers, etc
 - ⊗ A webpage
 - ⊗ Data packets
 - ⊗ Firewalls
 - ⊗ Networks
 - ⊗ A Building or an airplane

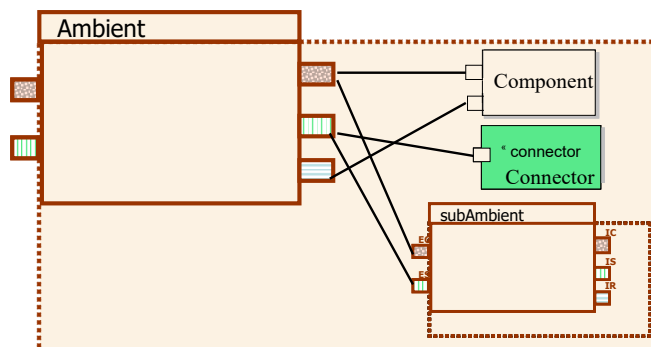


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What is an Ambient in software architecture?

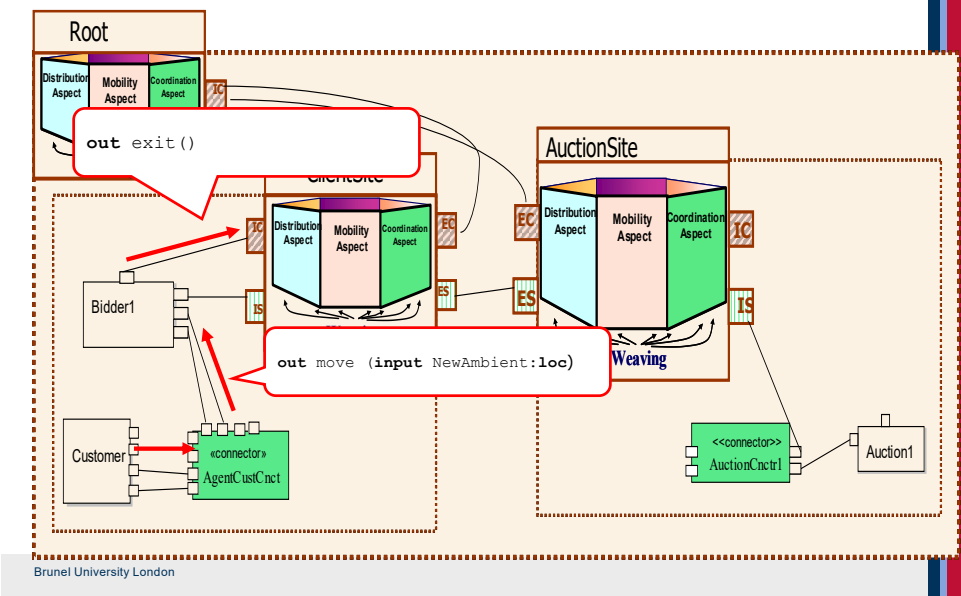
- An ambient is a kind of connector that...
 - ☐ Represents the boundary where Components and other connectors are located.
 - ☐ Coordinates what is in from what is out of a boundary for mobility or communication purposes.
 - ☐ Can locate other ambients.



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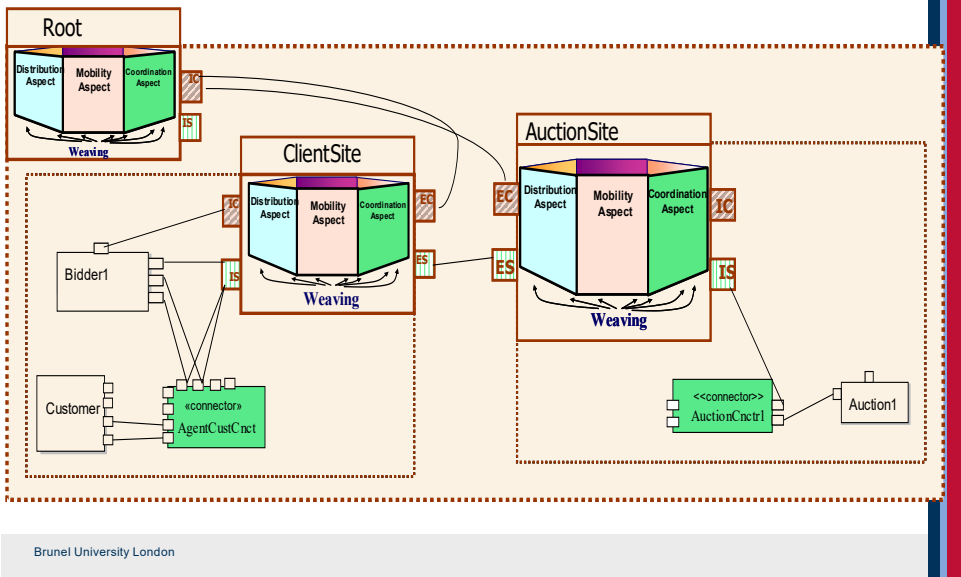
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Initial Configuration



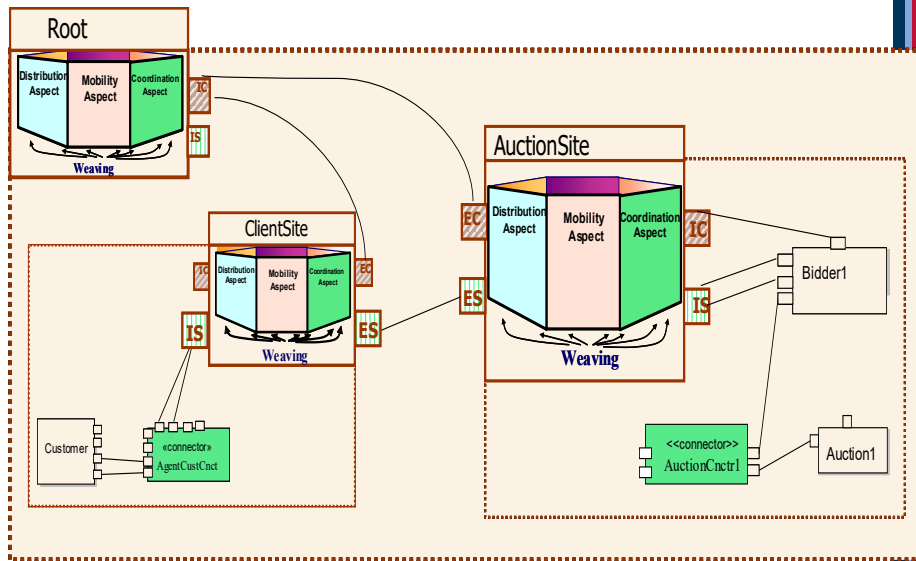
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Reconfiguration of attachments in ClientSite



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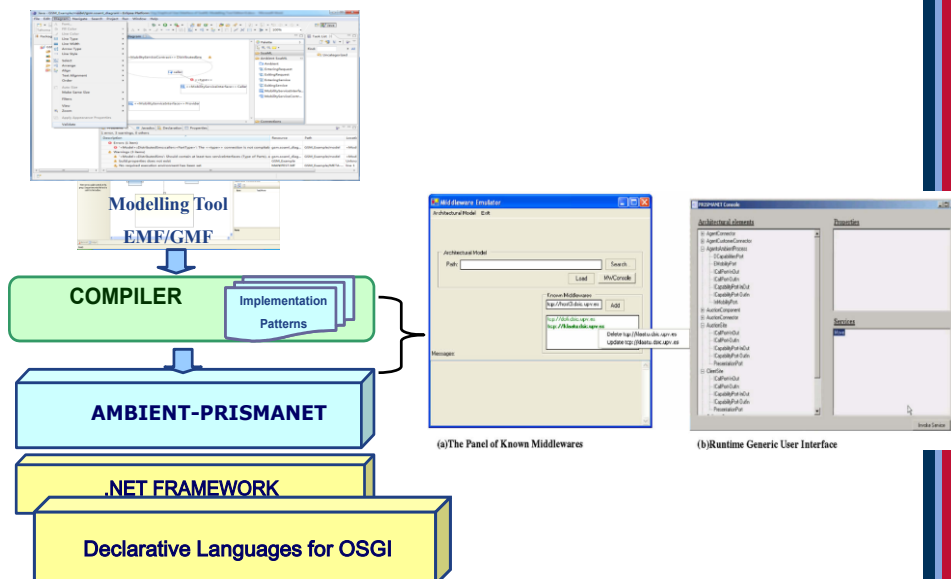
Bidder in AuctionSite



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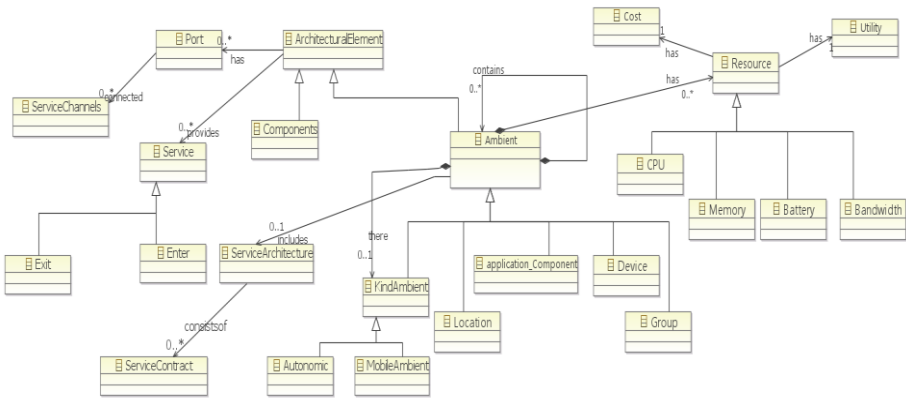
CASE TOOL



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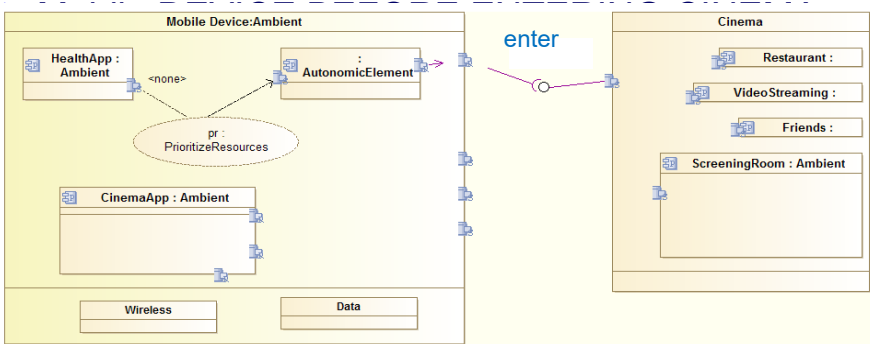
Ambient-service oriented runtime meta-Model



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SCENARIO



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Mobile Interface Implementation

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SWARM PARTICLE

Algorithm 2: Discrete Particle Swarm Optimization Algorithm

Particles is a set of particles
 $P_i.V_d$ is the predisposition (probability) of *particle*_{*i*} of changing bit *d* to 1
 $P_i.X$ is the position of *particle*_{*i*}, which is a bit array
 $P_i.X_d$ is bit *d* in $P_i.X$
bestGlobal is the best position achieved so far by any particle, it is a bit array
 $bestGlobal_d$ is bit *d* in *bestGlobal*
 ϕ_1 and ϕ_2 are two positive random numbers which sum *VMAX*
VMAX is a constant which value is 4 (Allows some probability of change using sigmoid function)

repeat

for $P_i \in Particles$ do

if $utility(P_i) > P_i.bestUtility$ then

$P_i.bestUtility = utility(P_i)$

if $utility(P_i) > bestGlobal$ then

$bestGlobal = utility(P_i)$

for $d \in dimensions$ do

$P_i.V_d = P_i.V_d + \phi_1 * (P_i.bestUtility_d - P_i.X_d) + \phi_2 * (bestGlobal_d - P_i.X_d)$

$P_i.V_d \in -VMAX \dots VMAX$

$P_i.X_d = \rho_{id} < Sigmoid(V_{id}(t))$

until end condition

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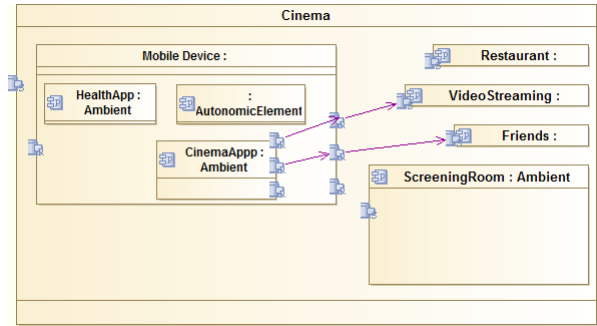
POSSIBLE CANDIDATE SOLUTIONS and UTILITY FUNCTION

➤ Create Possible Solutions

Data	WLAN	HAPP	VS	FS
1	0	1	0	0
1	0	1	1	0
0	1	1	0	0
0	1	1	1	0
1	1	1	1	1
1	0	0	1	1

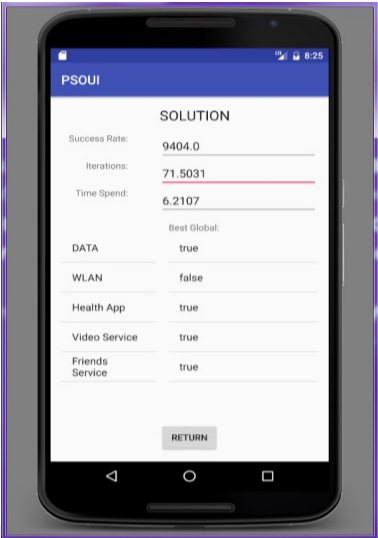
} Uf()=0

Mobile device in cinema



Mobile Interface Implementation

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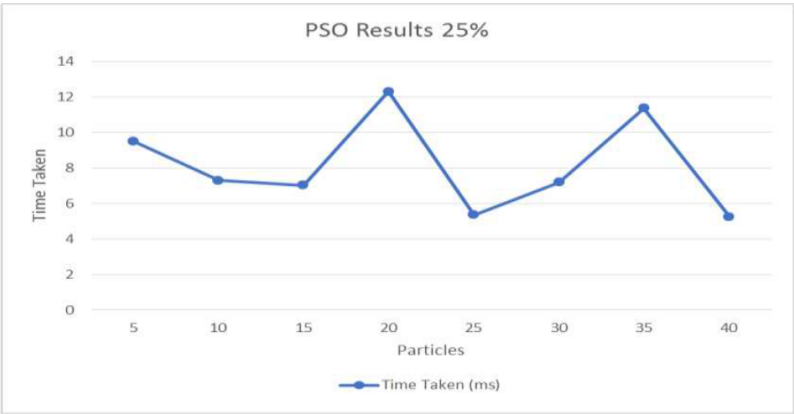
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Experimentation

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➤ 25% of the battery



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Summary and Ongoing Work

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- Architecture Recovery and Consistency
 - ❑ MiSAR: Implementing the transformations and tool.
- Granularity Adaptation of Microservices.
 - ❑ How to evaluate that adaptation is needed?
- Security of Ambients.

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References

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Questions

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