

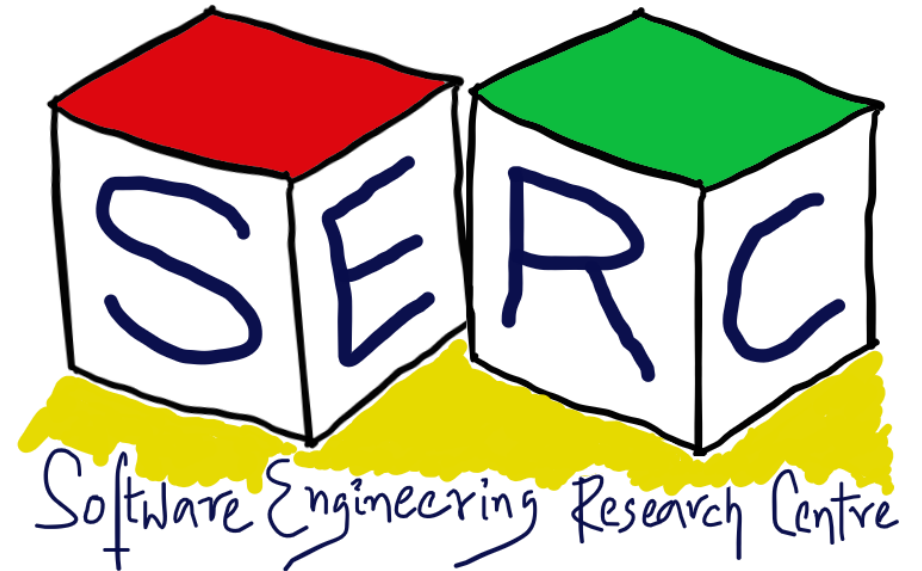
Architectural Framework

CS6.401 Software Engineering

Dr. Karthik Vaidhyanthan

karthik.vaidhyanthan@iiit.ac.in

<https://karthikvaidhyanthan.com>



INTERNATIONAL INSTITUTE OF
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HYDERABAD

Acknowledgements

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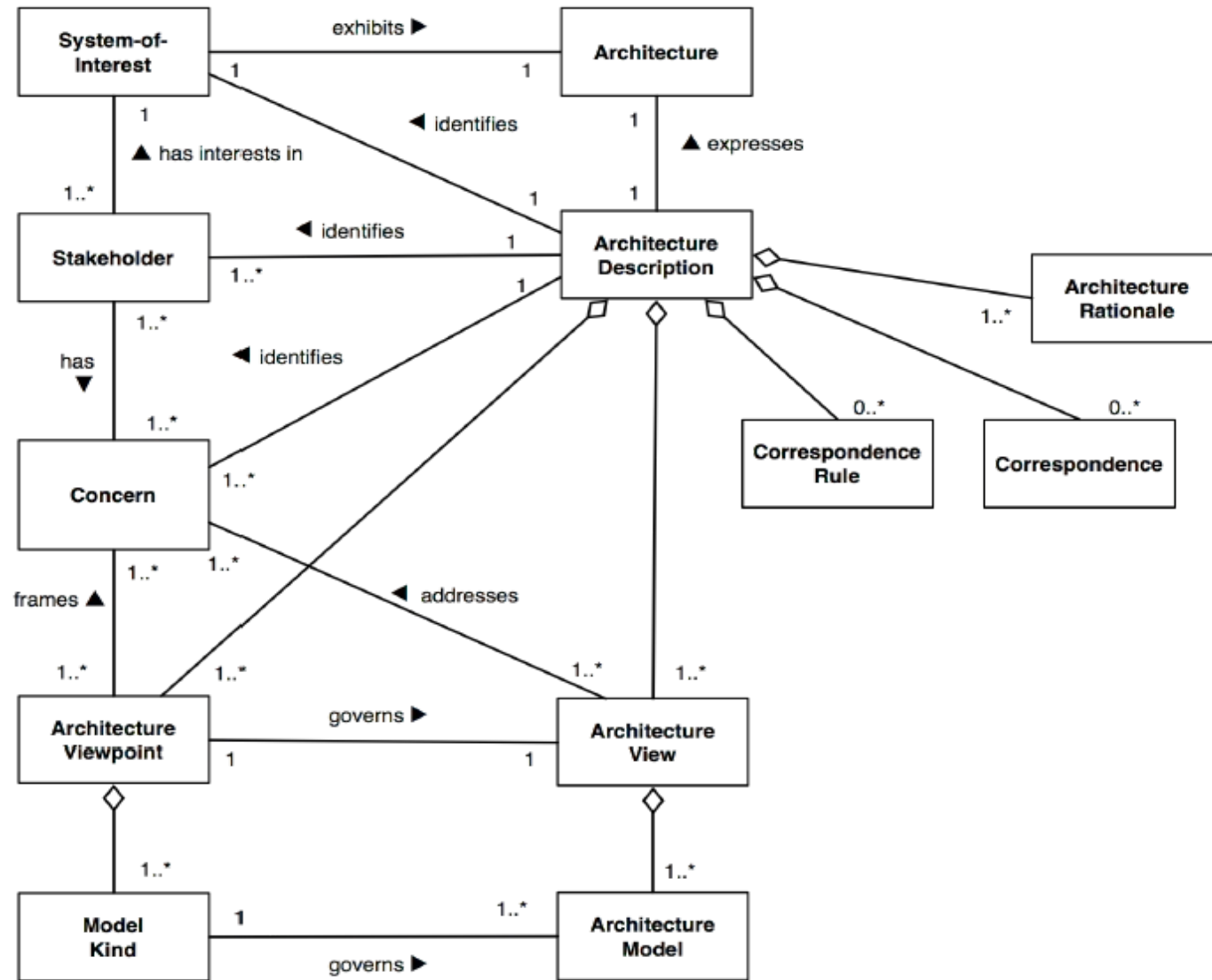
Sources:

1. Software Architecture in Practice, Len Bass, 3rd edition
2. ISO/IEC/IEEE 42010, Systems and Software Engineering – Architecture Description



Architecture Description

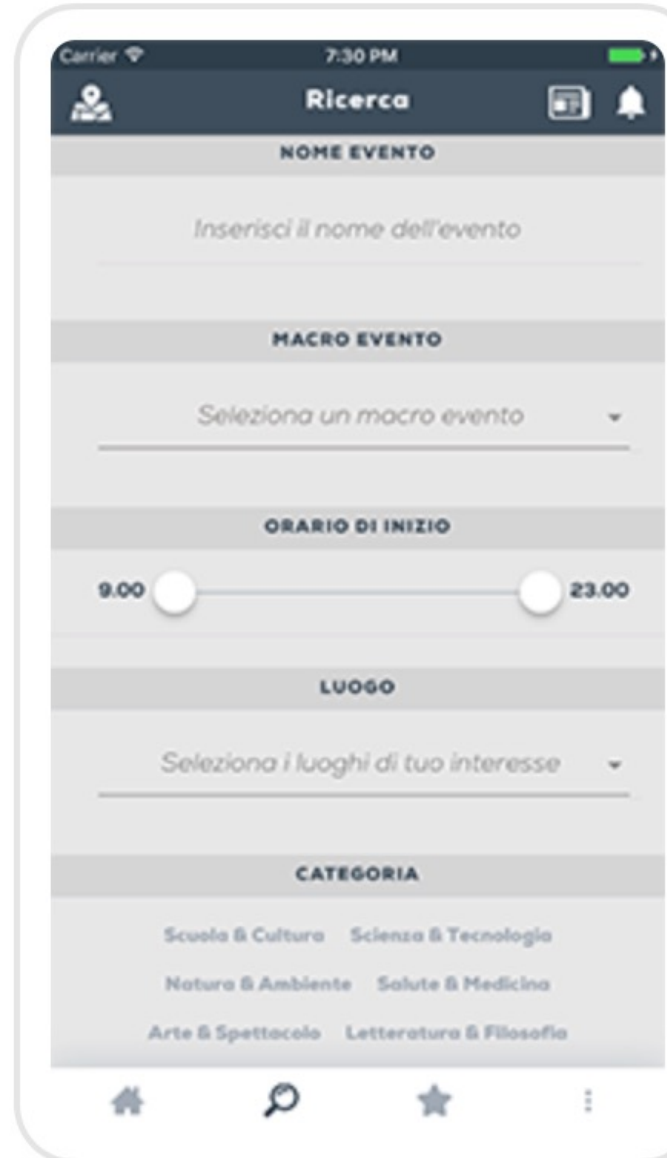
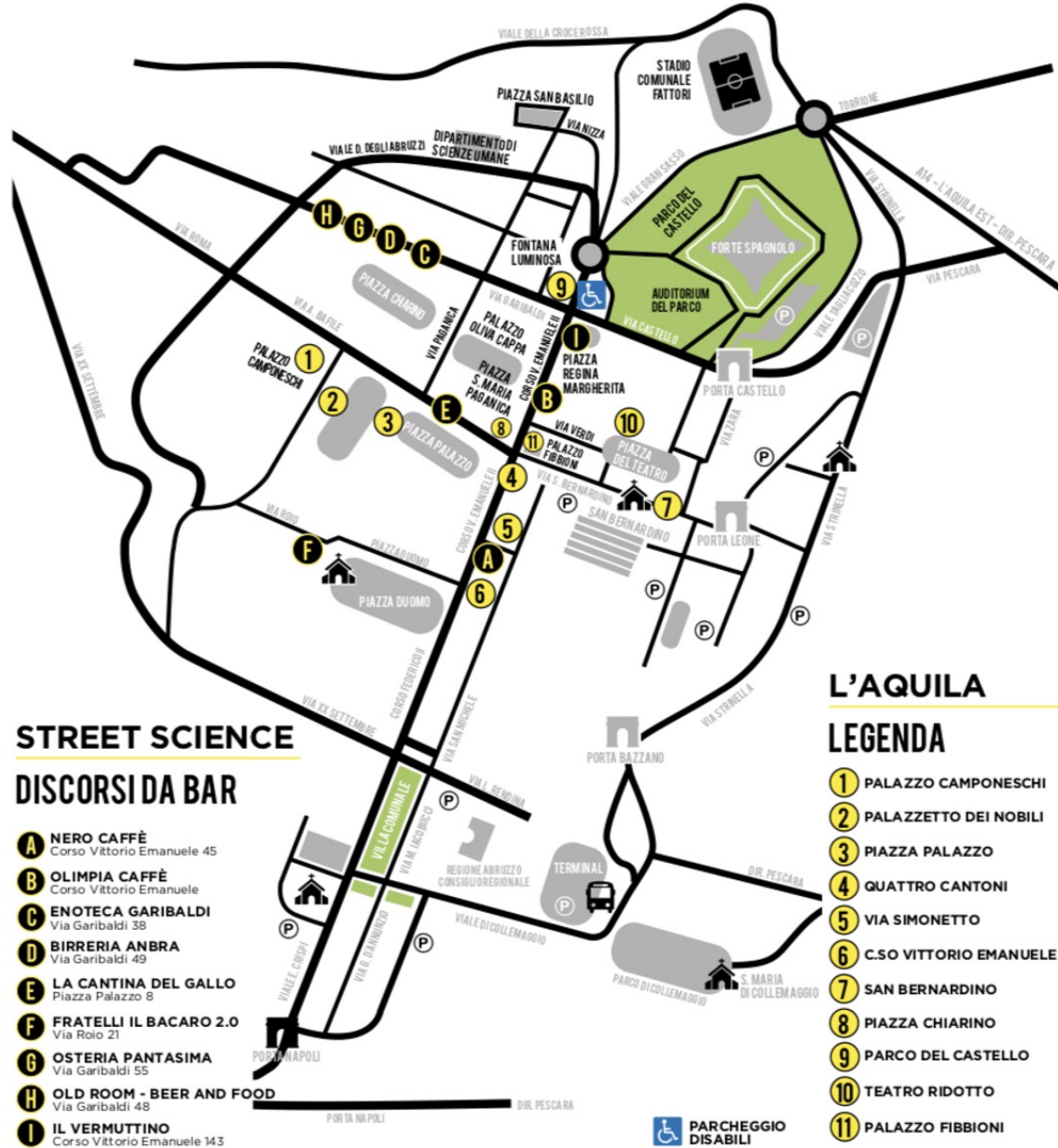
Architecture Description





Apply IEEE 42010 to NdR
Case Study

NdR: European Researchers Night



The NdR Case

Key Observations

1. Around 35K visitors per year
2. Late hours are more crowded than early hours
3. Weather affects user's preferences

Goal

1. A solution for crowd management
2. Automated venue and parking lot management

Constraints

Limited power and service accuracy constraints





Lets get the requirements
right

Functional and Non-functional Requirements

Functional Requirements

FR1: The app shall allow users to register to the NdR event

FR2: The app shall allow users to provide their preferred events

....

Extra(Non)-functional Requirements

NFR1: The app must provide 1 second response time or less in web browsers

NFR2: The app should be able to support 1000 users/second while maintaining optimal performance

.....



Who are the stakeholders?

Stakeholders



Software Developers



IoT Engineers



Urban planning



Software architect(s)

Many more....

Concerns

Language choice, the
modules,
Interactions, ...



Software Developers

Memory,
Battery,
platform ...



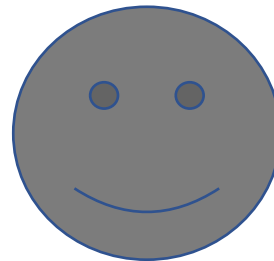
IoT Engineers

Space constraints,
Location for sensors,



Urban planning

System performance,
Integration,
Management,...

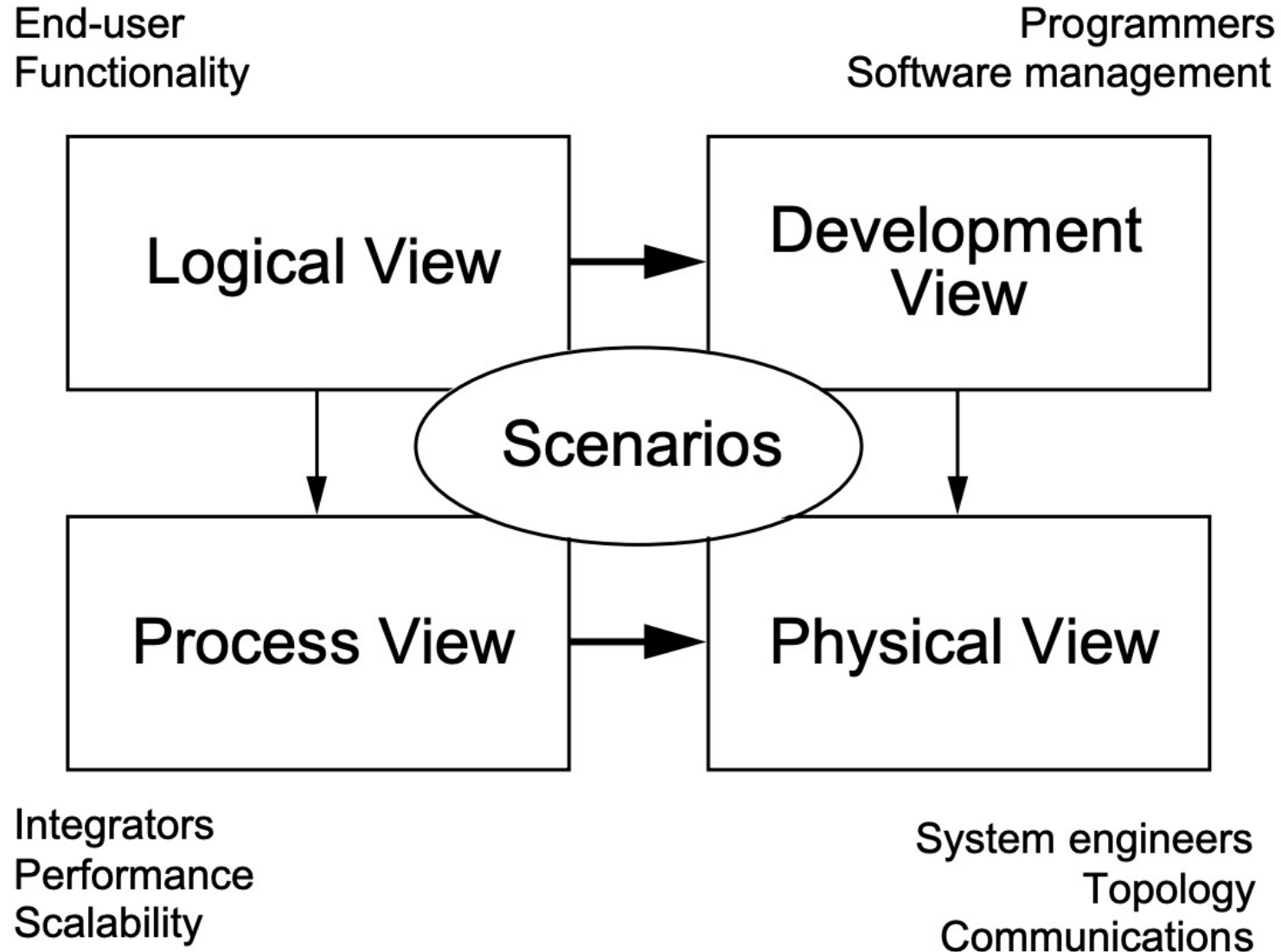


Software architect(s)



What can be the viewpoints
and views?

Can we create some models for each view?





What are some scenarios?

What can be some scenarios?

Book venue

Check
availability

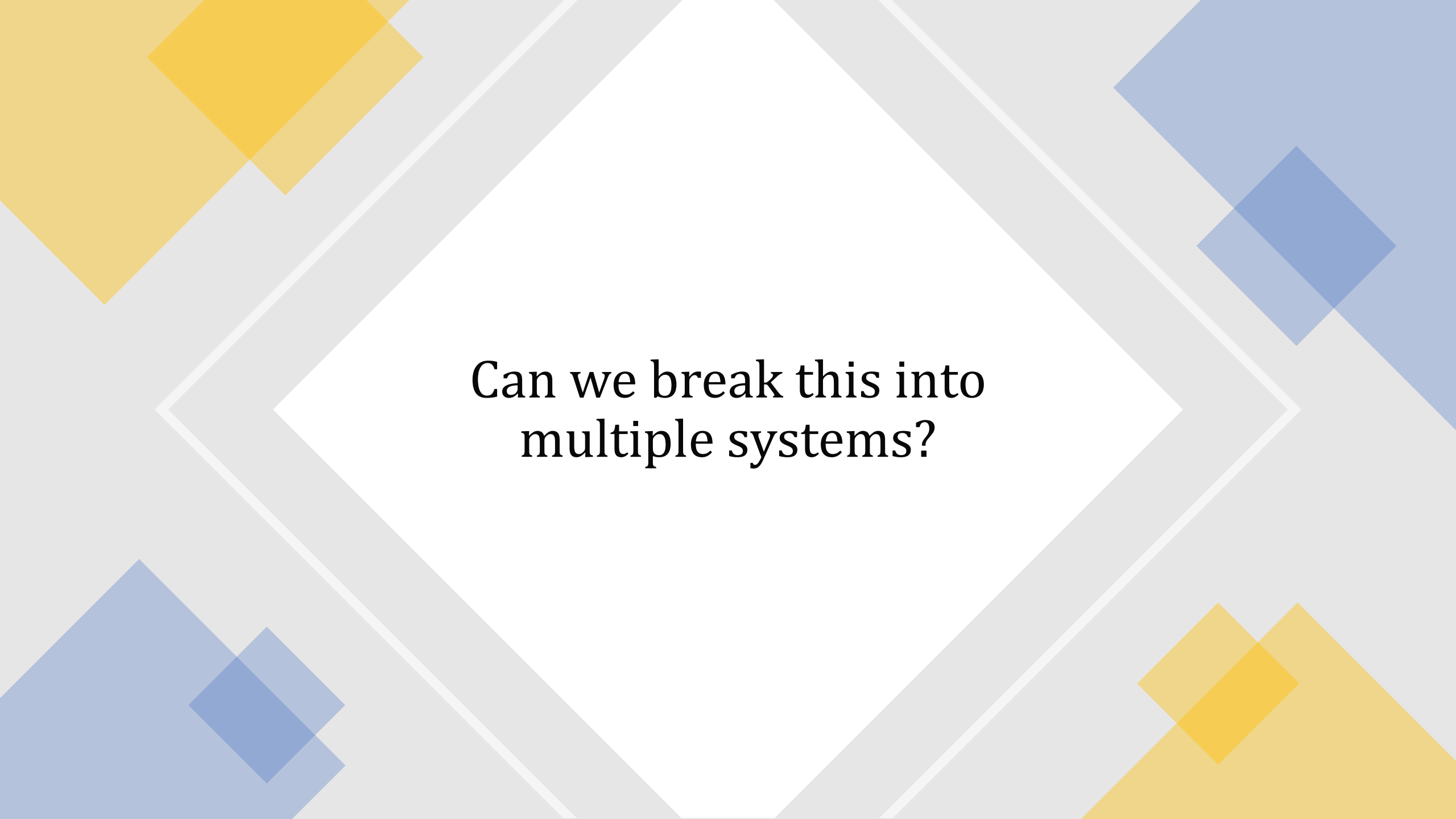
Check weather

Get
recommendations

Get confirmation

Book parking lots

Many more...each can be associated to a type of user



Can we break this into
multiple systems?

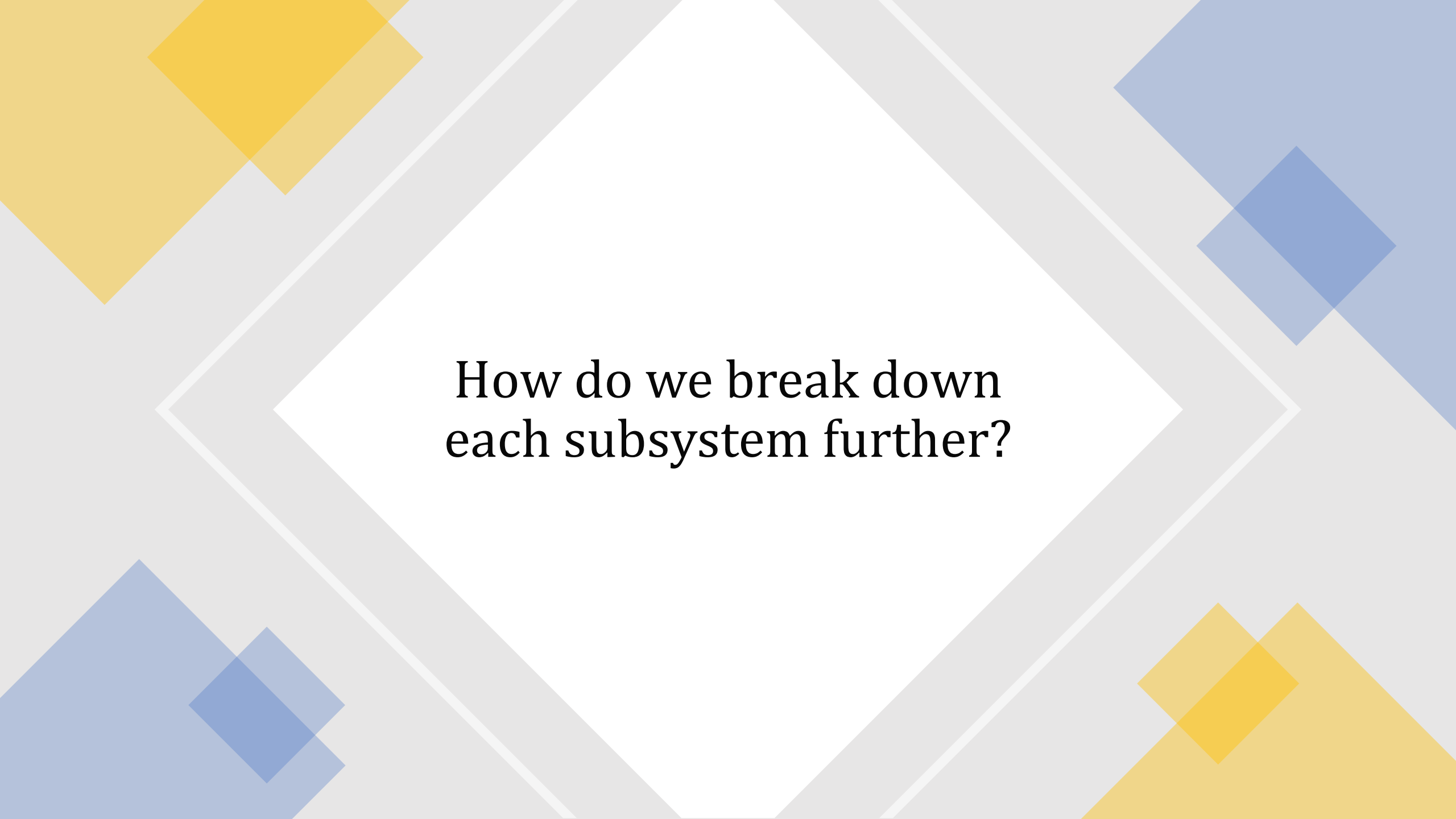
Subsystems in NdR System

IoT System

Booking System

Weather System

Analytics System



How do we break down
each subsystem further?

IoT system

Sensor
Controller

IoT middleware

Database

Visualization
Engine

Booking System

Web Application

Mobile Application

Database

NdR Backend



We can go further

NdR Backend

Venue Booking
Manager

Parking Lot
Booking Manager

Recommendation
Generator

Payment Manager

And many more..can you name?



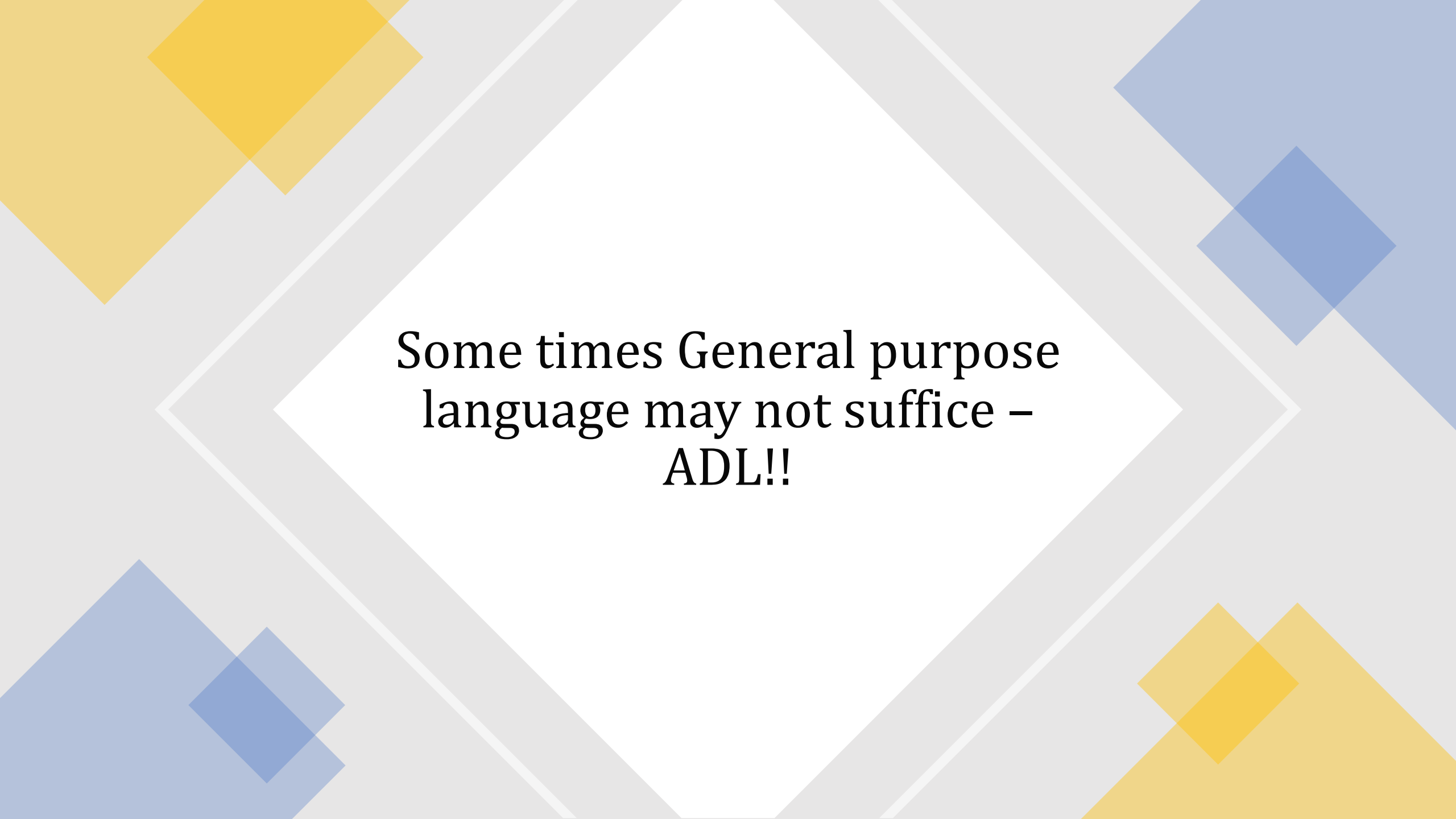
Further breakdown? – Think
of classes...



How to model? – UML,
C4Model,.....

C4Model

- Created by Simon Brown, Independent consultant (specialization: Software architecture)
- Overcome the challenges of UML, more intuitive language
- Visualize architectures in terms of Context, Containers, Components and Code
- Very developer friendly approach to software architecture diagramming



Some times General purpose
language may not suffice –
ADL!!

Is Software Architecture just some box and arrow?

*“Aside from providing clear and precise documentation, the primary purpose of specifications is to provide **automated analysis** of the document and to expose various kinds of problems that would otherwise go undetected”*

- Perry and Wolf, 1992

*“An architectural system representation is often essential to the **analysis and description** of the high-level properties of a complex system”*

- Garlan and Shaw, 1994

Architecture Description Languages

An Architecture Description language (ADL) or an Architecture Definition Language is a

- Formal specification language
- For describing the structure and behavior of a software system

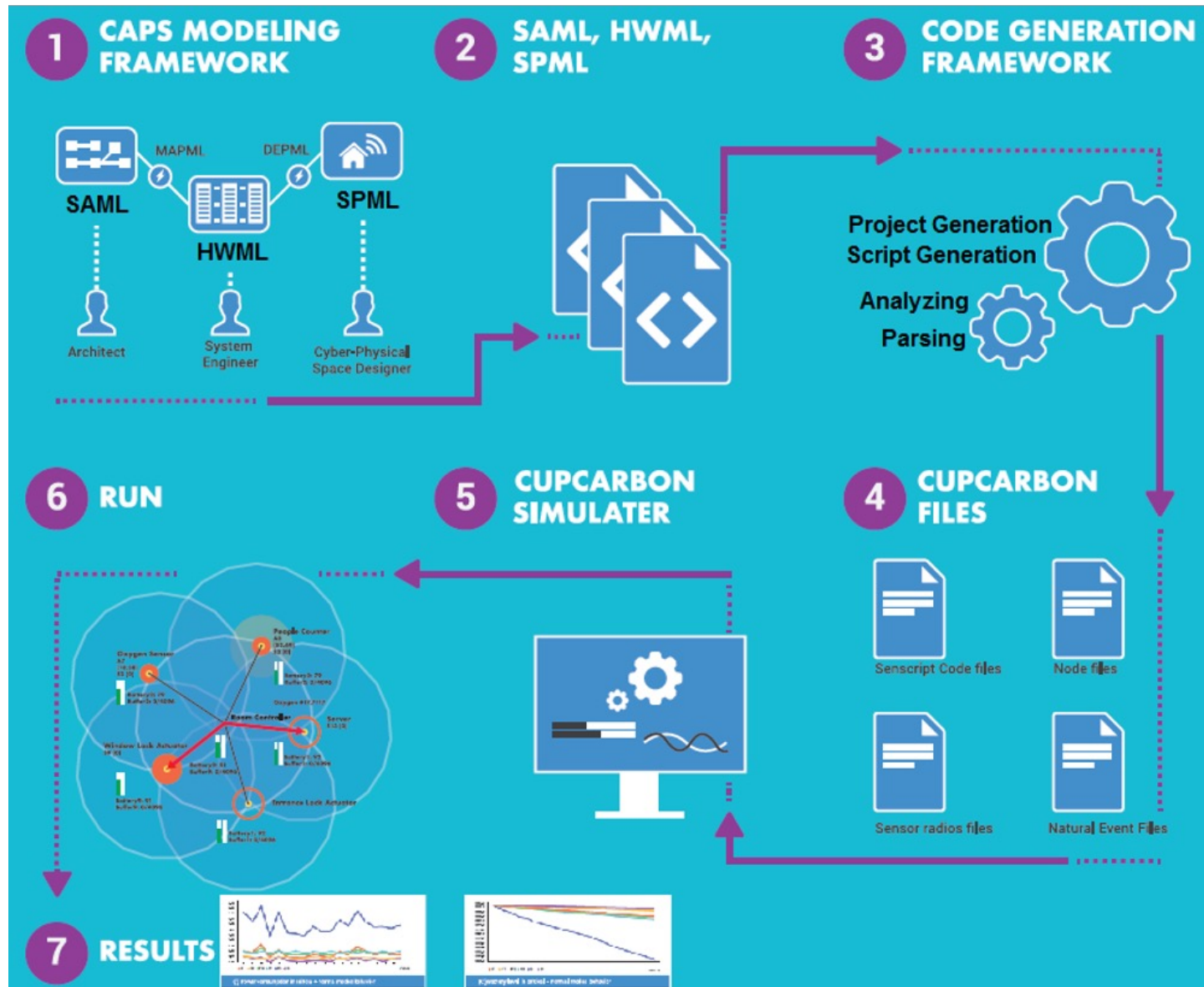
Some popular ADLs: Darwin, ACME, AADL,.....

Architecture Description Languages - CAPS

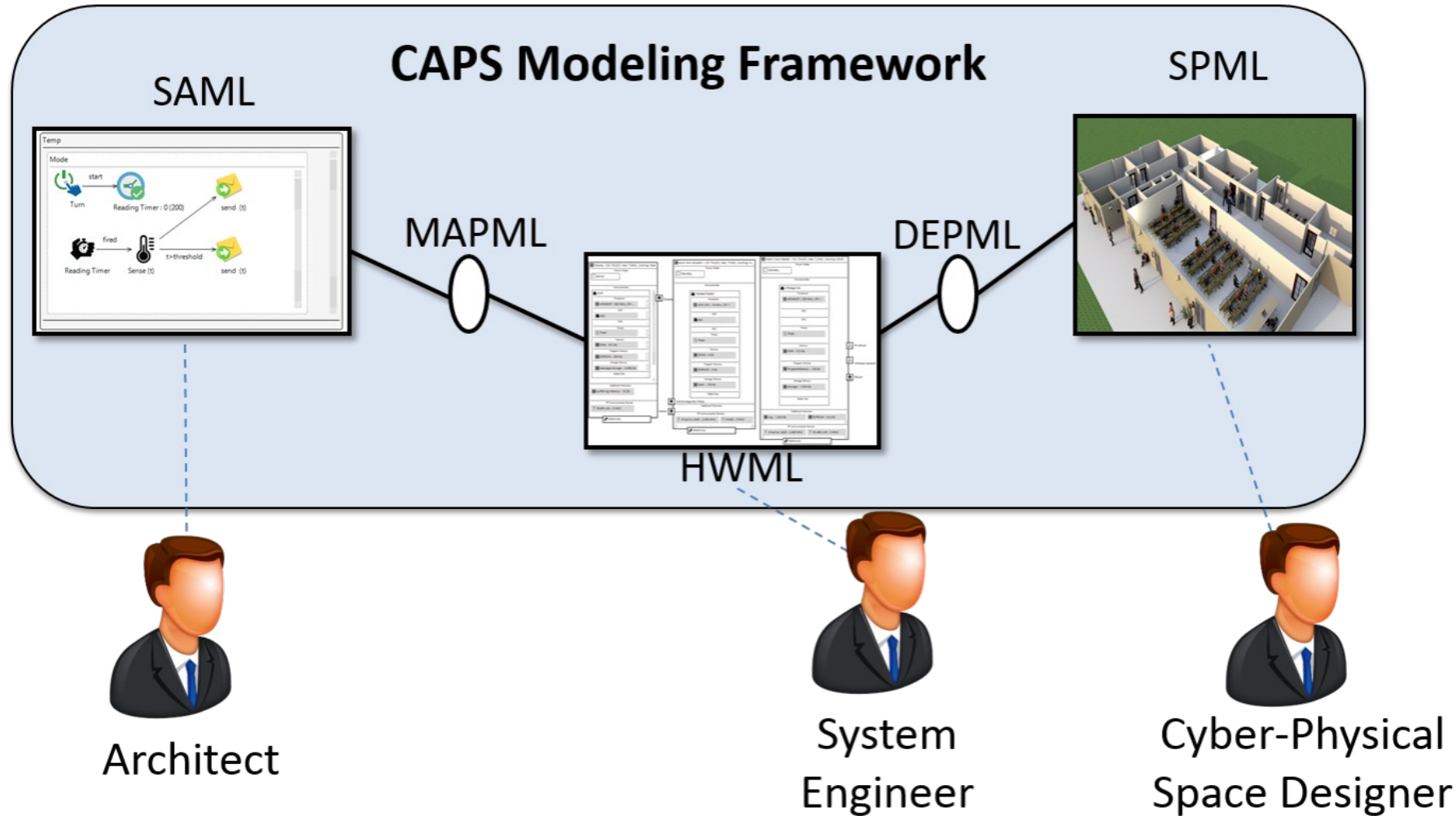


- Evaluate the systems **early** in the design process before the system or prototypes are built [IoT Systems]
- Avoiding **costly** redesign/re-development cycles

CAPS Modeling Framework

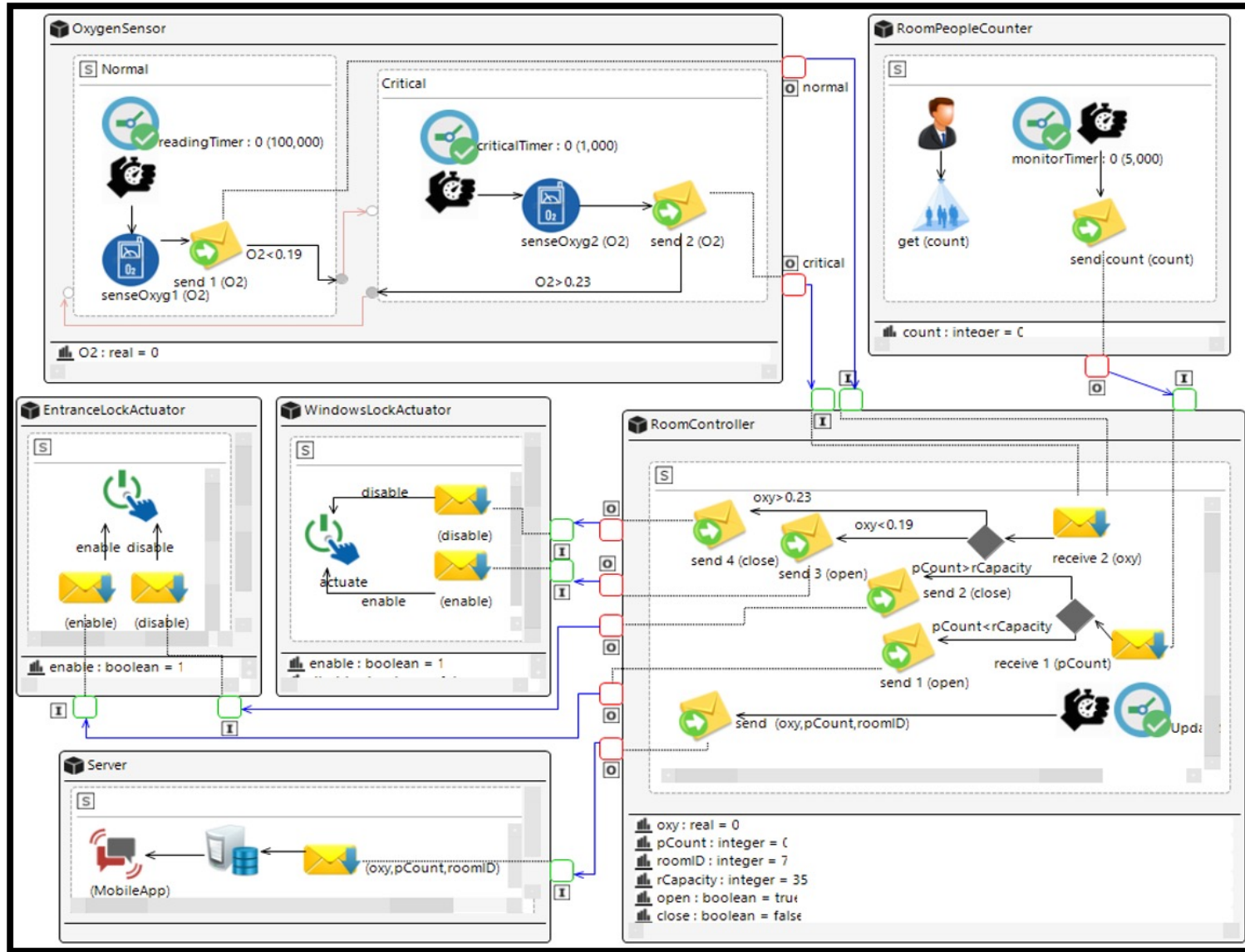


Multi-view Modeling Framework

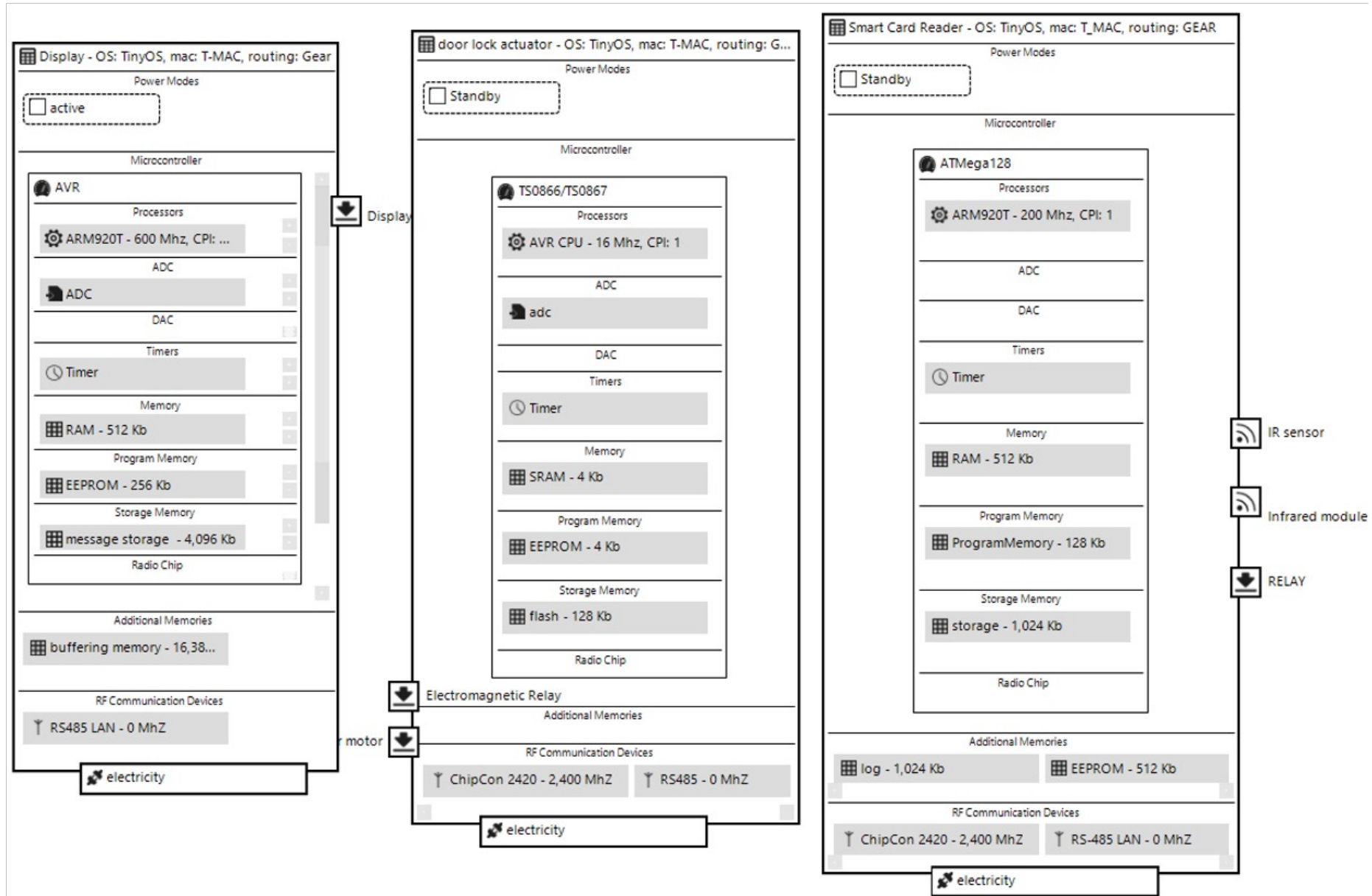


SAML – Software view, HWML – Hardware view, SPML – Space view

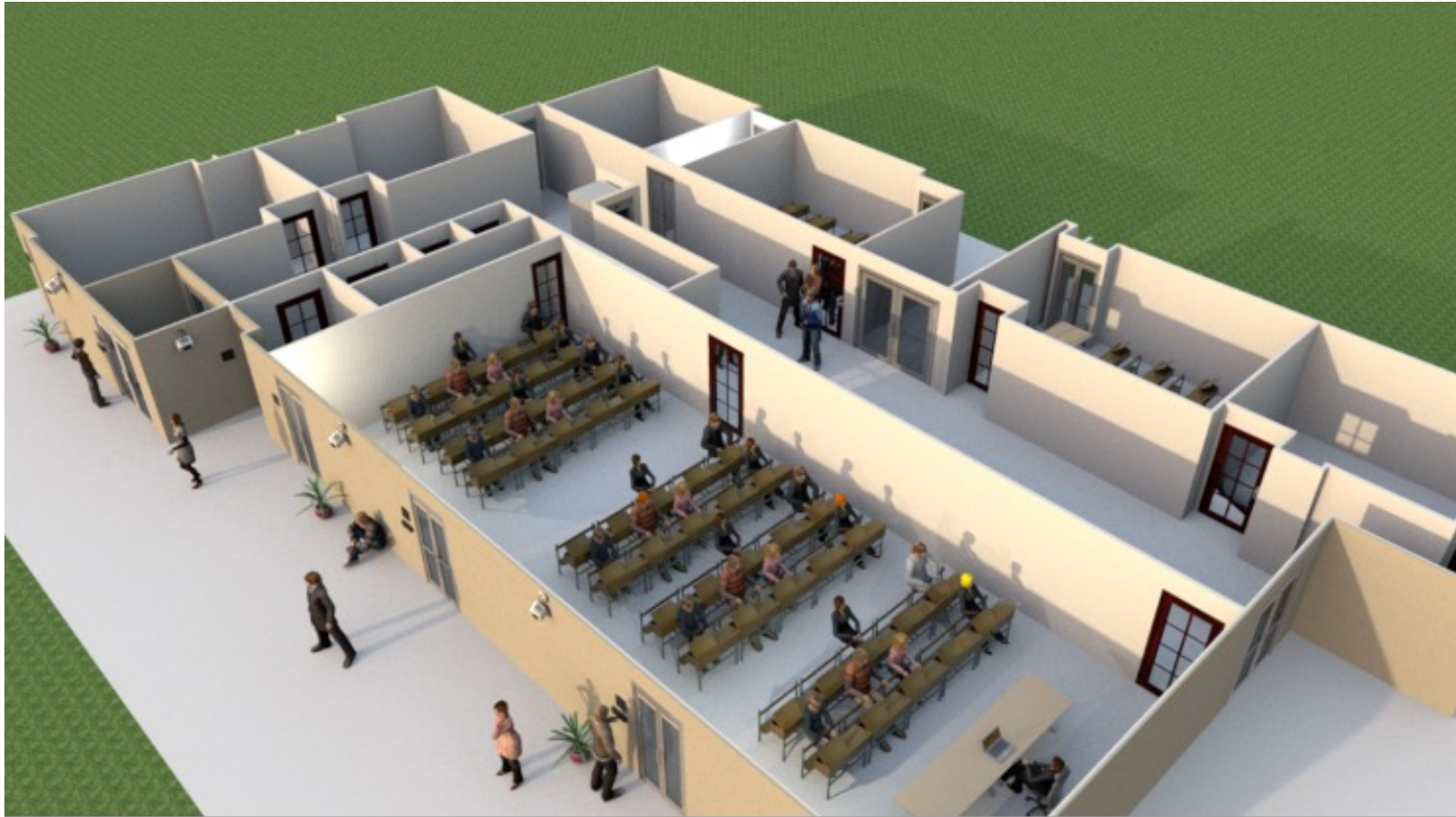
Software Architecture Modeling Language



Hardware Modeling Language

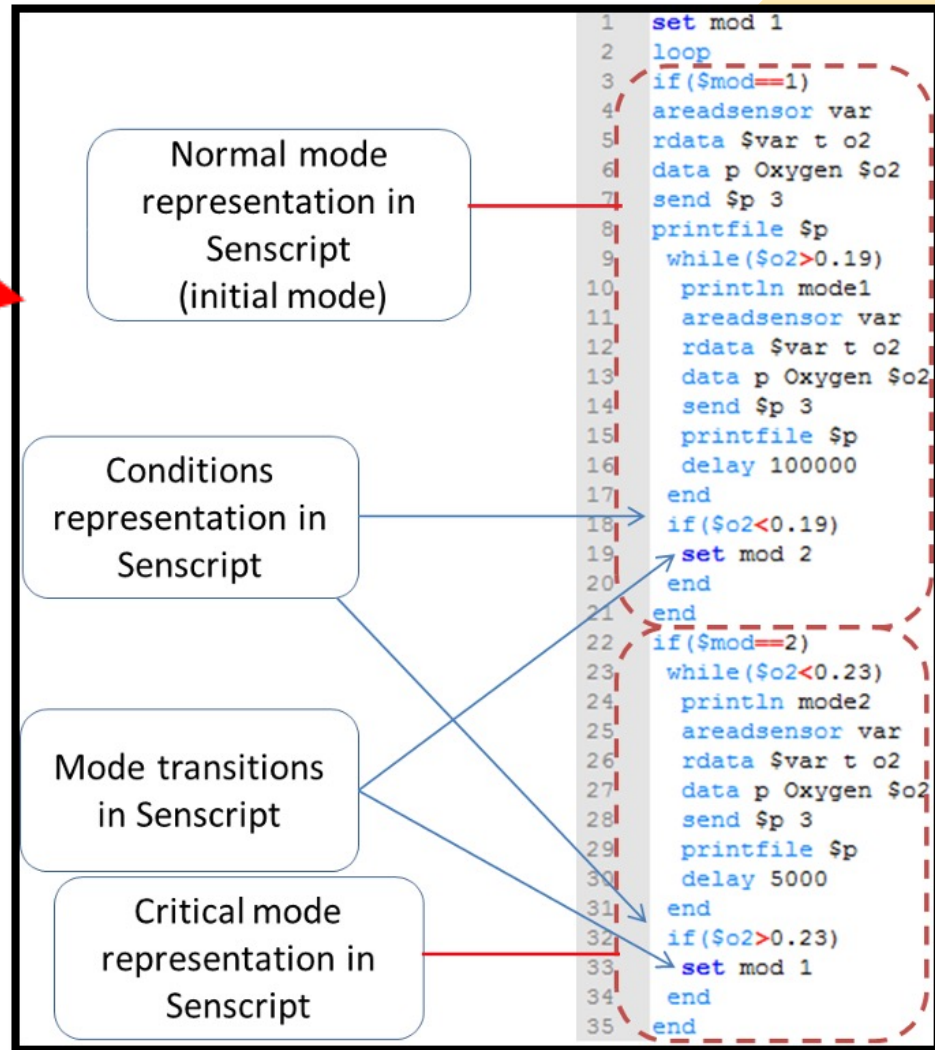
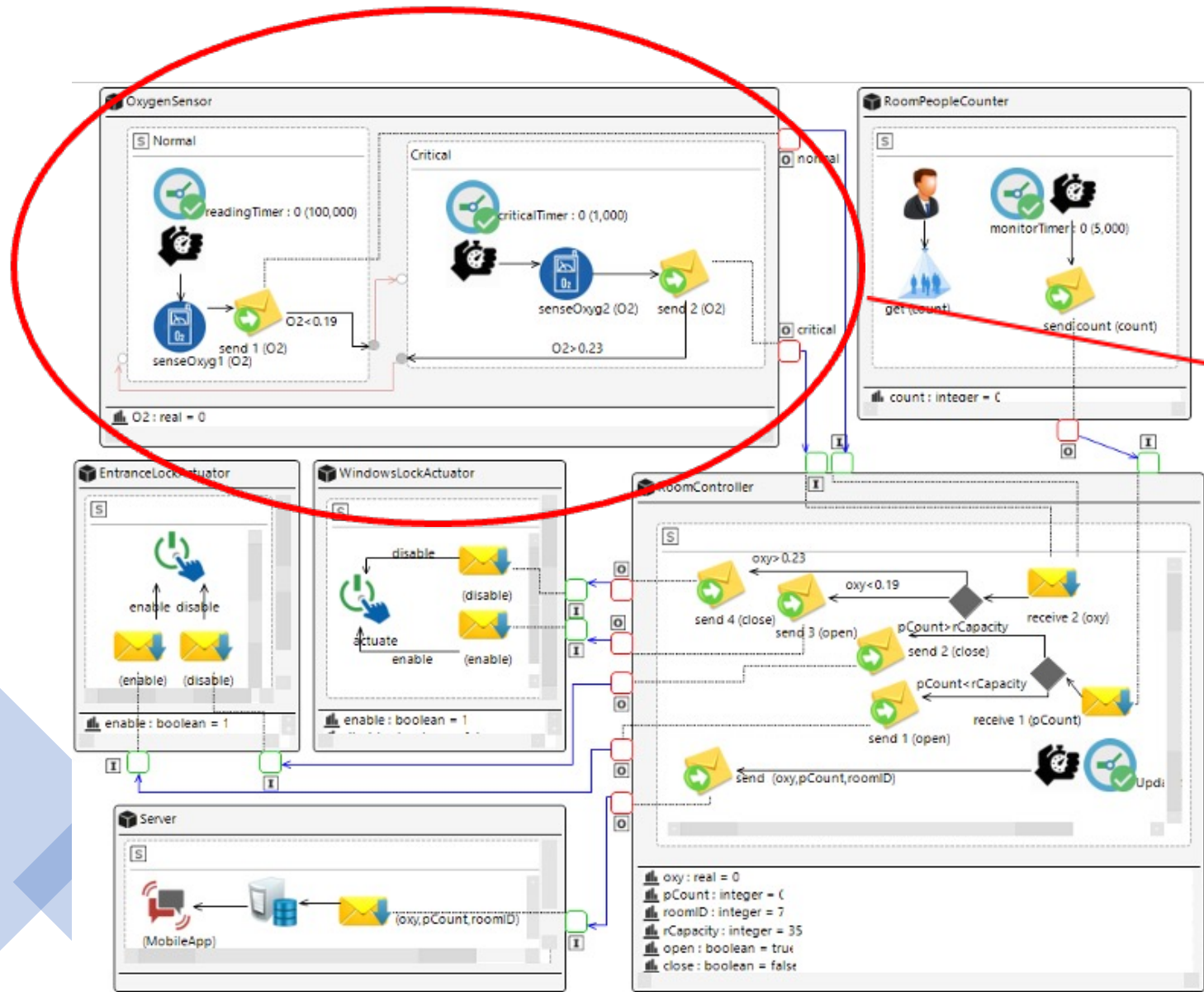


Space Modeling Language



This will be converted to an xml model

Space Modeling Language




Code Generation

The screenshot displays a network simulation environment. On the left, a sidebar contains a tree view with categories: Network information, Devices & Objects, Device Parameters, Radio Parameters, Marker Parameters, and Simulation Parameters. The Simulation Parameters section includes a 'SenScript' button, input fields for Simulation time (86400.0 s), Simulation Speed (1000 ms), and Arrow speed (1000 ms), along with 'Run Simulation', 'Stop Simulation', and 'Apply' buttons. Below these are checkboxes for Symmetrical links, Visibility, Log, Results (0.1 s), Mobility / Events, Clock Drift, ACK, Show, and MAC Layer (1.0).

The main area shows a map of a city street grid with a network topology overlaid. Nodes are represented by red fire icons and labeled with IDs and coordinates, such as A27 [0.00] 24 [0], A28 [0.00] 25 [0], A37 [0.00] 34 [0], A38 [0.00] 17 [0], A39 [0.00] 33 [0], A44 [0.00] 42 [0], A45 [0.00] 43 [0], and A1 [0.00] 1 [0]. Nodes are connected by lines, and several nodes have overlapping circular radio range indicators in shades of purple and yellow. A console window at the top right shows simulation statistics: Time: 0.0000 s, Number of SENT messages: 0.0 [0.0], Number of RECEIVED messages: 0.0 [0.0], Number of ACK messages: 0.0 [0.0], and Number of LOST messages: 0.0 [0.0].

At the bottom, a toolbar includes navigation arrows, a zoom level of 13, and buttons for Connections, Nodes, Radios, Sensors, All, Details, Distances, Links, Node Arrows, Map Contrast, Progression, N=32, and RT.



How do you guarantee
quality – Can we think of
tactics?

Thank You



Course website: karthikv1392.github.io/cs6401_se

Email: karthik.vaidhyanathan@iiit.ac.in

Web: <https://karthikvaidhyanathan.com>

Twitter: @karthi_ishere

