TRAINING

Supporting an advanced user experience using FIWARE

Philipp Slusallek, Torsten Spieldenner Web UI chapter

FIWARE

Open APIs for Open Minds

Supporting an advanced user experience in FIWARE

Philipp Slusallek, Torsten Spieldenner
WebUI Lead / Architect
<name.surname>@dfki.de

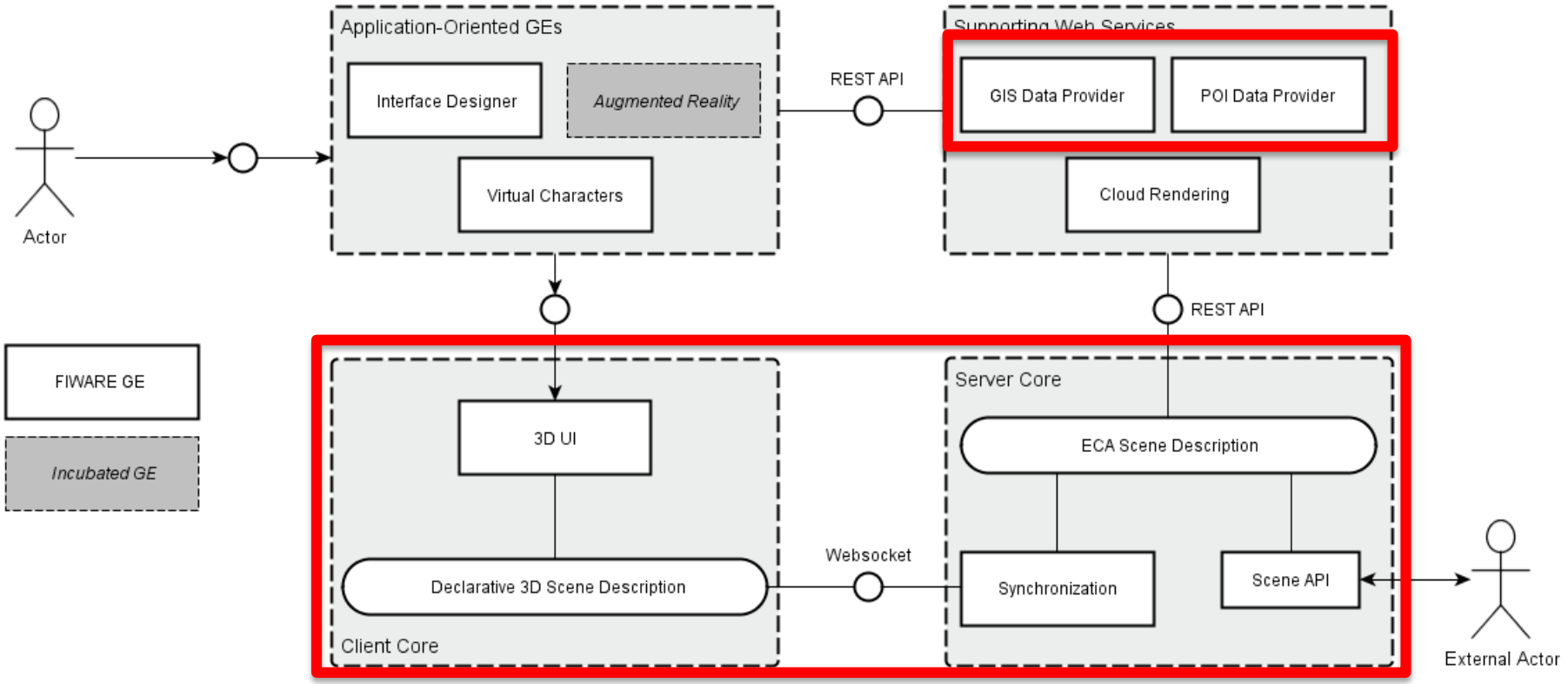
FIWARE

WebUI Chapter in FIWARE

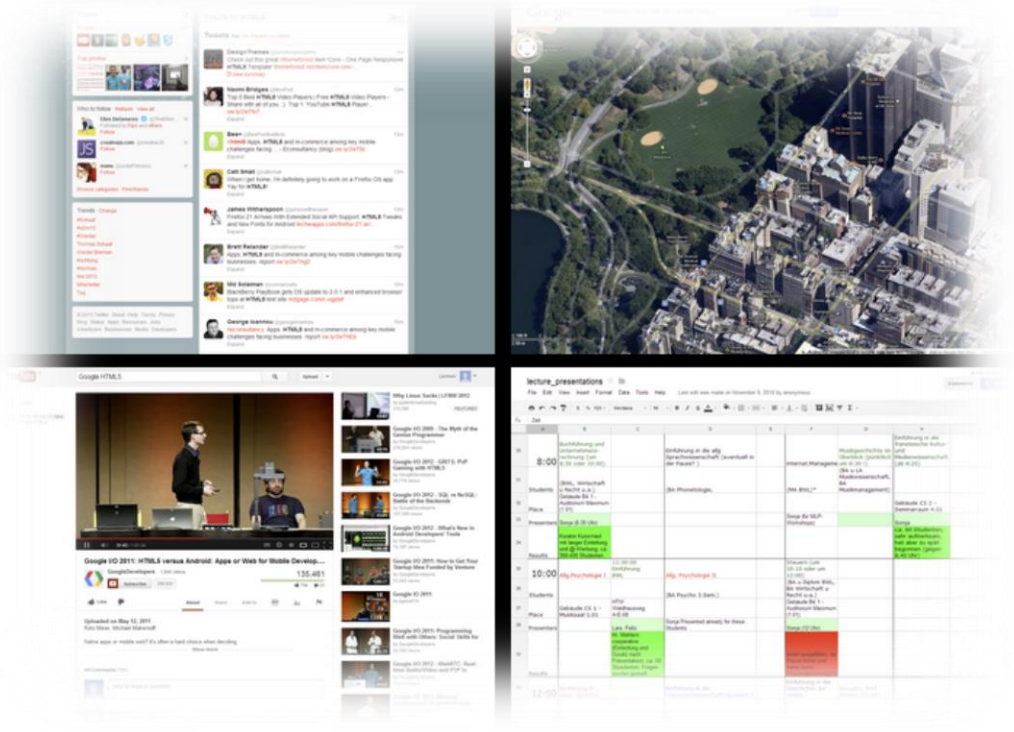
FIWARE

WebUI Chapter in FIWARE: Architecture

- **Objective: Significantly improve the user experience:**
  - **Interactive 3D graphics, shared 3D experiences**
  - **Integration with GIS and Point of Interest (POI) data**
  - **Immersive interaction (AR)**



Introduction



The modern Web:

- **Since the first text-based web pages, the internet now supports a wide range of interactive, multimedia content**

- **Formerly static web pages evolved into community driven social platforms**

- **Many types of stand-alone applications moved to the Web**
  - **Email, collaborative text processing, image and video editing, games, …**

FIWARE

Interactive 3D graphics with 3D-UI / XML3D

Bringing 3D graphics to the Web:

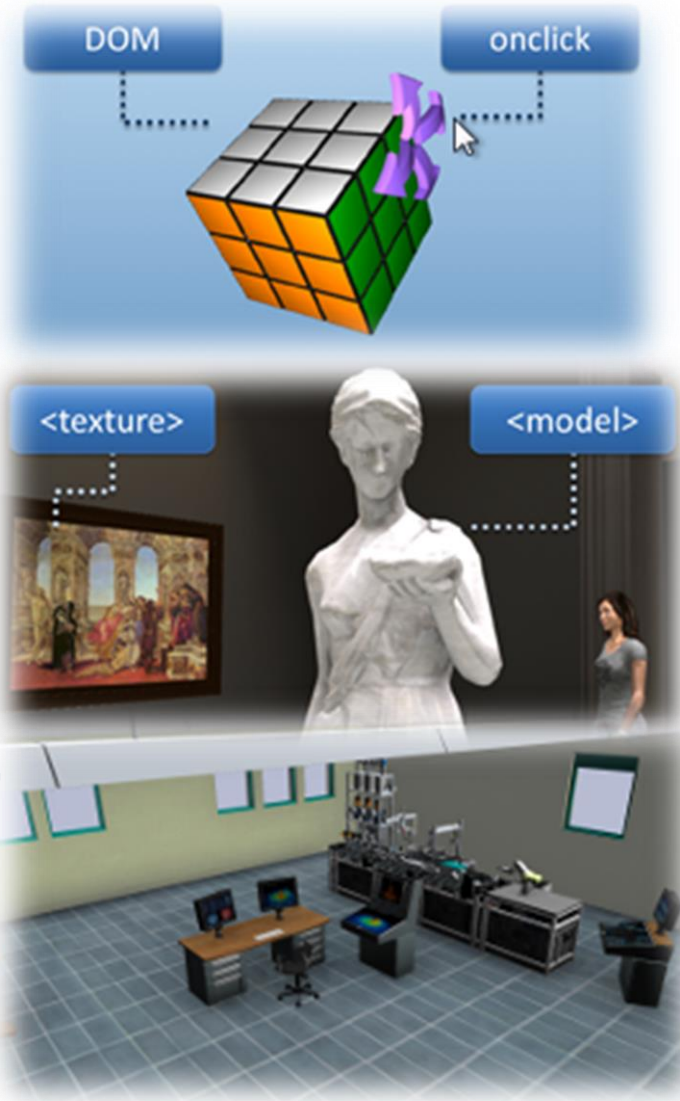
- **3D visualization provide a compelling and intuitive way to perceive and interact with different kinds of data**
  - **Smart City & IoT data, robotics, scanned point clouds, …**
- **3D in browsers became possible with WebGL**
- **Capabilities of WebGL and HTML5 used by modern game engines to deploy browser-based 3D games**
- **Requires deeper knowledge and experience in 3D application programming.**
- **Steep learning curve, and considerable effort also for simple applications**

FIWARE

Interactive 3D graphics with 3D-UI / XML3D

Declarative 3D for the Web:

- **Goal: Make creation of 3D content accessible to designers and artists**
- **3D-UI / XML3D: Extension of HTML5 to describe 3D scenes within web page**
- **Including 3D models, materials, lighting, …**
- **Runs directly in the browser (plugin free)**
- **Can link directly to services (e.g. FIWARE)**



FIWARE

Interactive 3D graphics with 3D-UI / XML3D

Simple example:

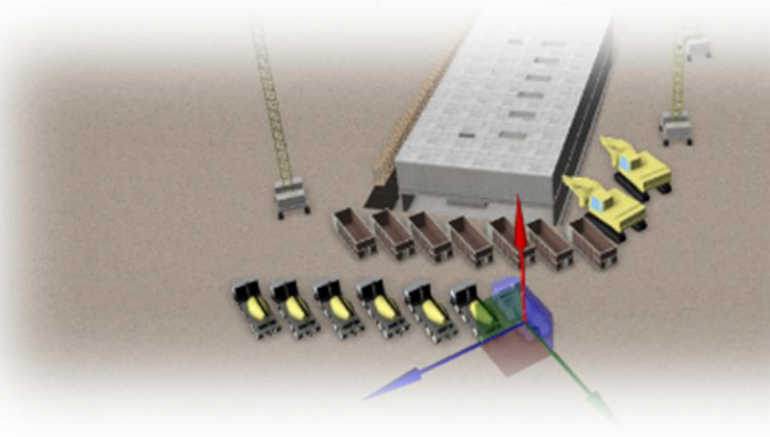
```
1 <body >
2    <xml3d >
3       <!-- ... -->
4       <transform id="tf" translation="11 22 33" />
5       <group material="materials.xml#xml3dTex" transform="#tf">
6           <mesh src="cube.json " />
7       </group >
8    </xml3d >
9 </body >
```

Supports various formats, including JSON representation, XML, glTF, COLLADA, ….

Support for additional formats can be provided as plugin

FIWARE

Interactive 3D graphics with 3D-UI / XML3D



Complex scenes with instantiated structured geometry:

Define externally:

```
1 <asset id = " myasset " transform ="# baseTransform ">
2     <assetmesh shader =" shaders .xml#tex" src=" cube . json " />
3     <assetmesh shader =" shaders .xml# tex2 " src=" part_2 . json " />
4 </asset >
```

Instantiate with one node:

```
1 <model id=" instance_1 " src="# myasset "/>
2 <model id=" instance_2 " src="# myasset "/>
```

FIWARE

Interactive 3D graphics with 3D-UI / XML3D

Interaction with 3D scenes:

- Standard HTML events directly registered on XML3D nodes
- Javascript API for scripting
- Create or modify nodes and node values, link 2D and 3D content ….
- Query and modify XML3D scenes with established frameworks, such as jQuery, backbone.js, and others

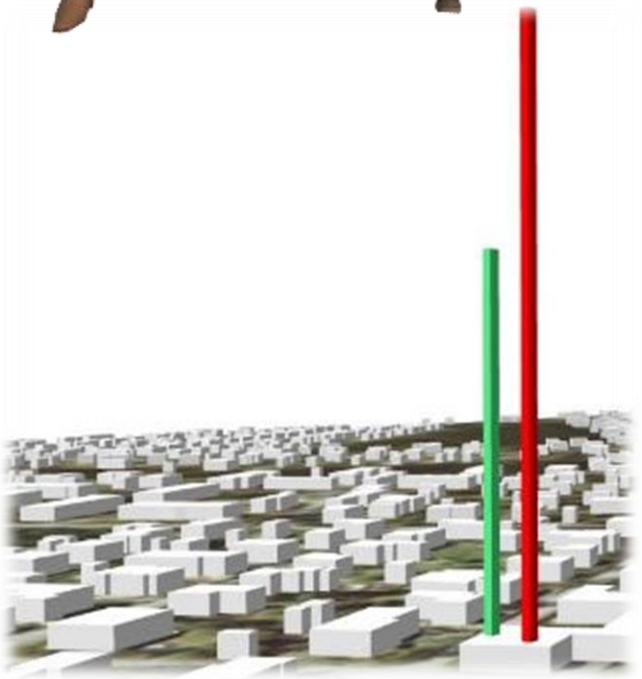
```
var myCube = $("#cube");

myCube.style = "transform:
      translate3d(0px, 1px, 0px);"

var newCube =
      document.createElement("mesh");
newCube.src = "cube.json";

$("#xml3d").append(newCube);
```


FIWARE

Interactive 3D graphics with 3D-UI / XML3D

Complex computations with "Xflow":

- **Dataflow description integrated into XML3D (can use GPU)**
- **Efficient computation of complex tasks, like character animation (skinning)**
- **Map input values (e.g. sensor data) to effects in the scene (e.g. scale or shading of a 3D object)**
- **Compelling tool to add information visualization capabilities to 3D scenes**



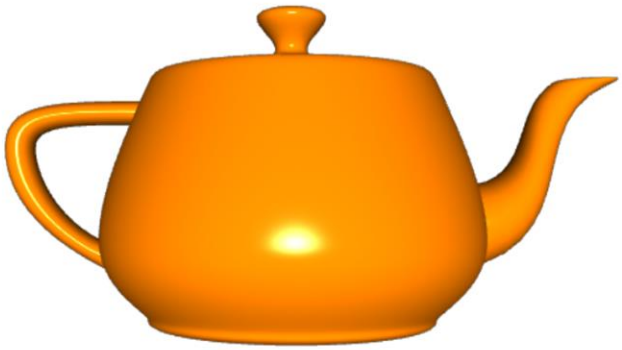
FIWARE

Interactive 3D graphics with 3D-UI / XML3D

Next Generation XML3D (in development):

- **Exploit capabilities of Web Components**
- **Web Components: Implemented in latest browser versions**
- **Define custom DOM-nodes that encapsulate complex, user-defined concepts**
- **Possibility to add *(scripted) behavior* of the node**
- **Maximum flexibility to define and extend application specific sets of 3D-UI nodes**

```
<xml3d-teapot scale="1 1 1" color="1 0.5 0"><xml3d-teapot/>
```



FIWARE

Interactive 3D graphics with 3D-UI / XML3D

Summary: Advanced user experience with 3D-UI:

- **3D-UI allows to add interactive 3D graphics to web applications using simple HTML5 primitives**

- **Web, JavaScript, and Xflow provide plenty of options to link 3D graphics to *external services* and *application specific data***

Augmented reality with 3D-UI / XML3D and AR

Using webcam input with Xflow with AR:

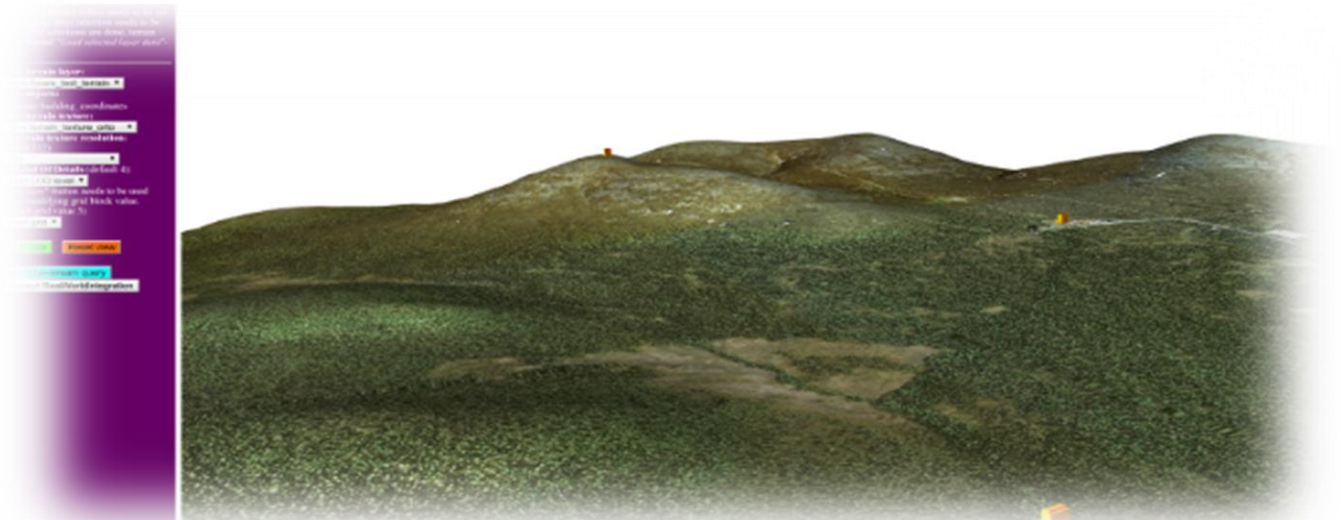
- **Feature / Markertracking implemented as Xflow-Operator**
- **Detects markers or features in the webcam stream**
- **Allows to position 3D-UI / XML3D objects according to marker positions in the webcam stream**
- **Nice Web game from FIWARE hackathon**

FIWARE

Interactive 3D maps with GIS Data Provider

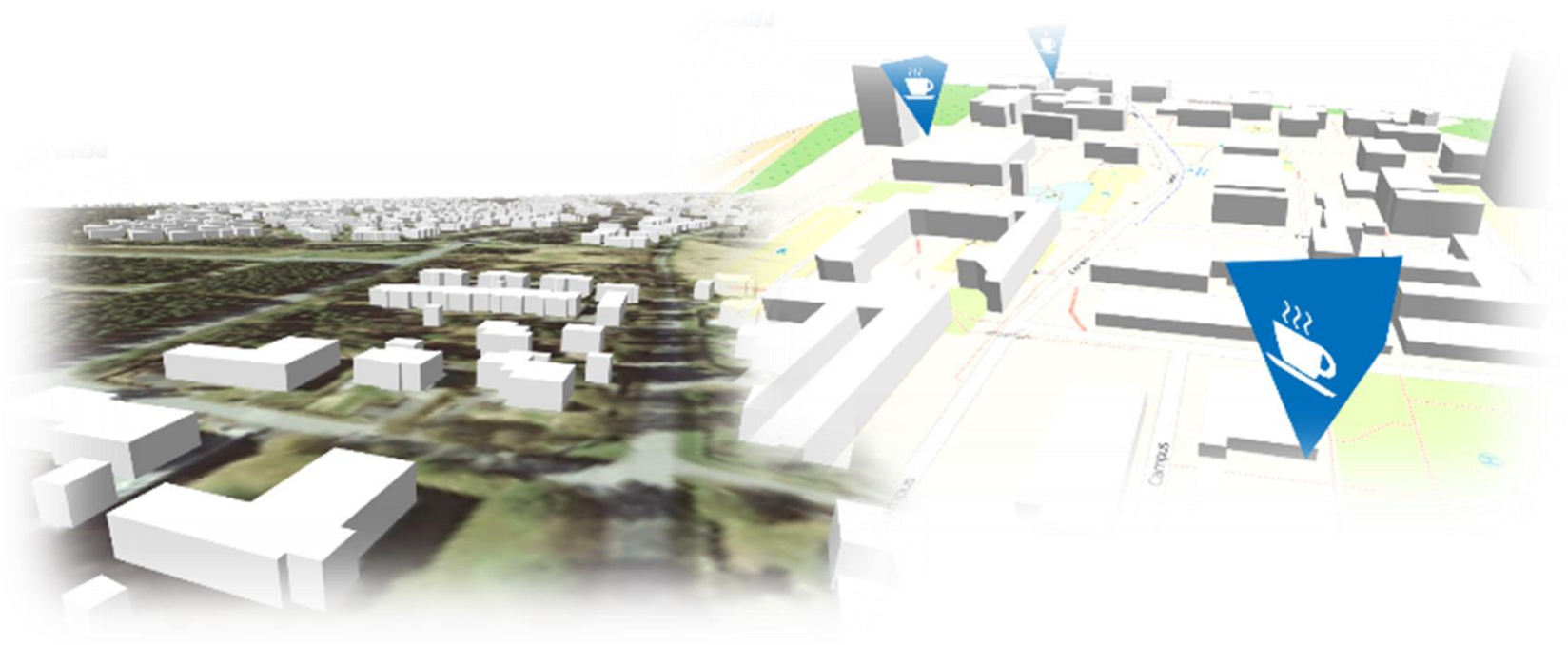
3D Terrain with GIS Data Provider:

- **GIS Data provider:**
  - **Provides elevation data sets for different regions of the world**
- **Can be queried using REST calls**
  - **Filter by geo-location, longitude / latitude, ….**
- **Result can directly be delivered in XML3D format**
  - **GIS Data Provider / GeoServer 3D returns query as XML3D node**



FIWARE

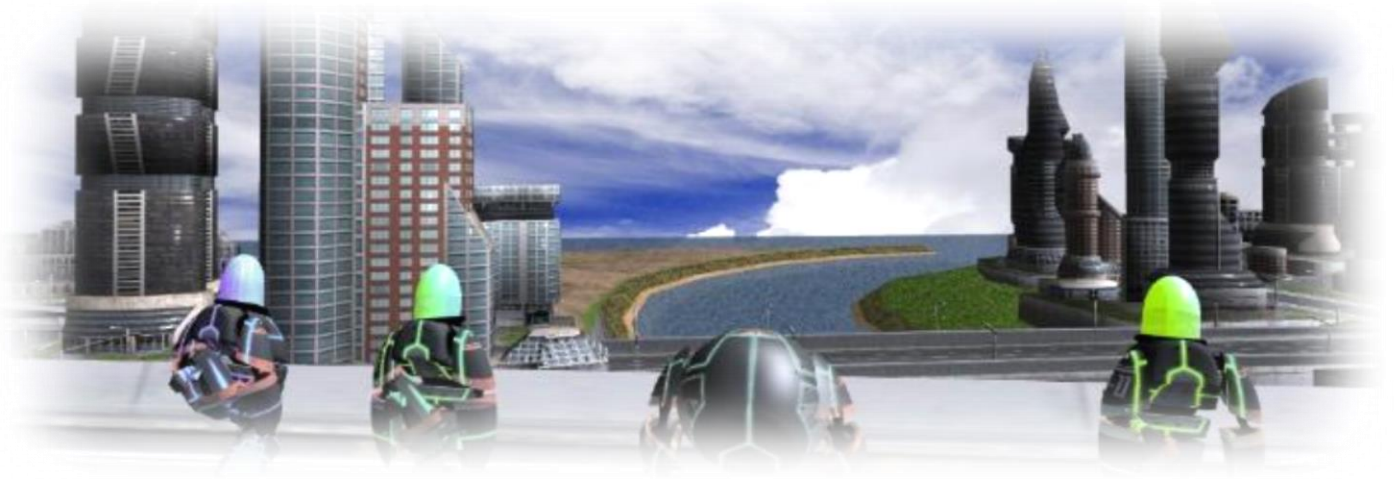
Interactive geo-visualization: With GIS, POI and 3D-UI



FIWARE

Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Recap:



We have seen so far:

- **Interactive declarative 3D for web browsers**
- **Interactive 3D maps and augmented reality applications**

Question:

- **How to share a 3D scene among multiple users?**
- **Possible use-cases: gaming, social platforms, training, collaborative work …**

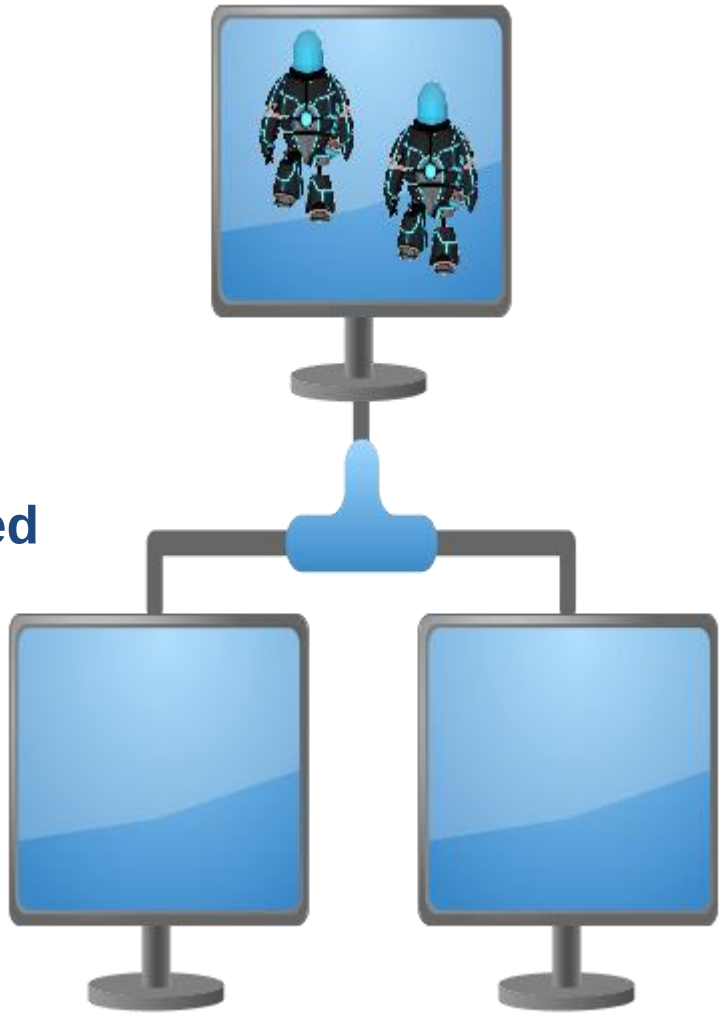
FIWARE

Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Synchronization Generic Enabler:

Common requirement of many multi user environments:

- **Consistent world state needs to be stored somewhere in the network**
- **Changes to the world state need to be synchronized to connected client applications**
- **Often: (Soft) real-time requirement**



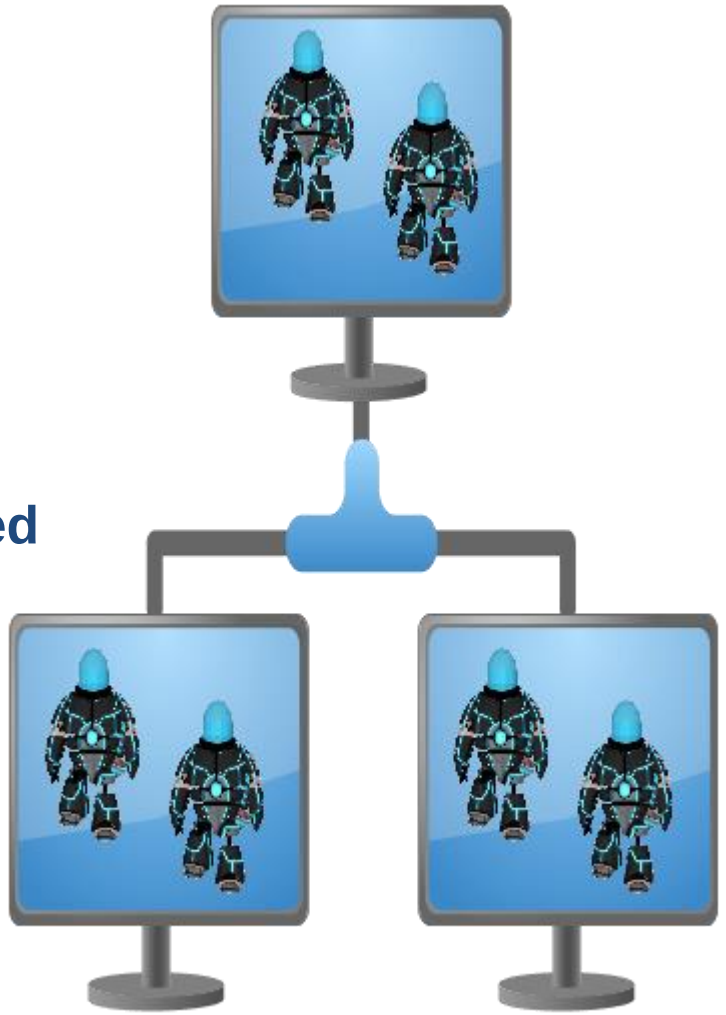
FIWARE

Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Synchronization Generic Enabler:

Common requirement of many multi user environments:

- **Consistent world state needs to be stored somewhere in the network**
- **Changes to the world state need to be synchronized to connected client applications**
- **Often: (Soft) real-time requirement**



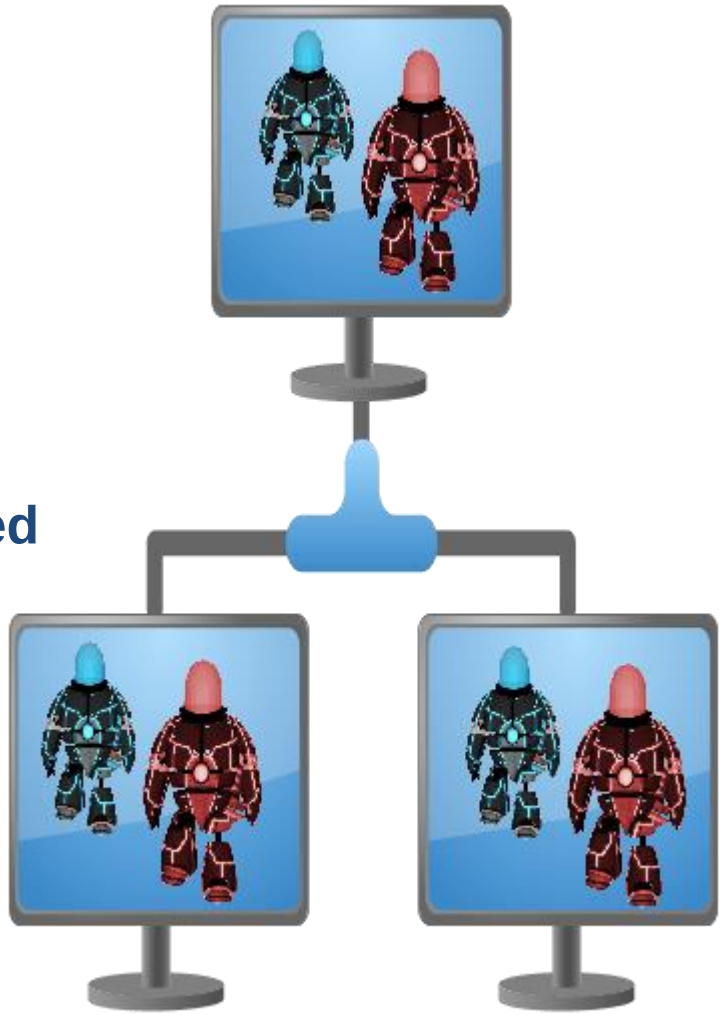
FIWARE

Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Synchronization Generic Enabler:

Common requirement of many multi user environments:

- **Consistent world state needs to be stored somewhere in the network**
- **Changes to the world state need to be synchronized to connected client applications**
- **Often: (Soft) real-time requirement**



FIWARE

Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Synchronization Generic Enabler:

Synchronization GE approach:

- **Lightweight server implementation with extendable component system**
- **REST HTTP SceneApi and WebSocket based real-time synchronization**
- **Targets browsers as client frontends (e.g. 3D-UI)**

Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Synchronization Generic Enabler:

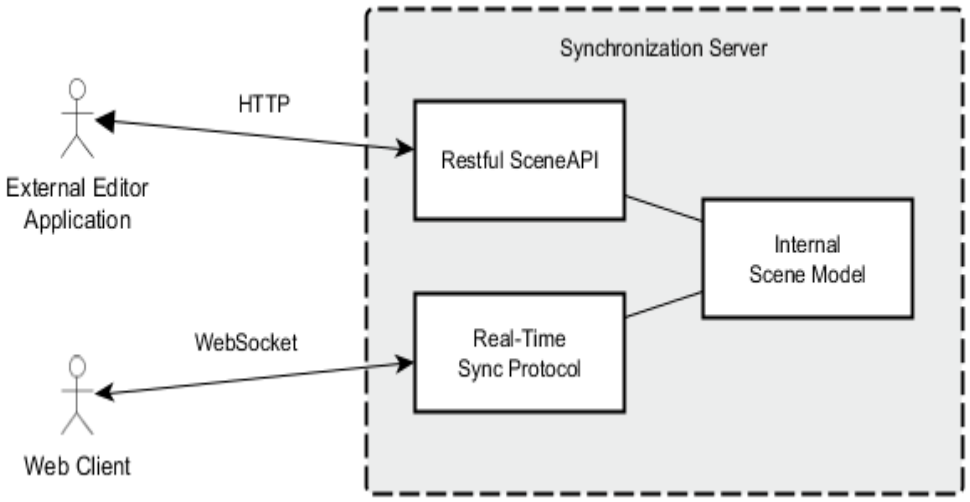
Role of Synchronization GE in FIWARE:

- **Context Broker (and others) as scalable backend data provider**
- **Provides access to data for large scale complex applications**
  - **E.g. city visualizations**
- **Synchronization: Allows implementing application logic in the cloud**
  - **Keep connected clients in synch w.r.t. to changes in data**
- **Simulation, filtering, visualization, …. before sending data to clients**
- **By this, building the bridge between data and WebUI visualization clients in FIWARE**

FIWARE

Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Synchronization GE architecture:



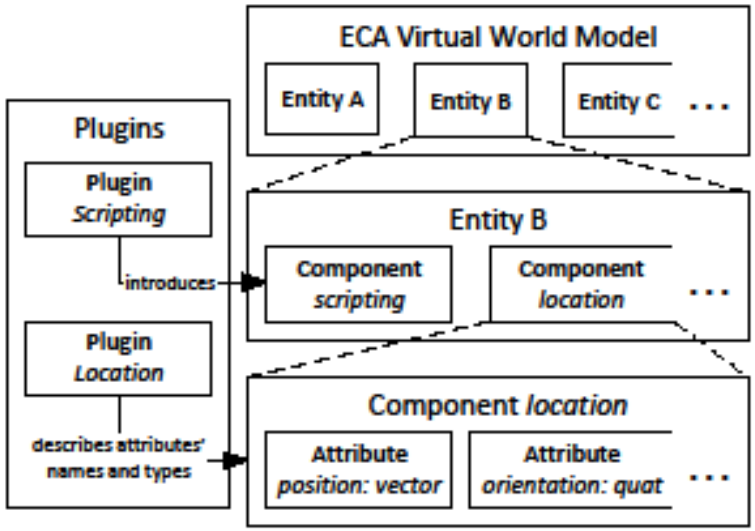
- **World state is described in internal scene model**
- **Restful SceneAPI for CRUD operations**
- **WebSocket support for real-time client applications**

FIWARE

Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Synchronization GE architecture:

- **Established highly flexible *Entity-Component-Attribute* model**
- **Entities: empty data containers. Roles of entity in the world assigned by *Components***
- **Components defined and assigned during runtime:**
  - **Easy adaption of the GE to application specific use-cases**



Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Mapping a scene to backend data:

- ECA model can be used to express basically any JSON-like object data

- This includes data from POI data provider and Context broker

- Support of NGSIv2 formatted messages in implementation *FiVES*

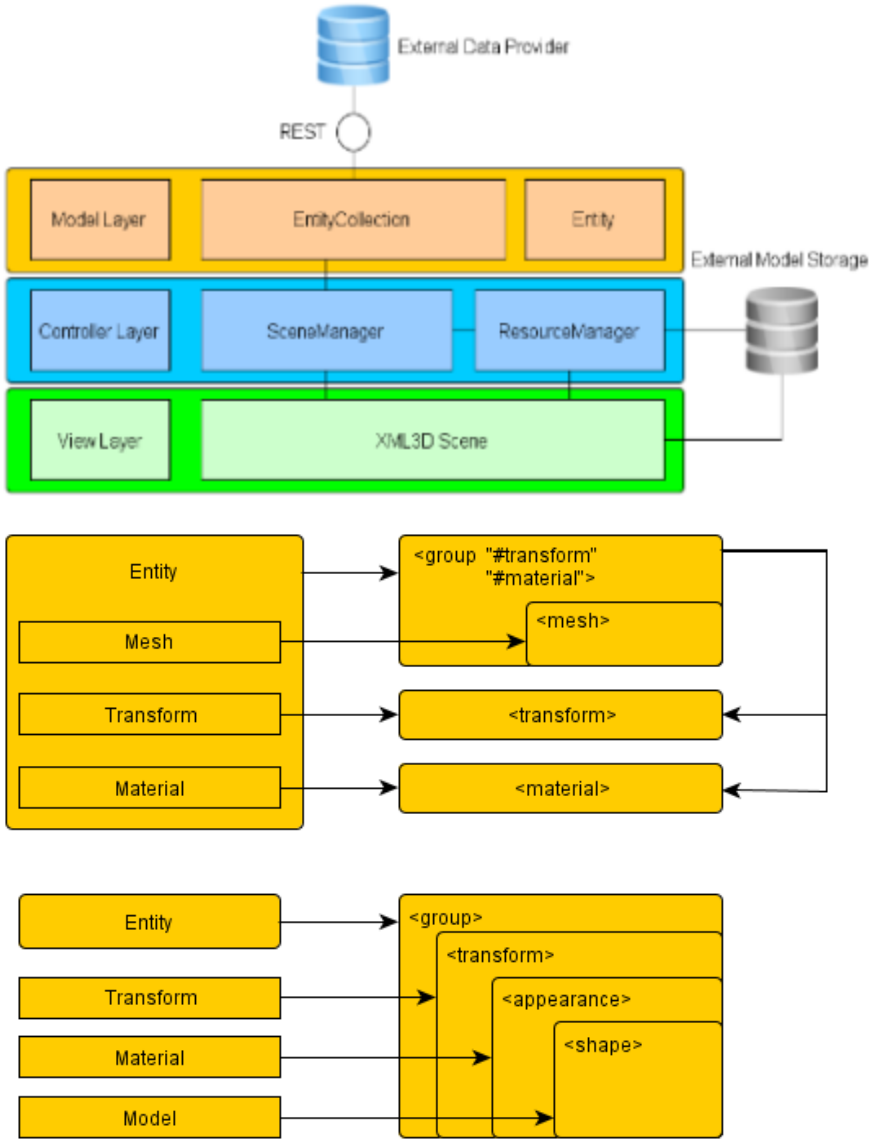
```
"bfd3d8c2-cc5b-440e-acec-83fe993c7ab2":
{
    "fw_core":
    {
        "location": {"wgs84":{"latitude":64.9927238,"longitude":25.5430454}}
    }
    ,
    "fw_xml3d":
    {
        "asset":"resources/temperature_poi/sensor-asset.xml#sensor_widget",
        "config":
        {
            "map":
            {
                "gradient":"fw_rvi.sensors.temperature.value",
                "pressure":"fw_rvi.sensors.pressure.value"
            }
        }
    },
    "fw_rvi":"rvi/bfd3d8c2-cc5b-440e-acec-83fe993c7ab2/components/fw_rvi"
}
```


FIWARE

Real-Time Shared Multi-User Scenarios with FiVES Synchronization

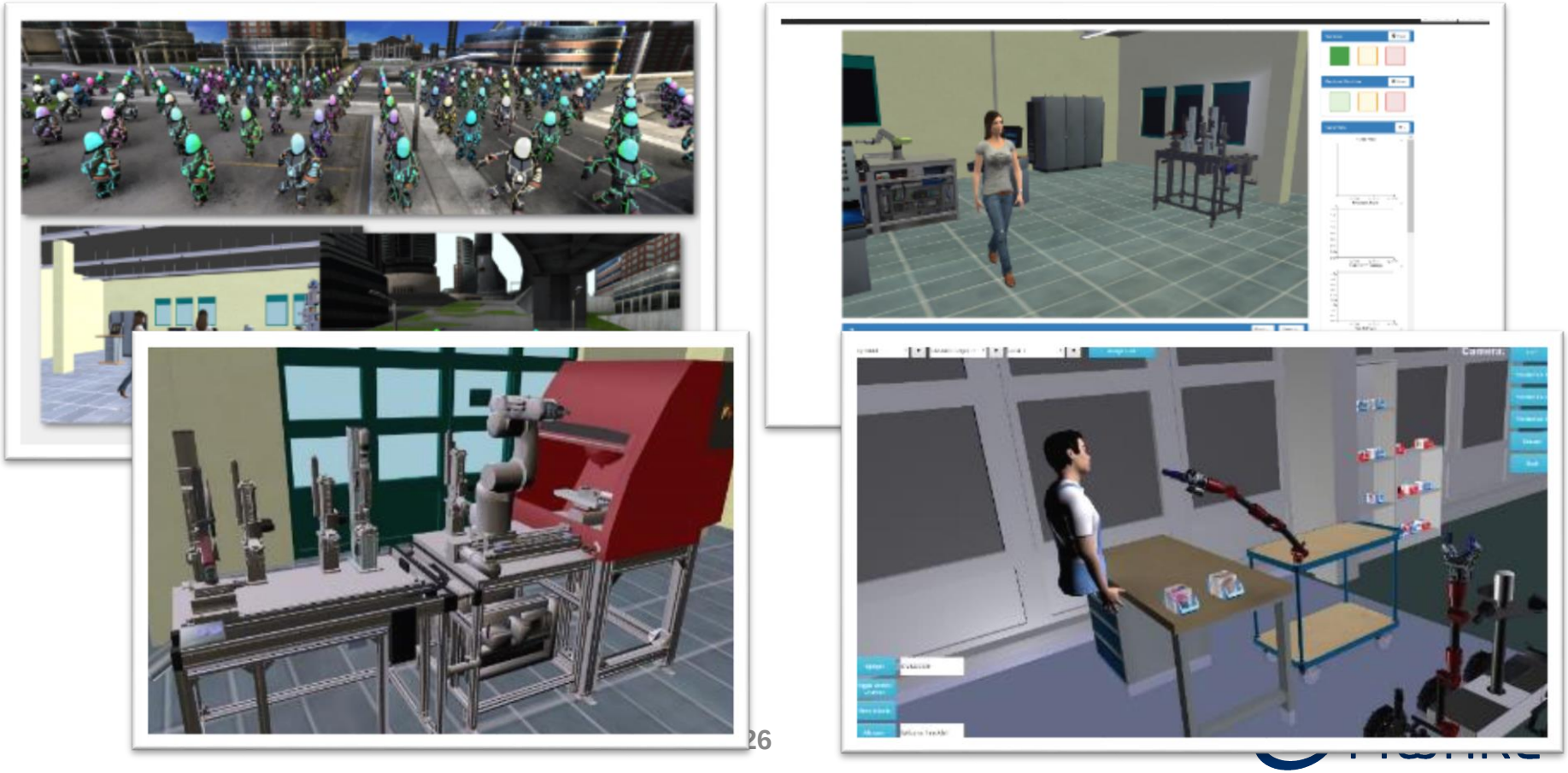
Mapping the scene to 3D-UI:

- **Components can directly be mapped to 3D-UI DOM nodes in a Model-View manner**
- **Common Model-View-* frameworks for HTML also work with 3D-UI**
- **Unambiguous mapping between entities and nodes**



Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Synchronization GE show case:



Real-Time Shared Multi-User Scenarios with FiVES Synchronization

Using 3D Maps in multi user scenarios:

- **Define a component that describes the role of an entity as geo patch with longitude and latitude**
- **Render this entity as result of query against GIS data provider**
- **Create entities from query response of POI data provider**

- **Extrude buildings, animate characters and visualize sensor data using Xflow**

FIWARE

Summary:
WebUI Chapter in FIWARE

Adding a new dimension to Web user interfaces:

- **3D graphics enhance the experience of existing web applications**
- **By building heavily on HTML5, 3D-UI makes creation of 3D Web apps also accessible for designers**
- **Building interaction on a 3D-UI application is as easy as adding interaction to standard HTML pages**

Summary:
WebUI Chapter in FIWARE

Linking data to 3D user interfaces:

- **3D applications can be linked to arbitrary sources of data using model-view-patterns**
- **Established HTML frameworks work for 3D-UI as well as for 2D websites**
- **We have seen examples of how to create applications from the domain of geo visualization**

Summary:
WebUI Chapter in FIWARE

Creating multi user experiences using FIWARE:

- **The *Synchronization* Generic Enabler is designed to serve multiple clients in a shared environment**
- **The underlying data model is designed such that both backend data from data providers and the 3D-UI scene graph nodes can be directly mapped to the synchronization runtime data**
- **By this, *Synchronization* provides the bridge between FIWARE data back ends and multi user 3D frontend applications**

Thank you!

http://fiware.org
Follow @FIWARE on Twitter