

Ubiquitous Computing in Business Processes

Part IV

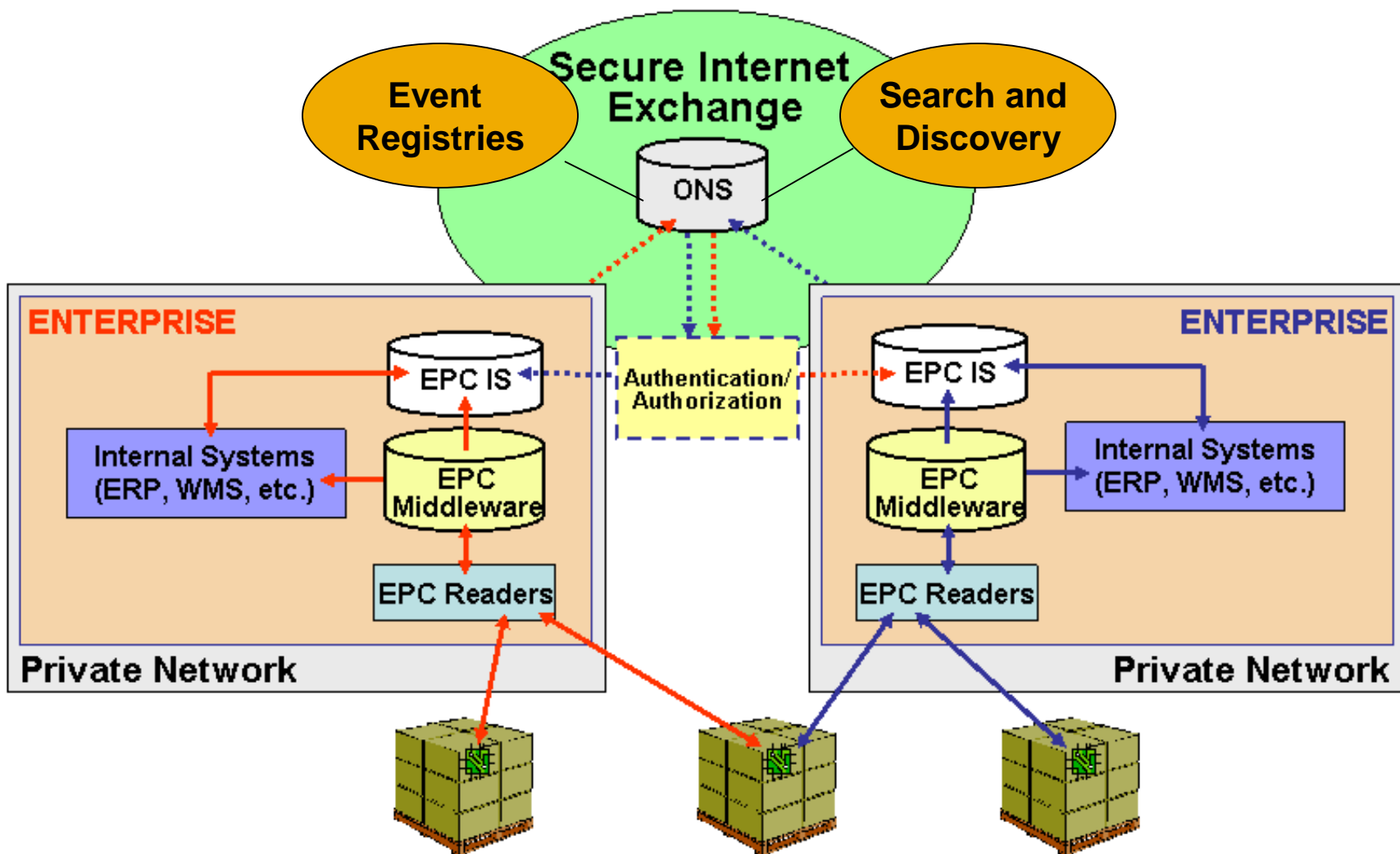
Prof. Dr. Lutz Heuser
Urban Software Institute

Darmstadt
December 15th, 2017

Outline

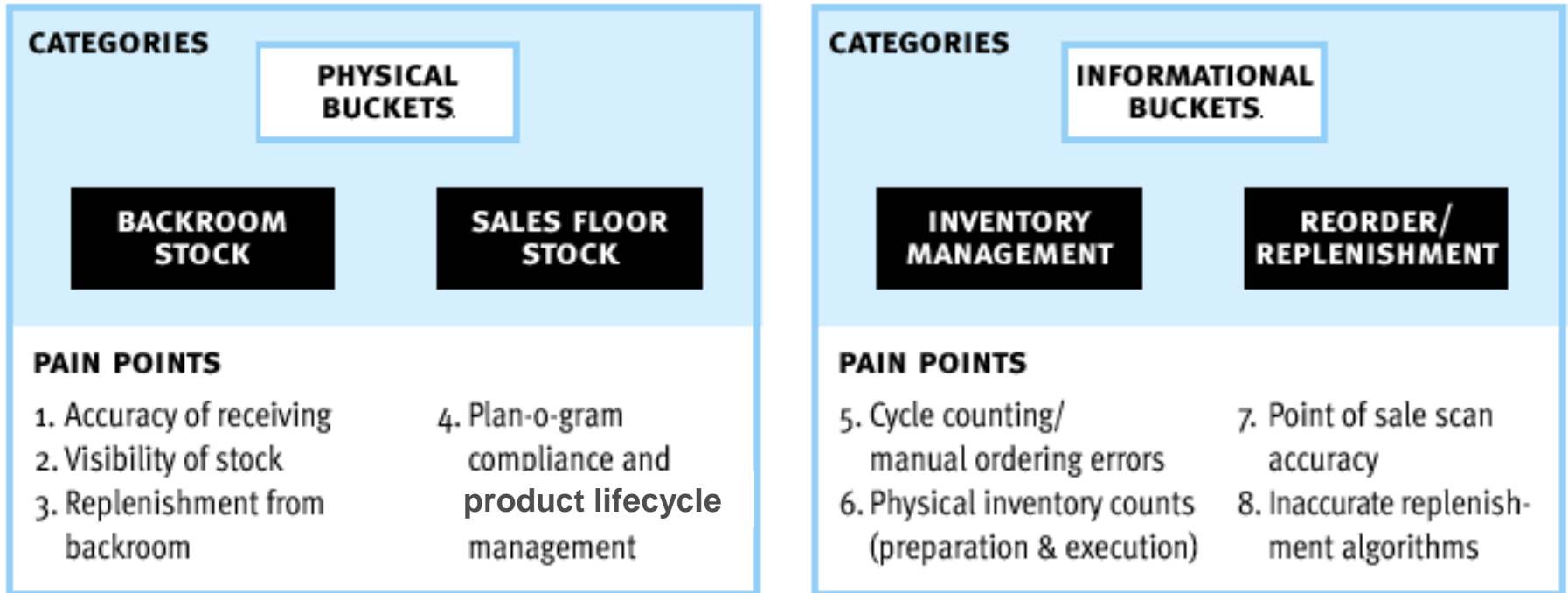
1. Recap

The 'Internet of Things' - EPCglobal Network Architecture



Source: EPCglobal

Retail Management: Overview Pain Point Categories



← Labor Allocation Inventory Management →

Source: PWC Consulting

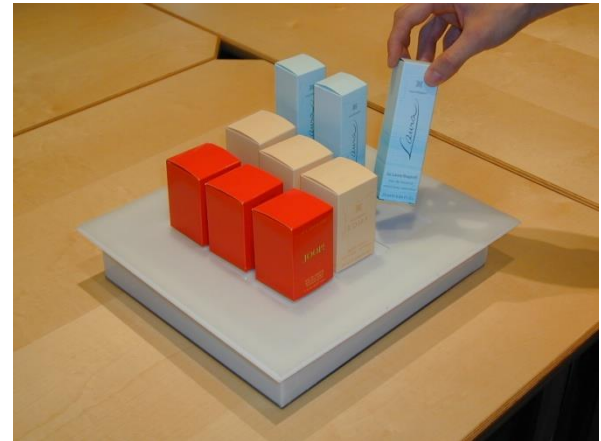
RFID Smart Shelves in Retail Stores: Overview

Smart Shelf with RFID technology

- Recognizes position of tagged products
- Sends state of shelf to back-end system

Back-end System

- Monitors state of shelf
- Recognizes
 - Misplacement
 - Expiration date
 - Out-of-Stock situation
 - Plan-o-gram compliance
- Triggers countermeasures
 - Sends orders to vendors
- Sends alerts to store staffs' mobile devices



Source: SAP AG

Outline

2. **Beyond RFID – How to construct smart shelves without tagging?**

Principle of Load Sensing

Load sensors under corners of a surface (e.g. pallet, shelf, floor) detect :

- Mass of objects on surface
- Position of objects on surface
- Interactions with surface, e.g. adding or removing objects

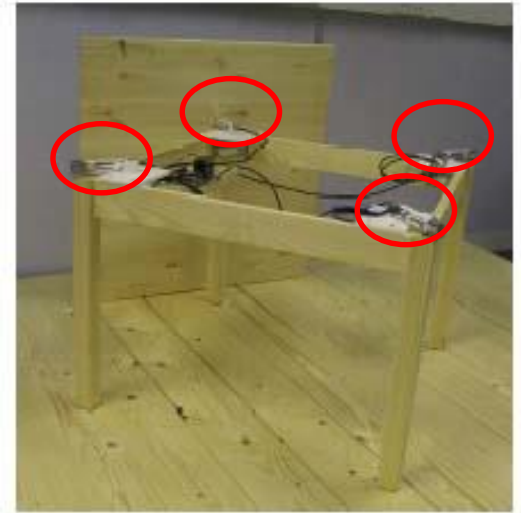


Table equipped with load sensors



1kg load sensor
(Photo: Bongshin)



50kg load sensor



50t load sensor
(Photo: Bongshin)

Basic Calculations

$F_i, 1 \leq i \leq 4$: Forces at sensors after action

$F0_i, 1 \leq i \leq 4$: Forces at sensors prior to action

$$F_x = \sum_{i=1}^4 F_i \quad F0_x = \sum_{i=1}^4 F0_i$$

Weight: $W = F_x - F0_x$

x_{\max} : length of surface

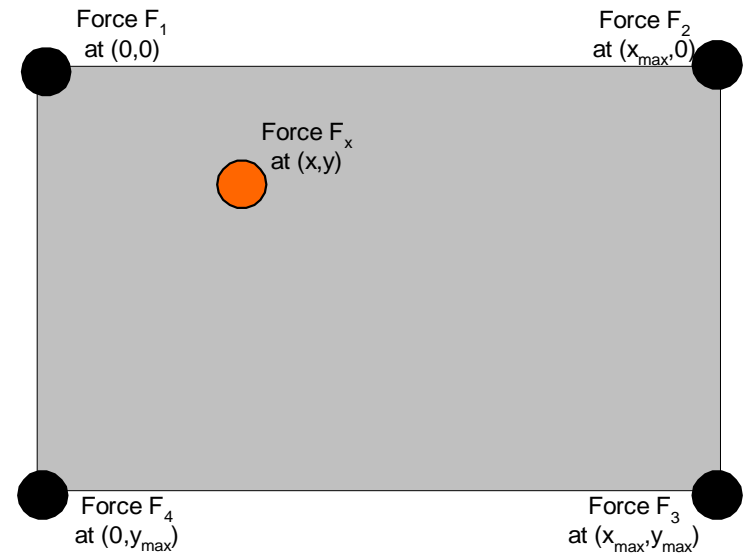
y_{\max} : width of surface

x : x-coordinate of point of action

$$x = x_{\max} \cdot \frac{(F_2 - F0_2) + (F_3 - F0_3)}{(F_x - F0_x)}$$

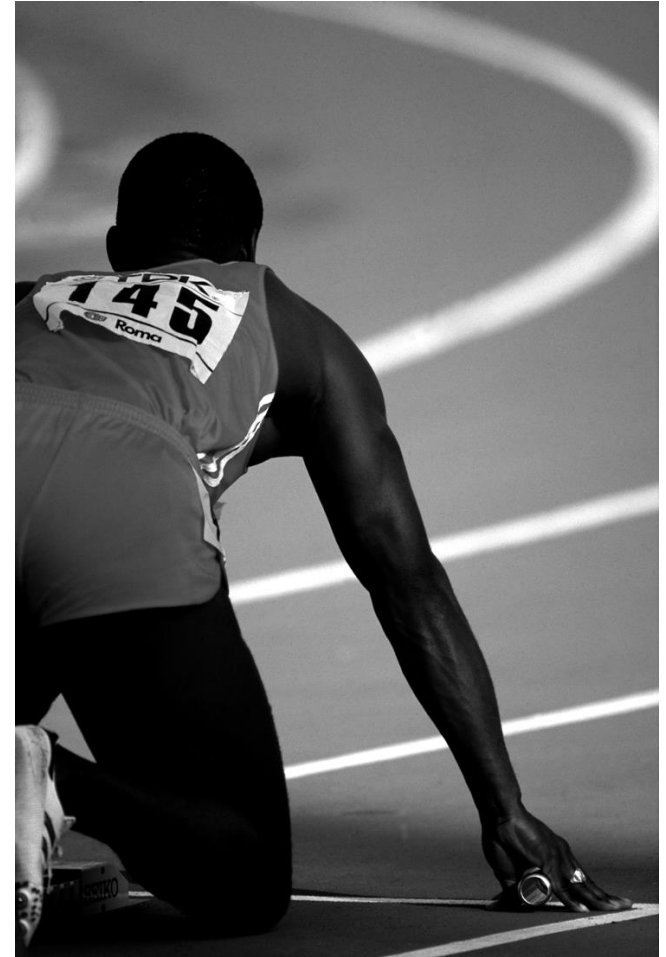
y : y-coordinate of point of action

$$y = y_{\max} \cdot \frac{(F_3 - F0_3) + (F_4 - F0_4)}{(F_x - F0_x)}$$



Advantages

- **Cheap:** load cells at less than \$100
- **Robust:** works in almost every environment (e.g. metal environment)
- **Everyday compatible:** no tagging of objects required
- **Flexible:**
 - Feasible for any kind of object
 - Feasible for any size of object (load cells from 1kg to 200t)



Source: SAP AG

Business Potential

Capabilities

- Object counting, e.g. number of items in a case
- Object tracking, e.g. trolleys in warehouse or finger on table
- Load balancing (trucks, helicopters, ...)

Application Areas

- Inventory management
- Warehouse management
- Supply chain management
- Transportation management



Source: SAP AG

Outline

3. Beyond RFID - Quality Management in Supply Chains

End-To-End Quality Management Goods



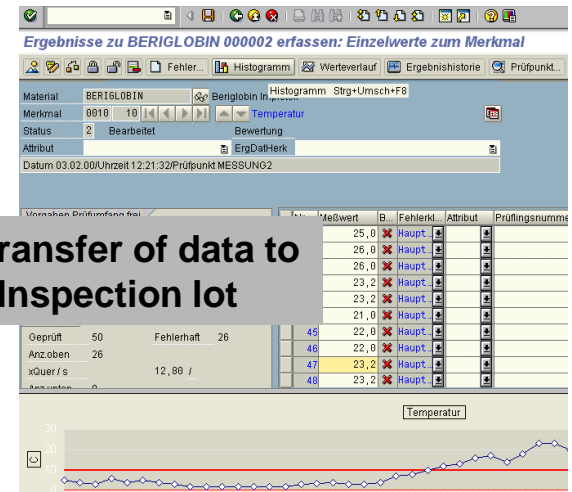
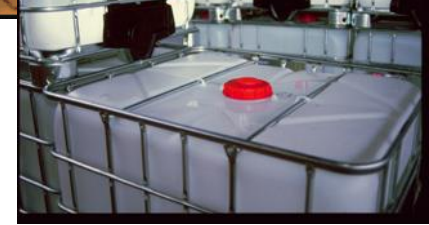
1. Vendor: Goods Issue



2. Carrier: Transportation



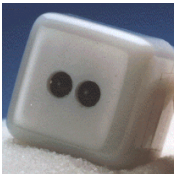
3. Customer: Goods Receipt



4. Transfer of data to Inspection lot



5. Usage decision



6. Reset Logger

Sensor-aided Supply Chain Monitoring

Technology

- Sensors (temperature, acceleration, ...)
- Local memory to store sensor and identification data
- Intermittent connection to backend

Example: ESYS - MINIDAN^{TEMP0,1}

- Temperature logging
- Temperature range: -40 ° C to +85° C
- Accuracy: 0.1 ° C or 0.5 ° C
- Storage: 16.000 to 32.000 values depending on accuracy

Potential

- Integrate shipping / transport of goods into Enterprise Quality Management processes



Source: SAP AG

Aware Goods @ Infineon

Scenario

- Shipley: Supplier for Infineon
- Polishing liquid for wafer production
- Liquid has to be transported within certain temperature range

Key Requirements

- Easy handling for customer and supplier
- One-step integration with SAP PLM avoiding manual data transfer

Solution

- Temperature logging during transportation based on ESYS MINIDAN^{TEMP0,1}



Source: SAP AG

Outline

4. Introduction Smart Items in Smart Cities of the Future



Digitalstadt Darmstadt (12-12-2017)

Browser tabs: „Auf Antwort von conenerg“, Google, AOL.de | Kostenlose Email, Logout-Timeout, SWR3 Verkehrszentrum - AI, Google, Digitalstadt Darmstadt: x

Address bar: www.echo-online.de/lokales/darmstadt/digitalstadt-darmstadt-projektteam-praesentiert-konzepte_18389839.htm

ECHO ONLINE / LOKALES / DARMSTADT

Darmstadt

14.12.2017

Digitalstadt Darmstadt: Projektteam präsentiert Konzepte



Die mögliche Optik einer Online-Plattform für Verkehrs- und Umweltdaten wurde im Fraunhofer SIT präsentiert. Foto: Daniel Baczyk

Anzeige

Mannheim - Prag ab 29,90€

Jetzt Ticket ab 29,90 € online buchen! bahn.de

Von Daniel Baczyk

DARMSTADT - Eine offene Internetplattform mit Echtzeit-Daten vom Darmstädter Verkehrsgeschehen sowie zu Umweltbelastungen, eine Parkplatz-App mit Informationen über freie Stellplätze, online abrufbare städtische Dienstleistungen und ein digitales Schaufenster des Darmstädter Einzelhandels; Das werden voraussichtlich einige der ersten Neuerungen sein, an denen für die Darmstädter Bürger der neue Status der Stadt als Digitale Stadt erfahrbar wird.

Ein halbes Jahr nach dem Gewinn des bundesweiten Wettbewerbs stellen Oberbürgermeister Jochen Partsch und die Geschäftsführer der neu gegründeten Digitalstadt Darmstadt GmbH über 100 Unterstützern am Dienstagabend im Fraunhofer-Institut für Sichere Informationstechnologie (SIT) die ersten Projekte sowie die Grundkonzeption des Digitalisierungsprozesses vor.

Weitere Empfehlungen

- DARMSTADT**
Status in der Heidelberger Straße
- DARMSTADT**
Jetzt soll vieles ausprobiert werden
- DARMSTADT**
Finanzspritze aus Wiesbaden
- GROß-GERAU**
Typisiersaktion für Mathilda
- RHEIN-MAIN**
Rüsselsheim droht die Zahlungsunfähigkeit

Digitale Stadt

- RIEWELMADDDHES
- HISTORISCHES
- CITYZEITUNG

Regionale Partner

Anzeige

HÖCHSTE QUALITÄT FÜR IHREN MOTOR

Mit TOTAL QUARTZ Motorölen sind Sie immer bestens gerüstet.

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Schließen

The Challenge

The world's cities are on a collision course with the future.

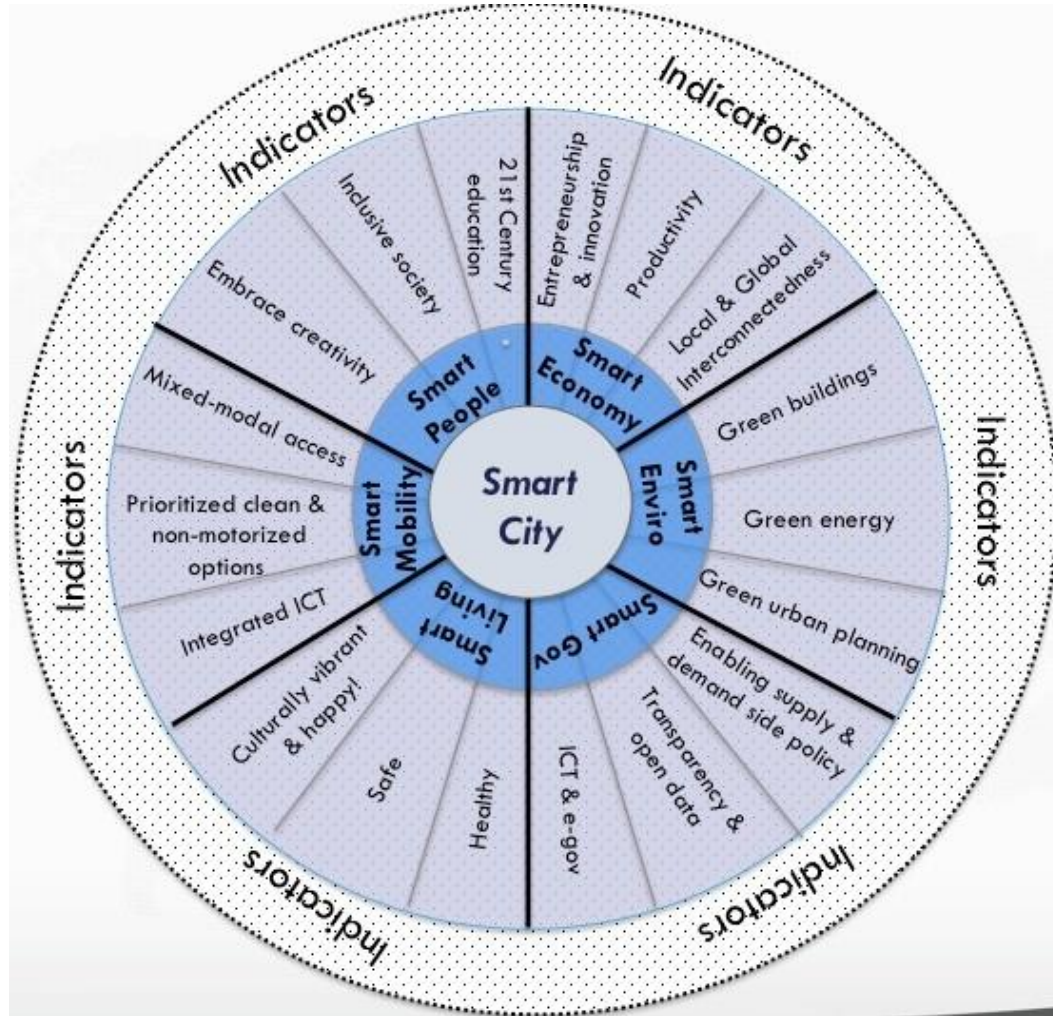
- 1 million people move to cities every day
- 1 billion people call slums home today
- There are 21 megacities with over 10 million people
- China alone will create 81 new major cities by 2025

By 2050, cities will be home to 70% of the world's people. This rapid urbanization is will increasingly stress city resources, leaders and citizens. Fortunately, technology can play an enormous role in naming our cities smarter and much more livable, workable and sustainable.



Source: smart cities council brochure

Smart Cities Wheel



source: Boyd Cohen, <http://smartcitieshub.com/2012/11/11/smart-cities-ranking-methodology/>



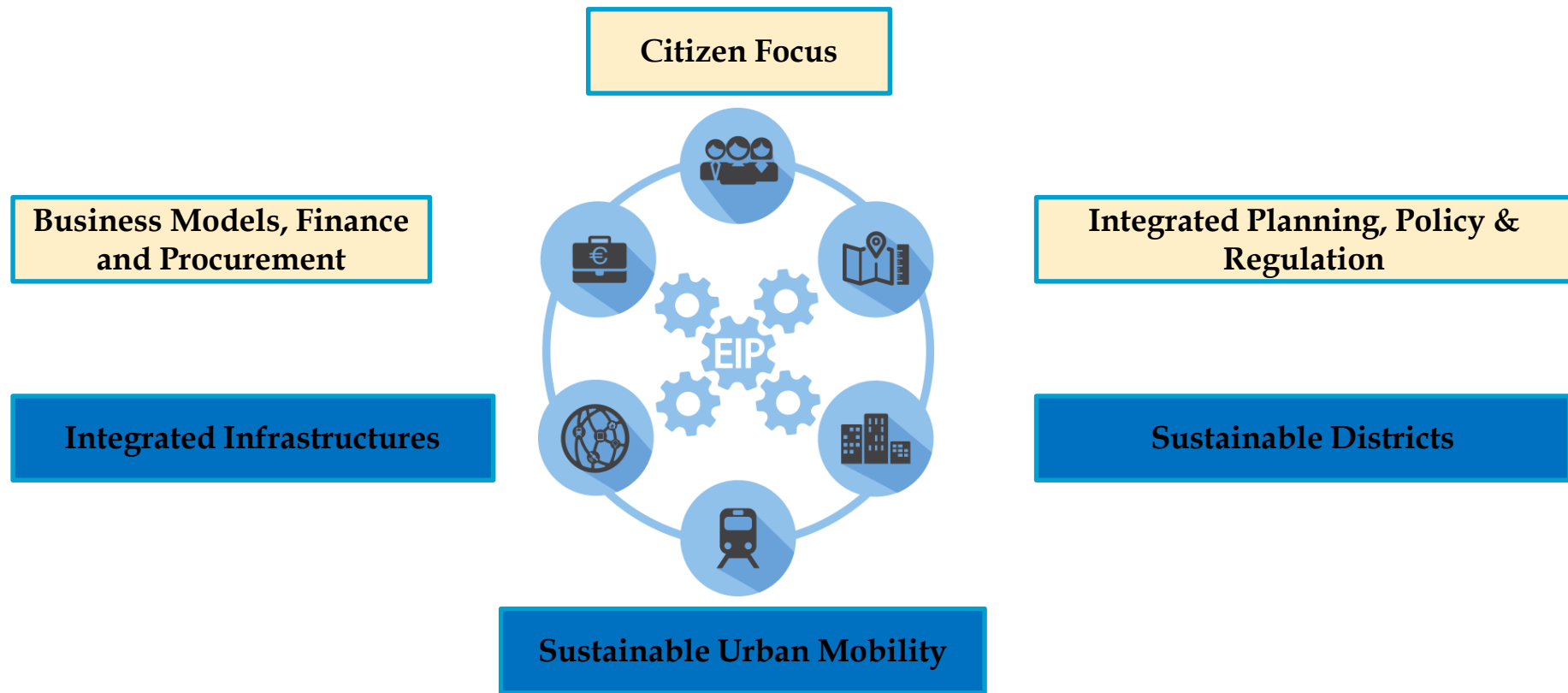
European Innovation Partnership on Smart Cities and Communities

The EIP-SCC is an initiative supported by the **European Commission**.

Aiming at overcoming market fragmentation, the EIP-SCC brings together **cities, industry, financiers, citizens** to improve urban life through more sustainable integrated solutions.

Its Market Place has already **5.300 members from 31 countries**.

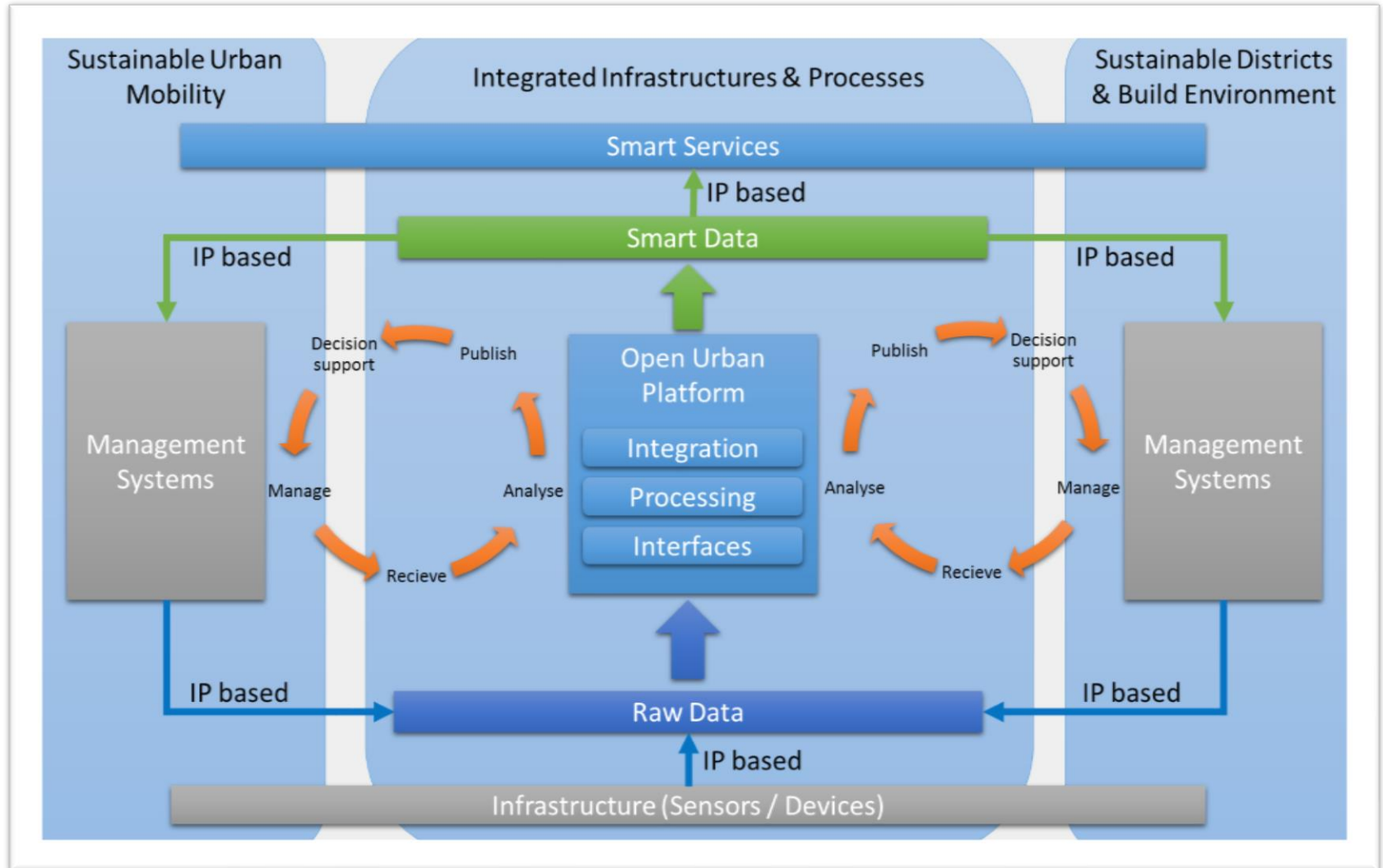
Structure of EIP SCC



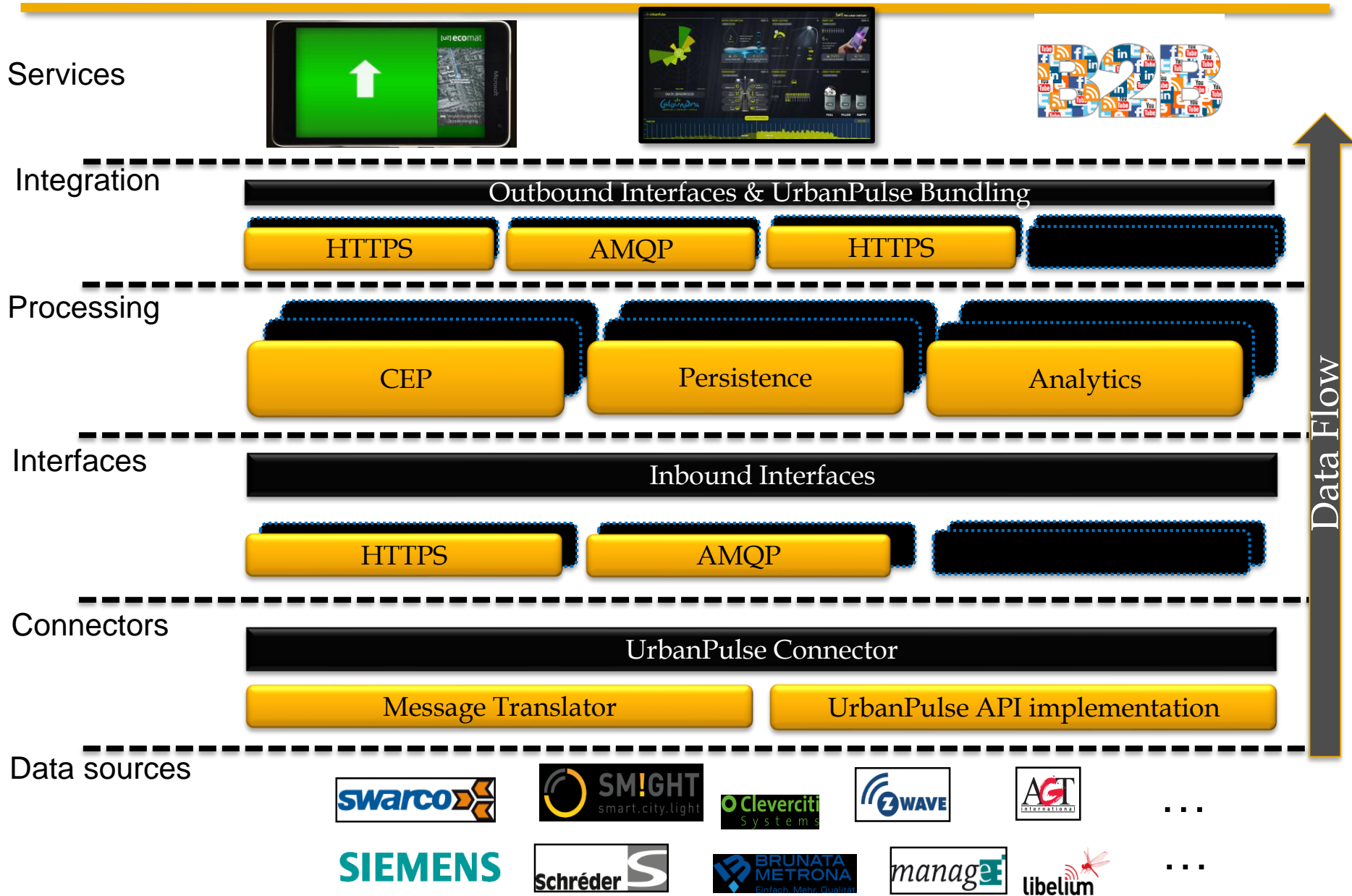
Outline

5. Open Urban Platforms

Reference Architecture



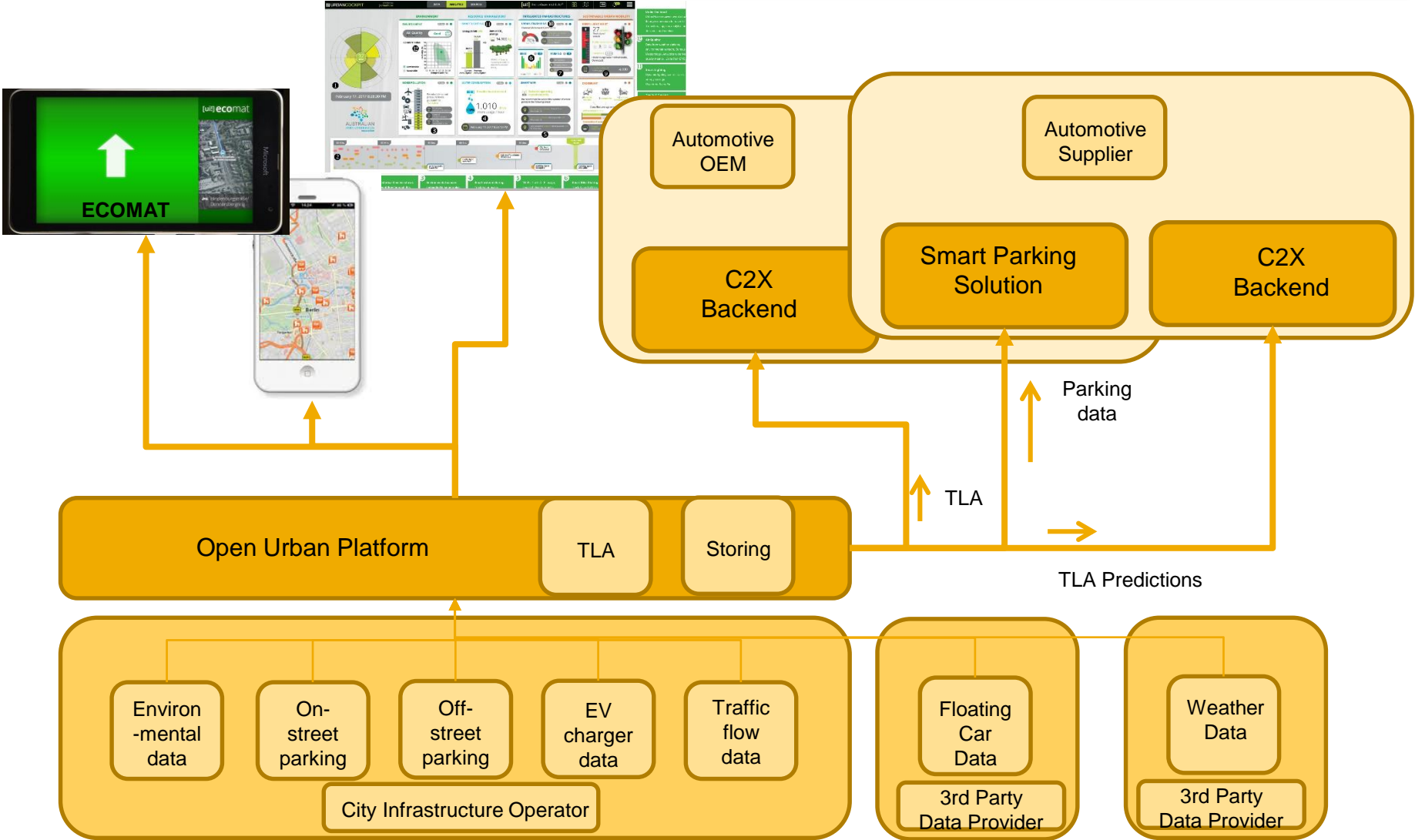
Mapping of the Reference Architecture to a concrete System Architecture



High Level System Architecture Of Sustainable Urban Mobility



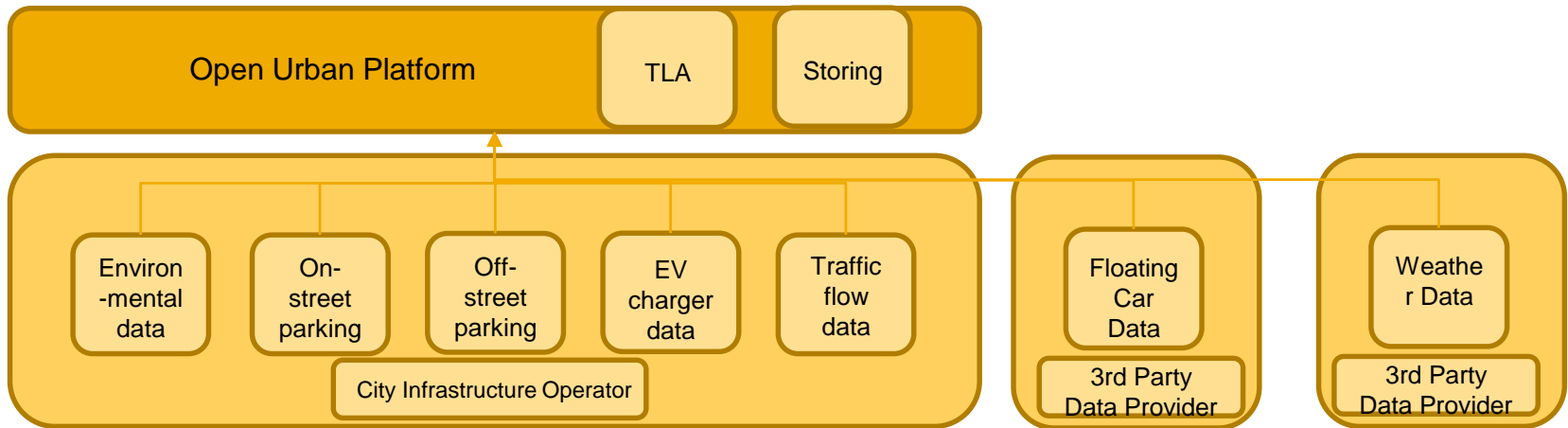
Implementation Architecture of an OUP for Sustainable Urban Mobility



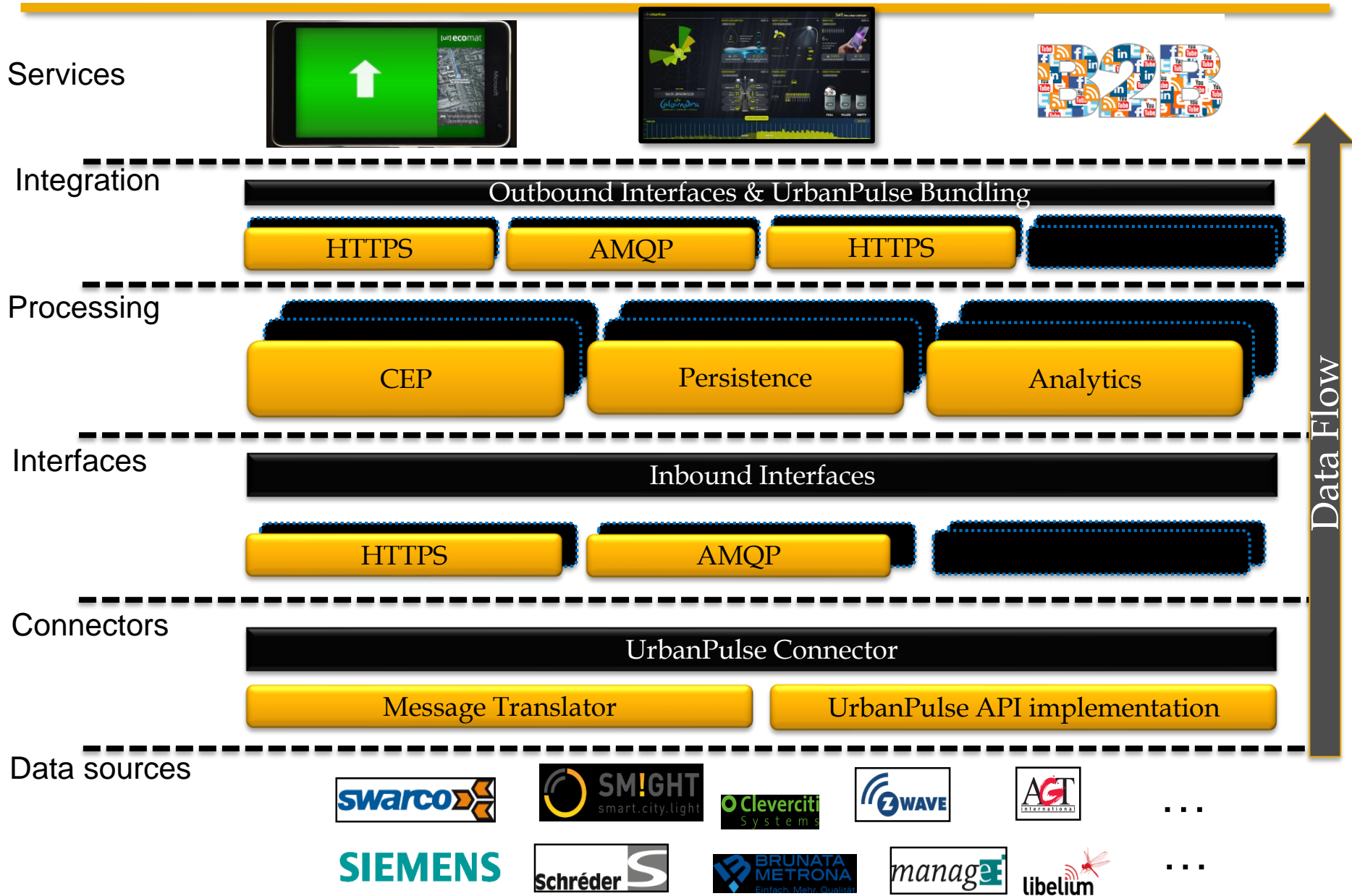
Urban Data Sources including Smart Items

Data Collection

- **Multiple sources**
- **Harmonizing data sets via CONNECTOR layer**
- **Storing data for multi-channel provisioning**



Connector Layer



Connector Architecture

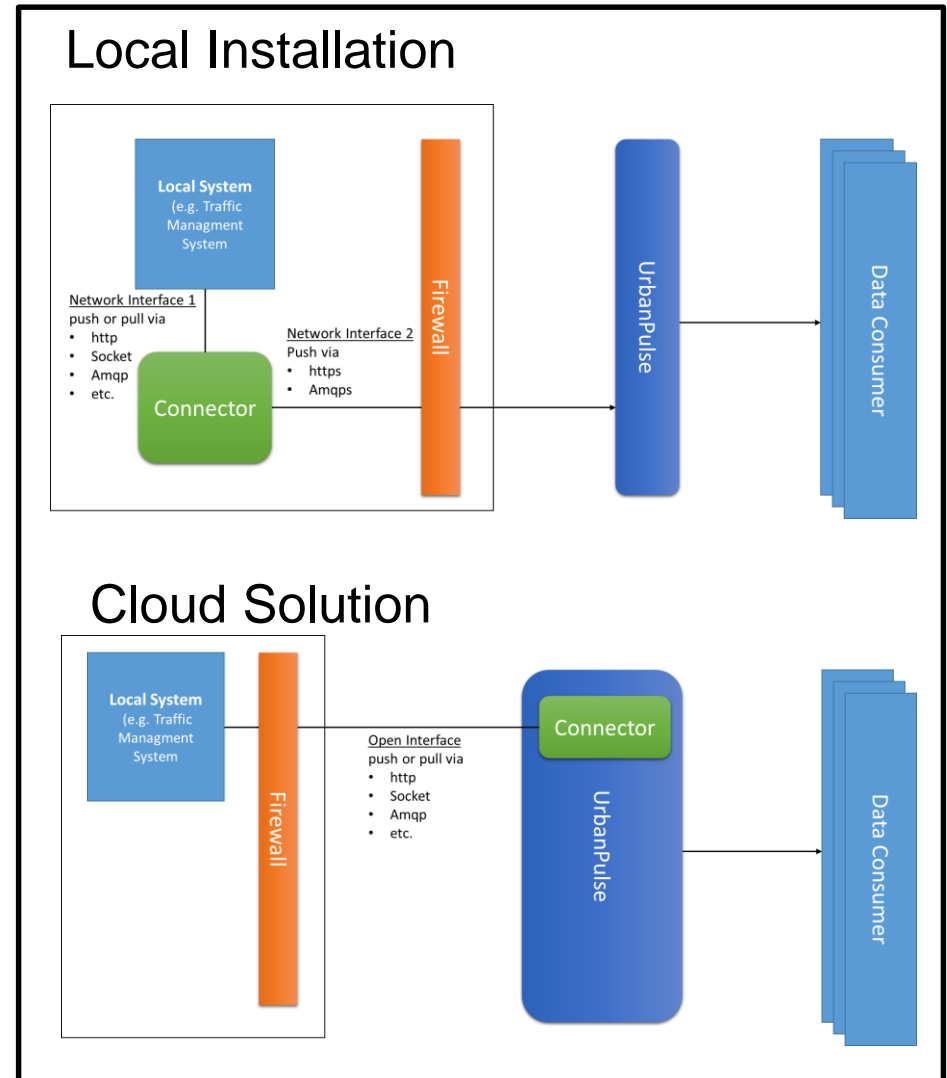
Connectors can be operated locally or in the cloud.

Supported communication protocols

- TCP/UDP
- HTTP(S)
- Web socket
- Amqp
- And if needed, more...

Benefits

- Easy
- Simple
- Scalable



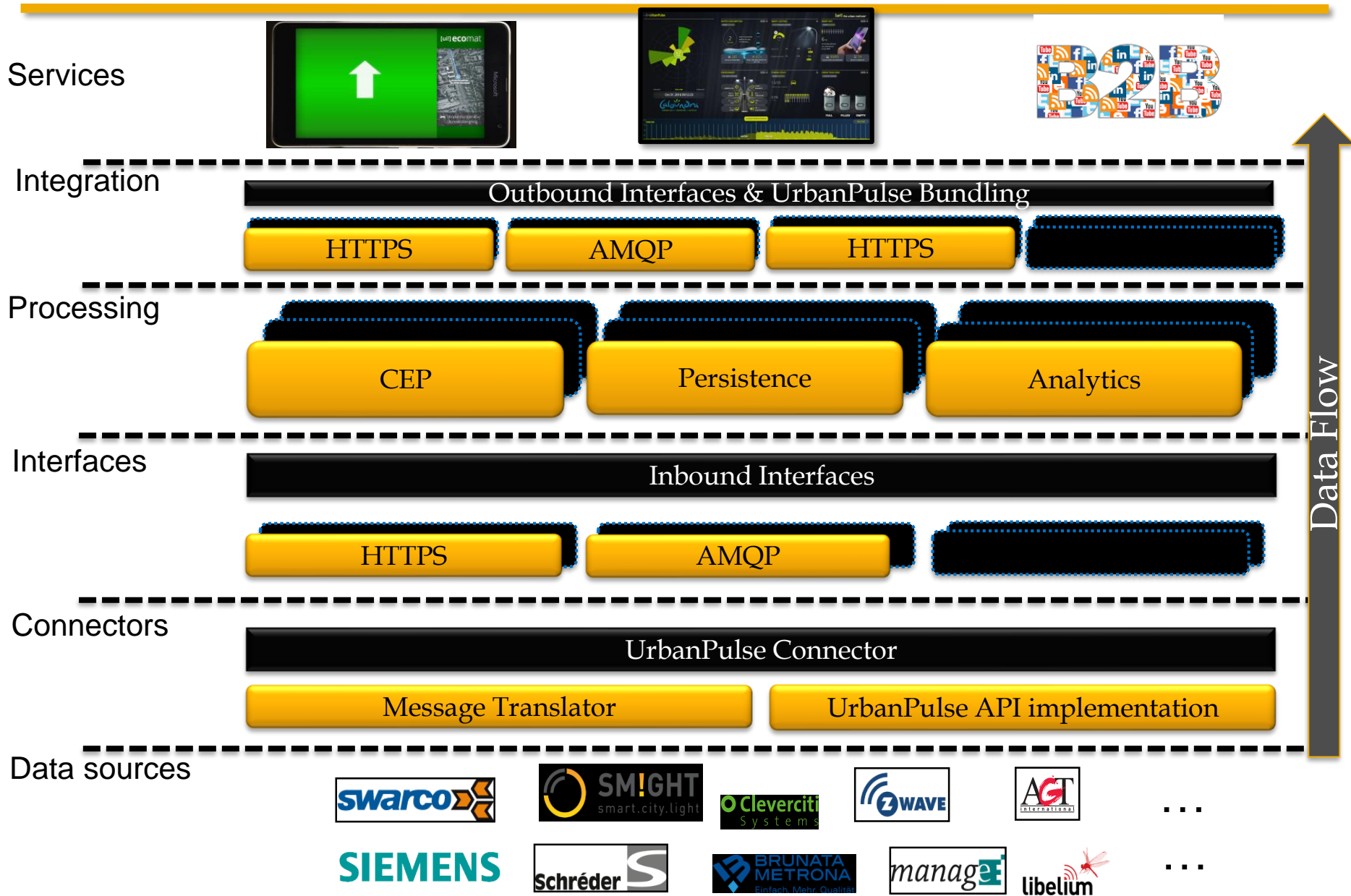
UrbanPulse - Connectors



```
public class ProcessingVerticle extends DefaultProcessingVerticle {
    /**
     * @param event
     * @return EnBW event type name mapped from 'sensorTyp' field, null in case of null or
     invalid field
     */
    @Override
    public String getEventTypeName(JsonObject event) {
        String sensorTyp = event.getString("sensorTyp");
        if (null == sensorTyp) {
            container.logger().warn("null 'sensorTyp' field!");
            return null;
        }

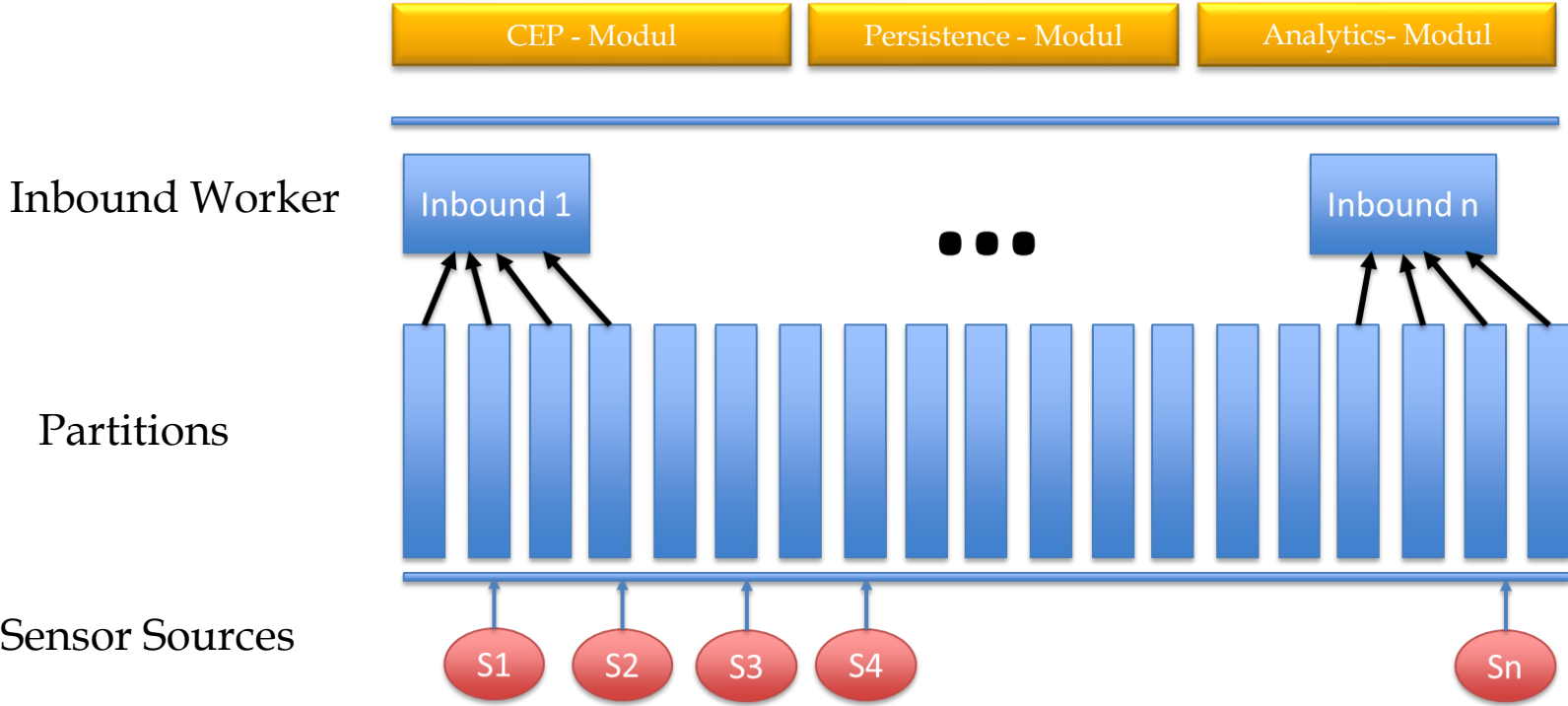
        switch (sensorTyp) {
            case "Dust detector":
                return "DustEventType";
            case "Ambient Light V2":
                return "AmbientLightEventType";
            case "Barometer":
                return "BarometerEventType";
            case "Humidity":
                return "HumidityEventType";
            case "Sound Intensity":
                return "SoundIntensityEventType";
            case "Temperature":
                return "TemperatureEventType";
            default:
                container.logger().warn("unsupported 'sensorTyp' value: " + sensorTyp);
                return null;
        }
    }
}
```

Inbound Interface

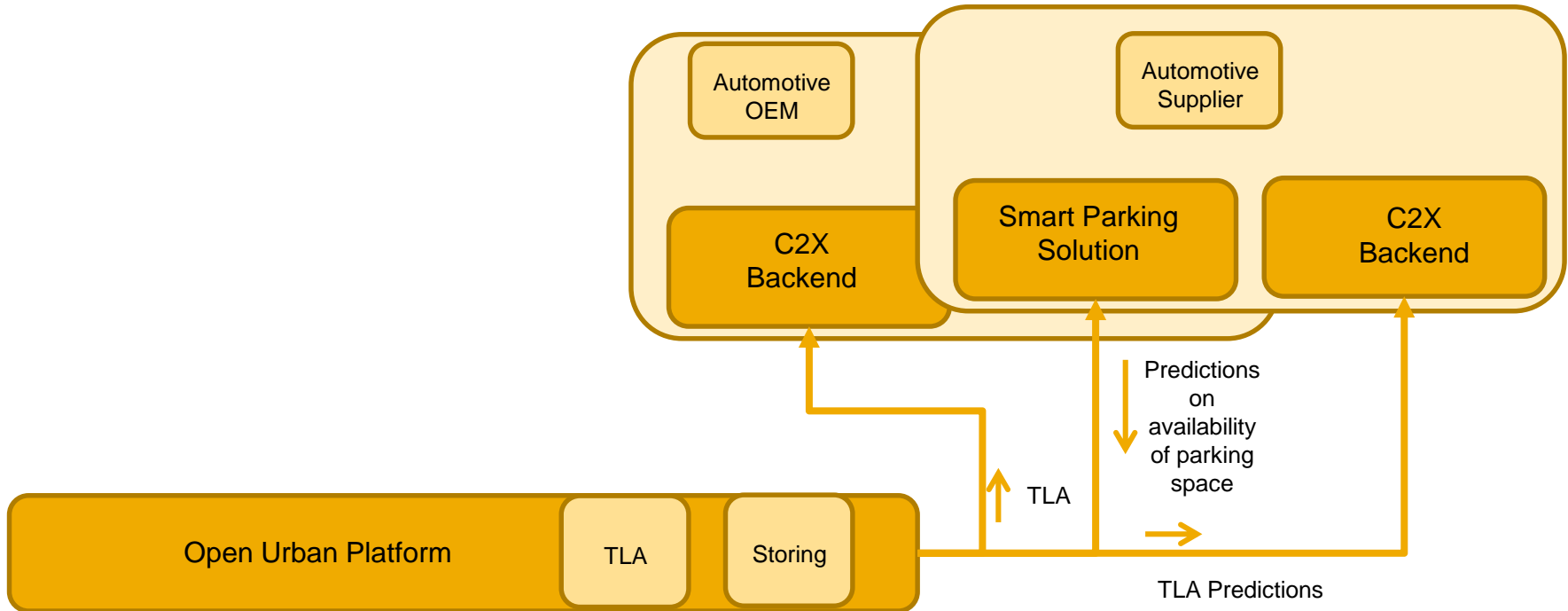


Inbound Interfaces

High performance and scalable interface for Events.



Predictions & Backends

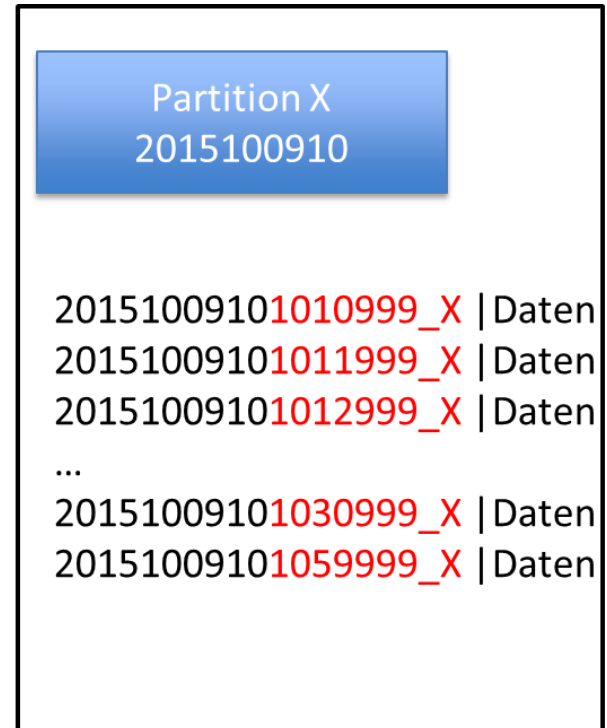
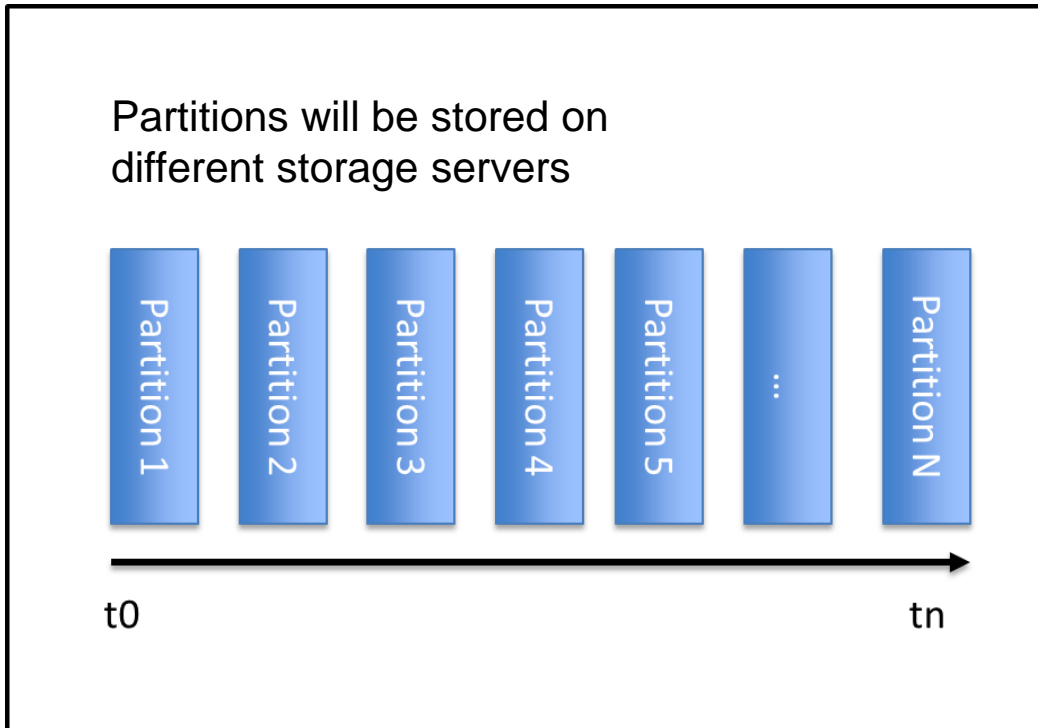


Data Processing & Provisioning

- **Combining different data sets**
- **Pre-Processing (e.g. TLA)**
- **Real-time Provisioning (sub-second)**
- **SLA & Licensing for smart data**

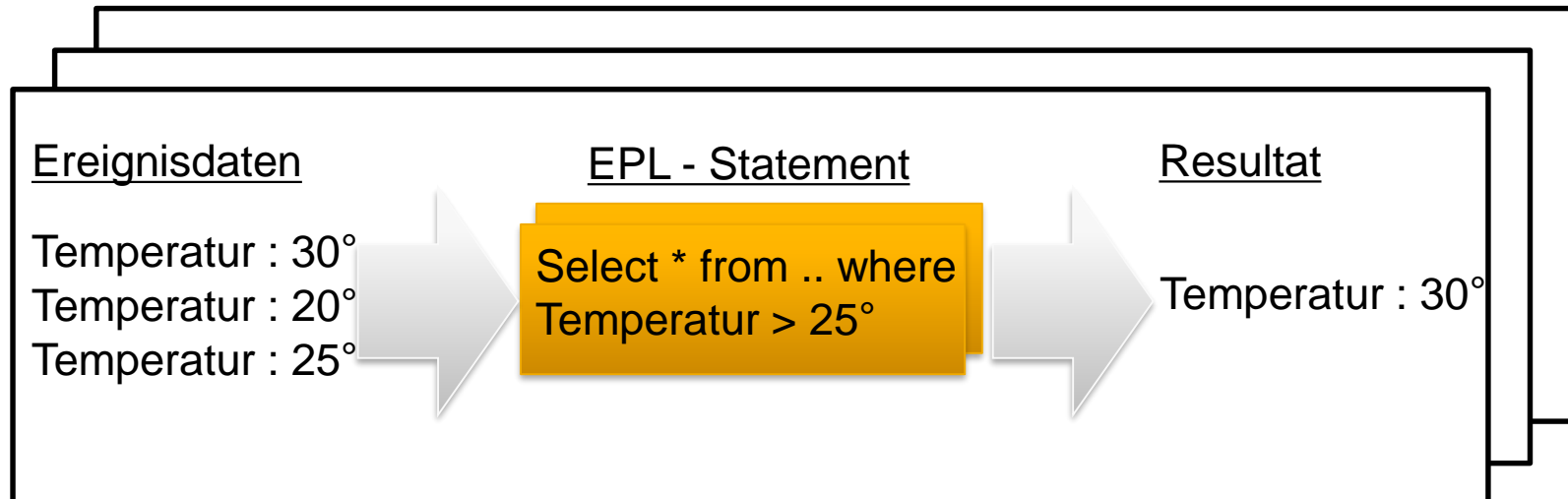
UrbanPulse - Persistence

High performance and scalable storage structure for events

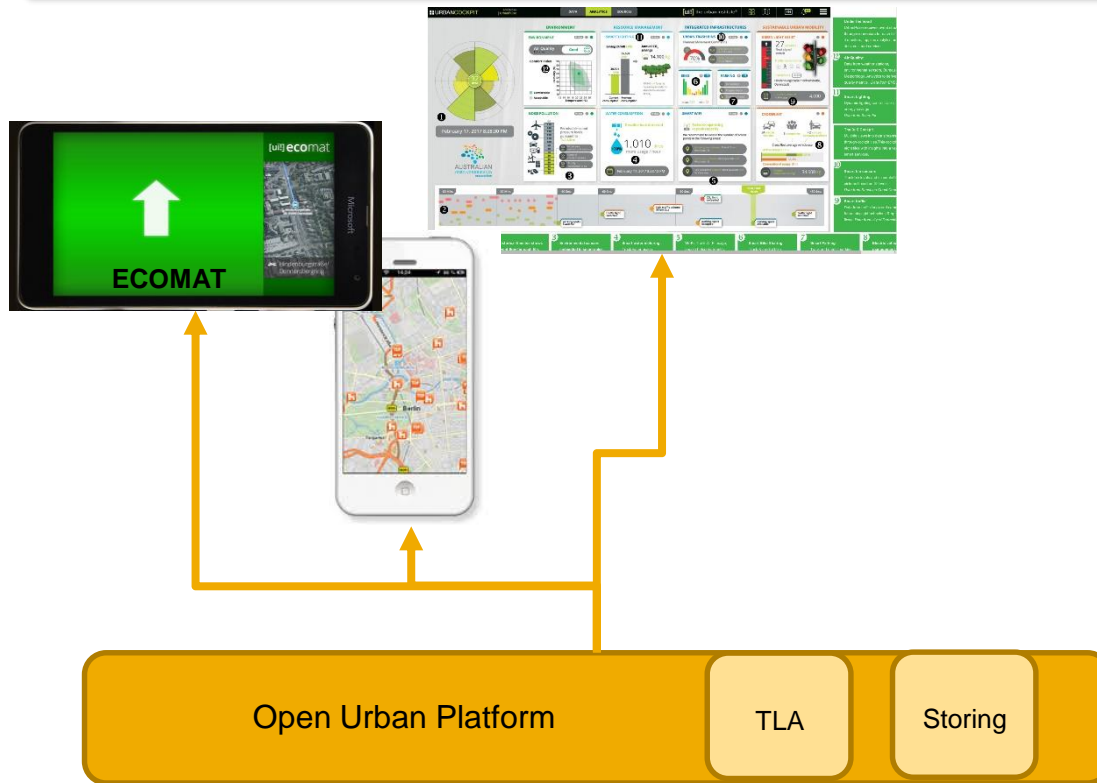


UrbanPulse – Complex Event Processing

Complex Event Processing Module to select and aggregate events



End User Experience

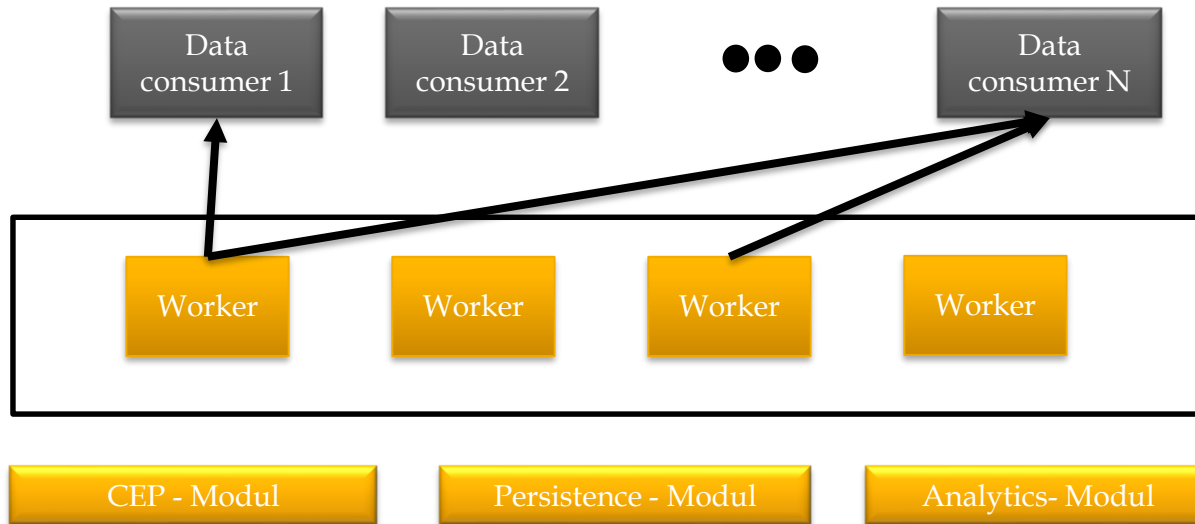


Service Provisioning & Bundling

- Multiple output channel
- Combining services from third parties
- SLA and Licensing

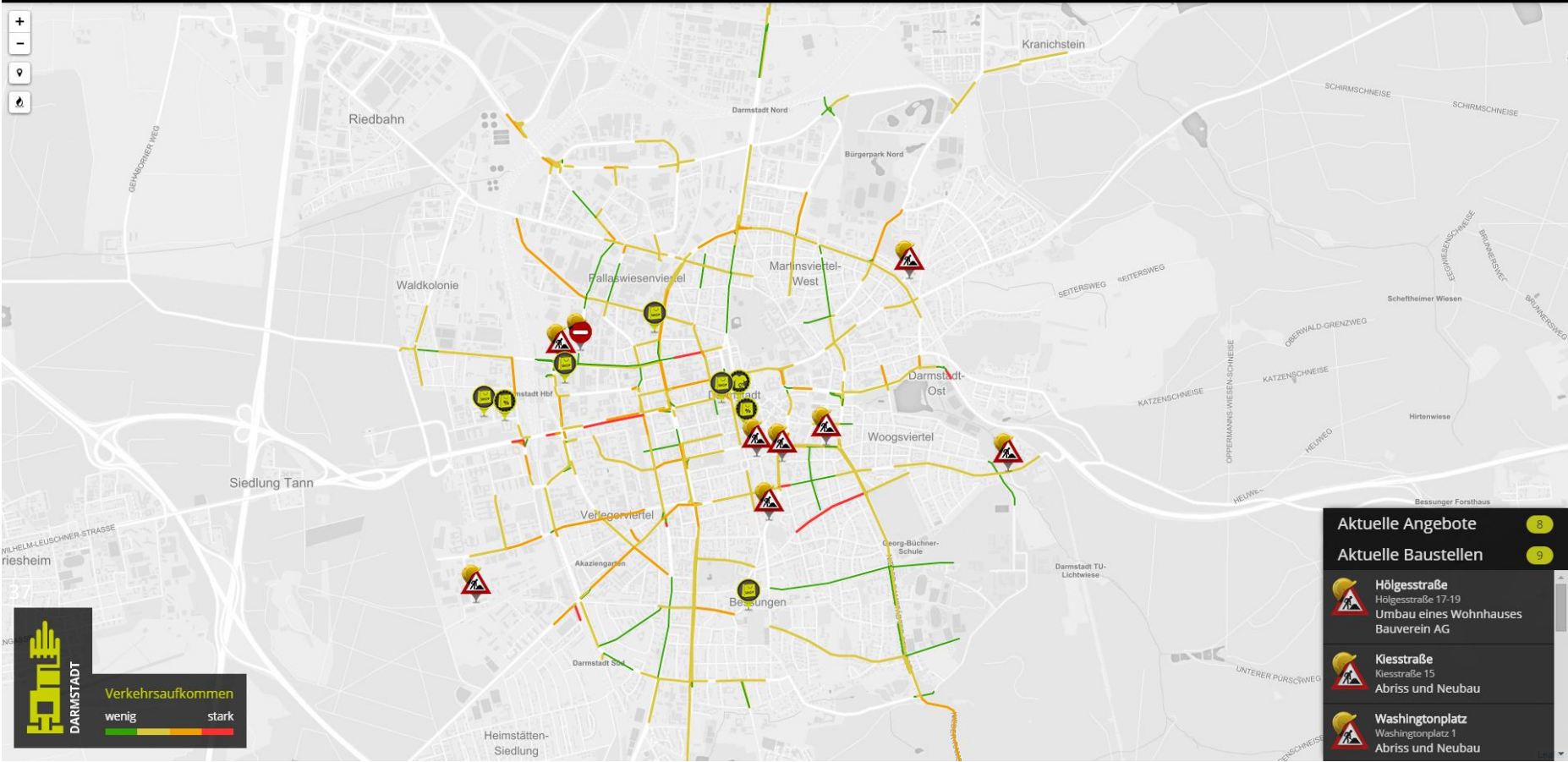
UrbanPulse – Outbound Interfaces

Worker of Outbound Interfaces distribute the Data to different consumers

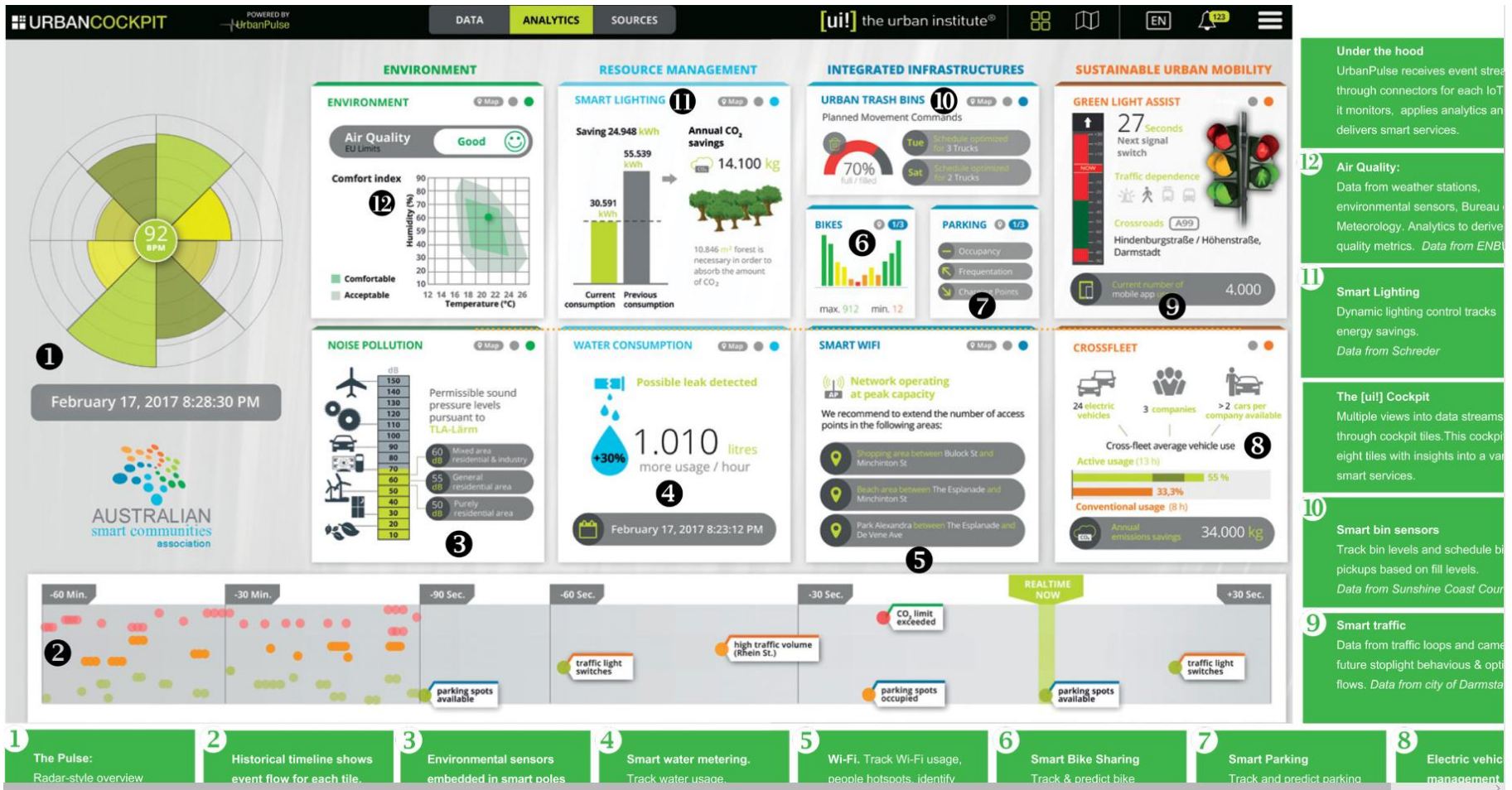


Traffic App (www-darmstadt.ui-traffic.de)

[uil] TRAFFIC



Visualizatiuon using [ui!] Cockpit



- 12 Under the hood**
UrbanPulse receives event stream through connectors for each IoT it monitors, applies analytics and delivers smart services.
- 12 Air Quality:**
Data from weather stations, environmental sensors, Bureau Meteorology. Analytics to derive quality metrics. *Data from ENB*
- 11 Smart Lighting**
Dynamic lighting control tracks energy savings. *Data from Schreder*
- The [ui!] Cockpit**
Multiple views into data streams through cockpit tiles. This cockpit eight tiles with insights into a vast smart services.
- 10 Smart bin sensors**
Track bin levels and schedule pickups based on fill levels. *Data from Sunshine Coast Cour*
- 9 Smart traffic**
Data from traffic loops and camera future stoplight behaviour & optimize flows. *Data from city of Darmstadt*
- 8 Electric vehicle management**
- 7 Smart Parking**
Track and predict parking
- 6 Smart Bike Sharing**
Track & predict bike
- 5 Wi-Fi. Track Wi-Fi usage, people hotspots, identify**
- 4 Smart water metering.**
Track water usage.
- 3 Environmental sensors embedded in smart poles**
- 2 Historical timeline shows event flow for each tile.**
- 1 The Pulse: Radar-style overview**

Visualization of urban Data based on data analytics used by cities to understand their current urban data portfolio and how to address pressing issues (ASCA Guide)

Outline

6. Group Exercise - Q & A