Auditing and Assessement of data traffic flows in an IoT Architecture

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- by inspecting the DevDash tool time trend

Speaker

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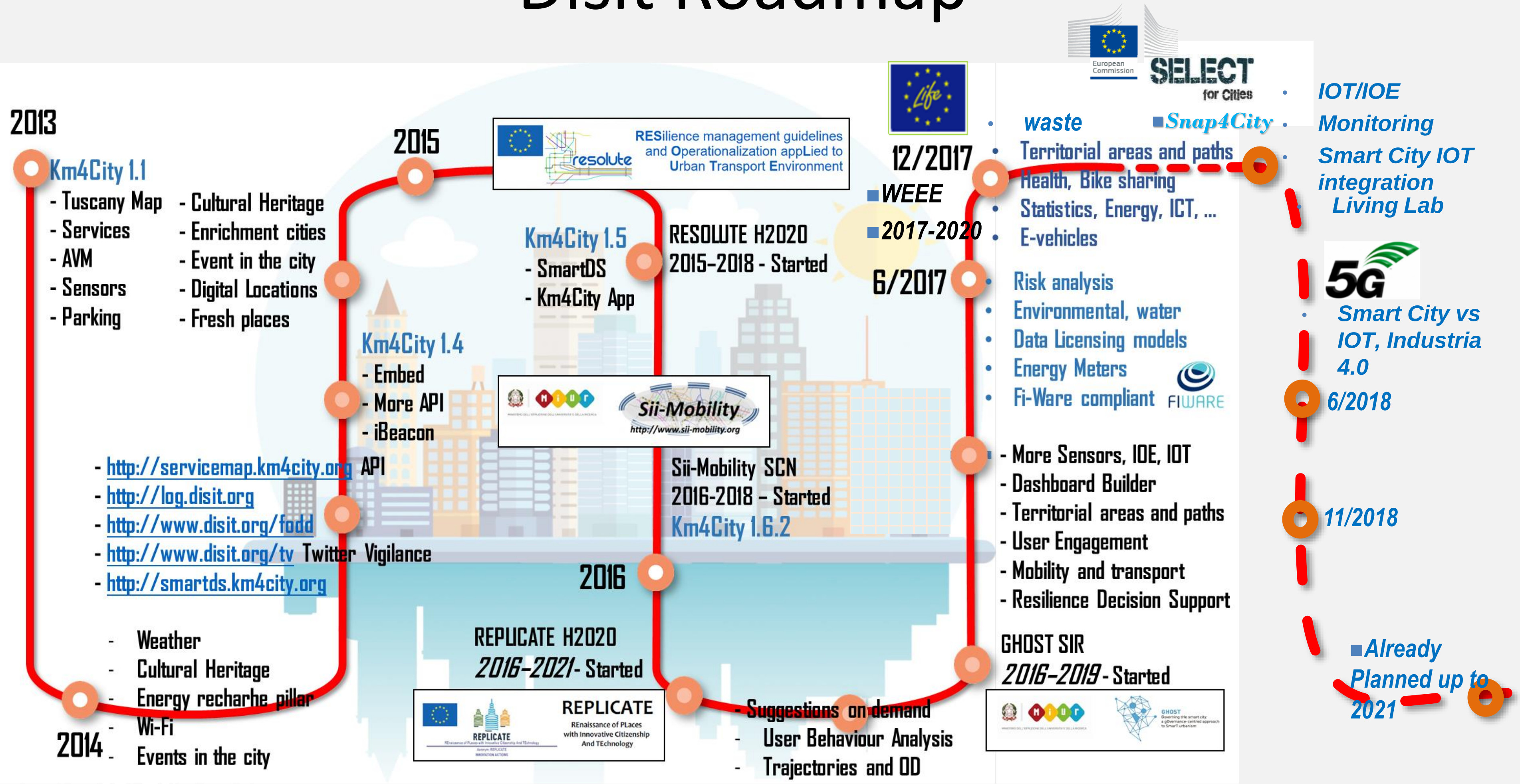
Disit Roadmap



Smart Cities / IoT Solutions features

- Collect Big Data from the cloud of city sensors and IoT devices
- Provide to final users a set of tools and items to easily access, read and monitor the_ingested data
- Give the possibility to build applications to visualize, process and perform different kinds of data analytics

Smart City Requirements (1)

- I) Necessity of minimizing the problems induced to data-driven applications:
  - storing continuously last values from all devices
  - collecting historical trends generated by the ingestion of last values cumulated over time (data caching on IoT)
  - enriching ingested data (LOD, SC semantic KBs, ontologies and repositories)
- II) Necessity of quantitatively monitoring messages/data flows in order to detect anomalies and problems in data traffic

Data Flows (1)

- IoT Devices
  - providing/receiving data to/from: IoT Brokers, IoT Apps, control messages to IoT devices (e.g. red lights, video cameras, signage, etc.) mainly via http carrying other protocols such as MQTT, NGSI, etc.
- IoT Brokers
  - providing/receiving data in push/pull
- Data Transformation Processes
  - ETL (Extract, Transform and Load) processes for data warehousing, which collect data in pull/get or through http/https/ftp/ftps/WS-soap, etc., protocols

Data Flows (2)

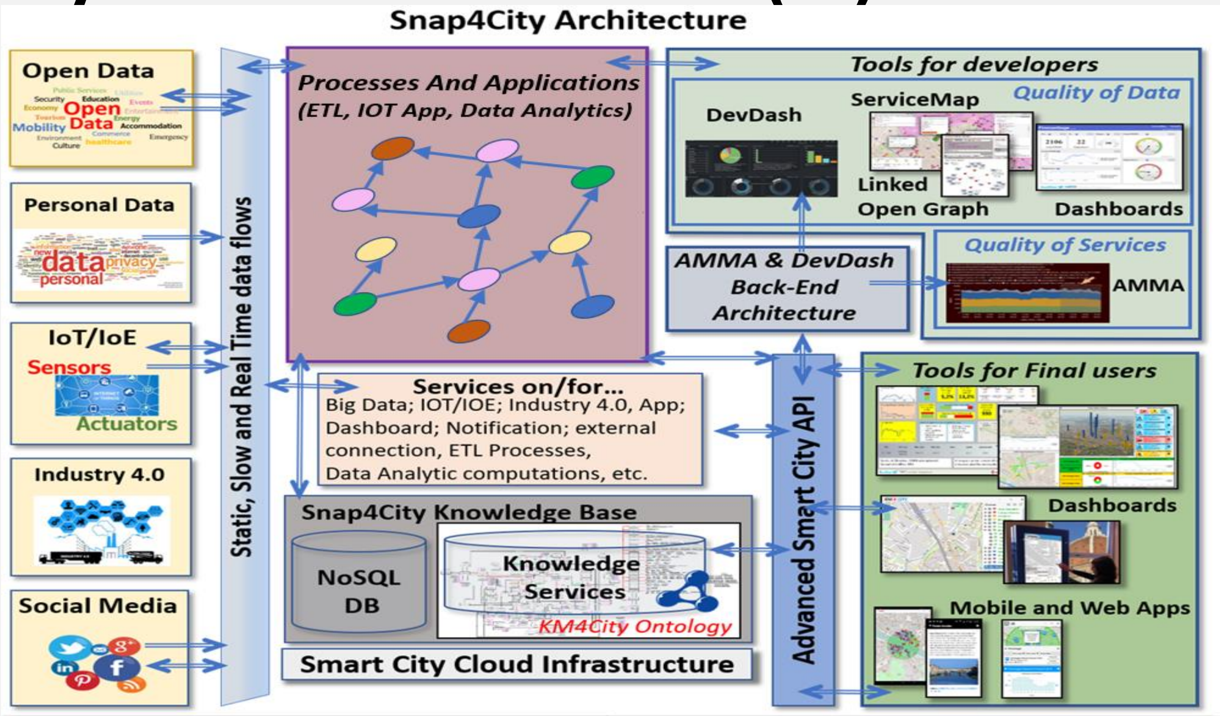
- Data stream processing data coming from
  - video cameras and other several kinds of sensors (weather, air quality, traffic flows, levels of water in rivers and underpasses, etc.)
- Dashboards
  - web representation of data regarding the city status that can be represented in several control rooms
- Resource and Data portals
  - provide, receive and manage a set of resources
- Database storage
  - MySQL, NoSQL, HBase, Mongo, Virtuoso, etc.

Snap4City Architecture

- The general purposes of the Snap4City system are:
  - Collect data from external sources
  - Semantically aggregate
  - Exploiting data by data analytics and produce new knowledge and services for the users:
    - Traffic flow reconstruction
    - Routing
    - Predictions: on free parking, on traffic flows
    - Points of Interest (POI)
    - Smart City services: bike sharing, first aid, public transportation, smart waste management, air quality monitoring, weather reports and predictions, city events and entertainments, etc.

Snap4City Architecture (2)

- Data to be collected come from: OD, RT data, personal data, IoT/IoE, stream, data driven, Industry 4.0, Social Media, etc. (any kind of source, protocol and format)



- Consists of a set of tools to cope with the whole process of ingestion, collection, analysis of data

Snap4City tools for monitoring traffic flows

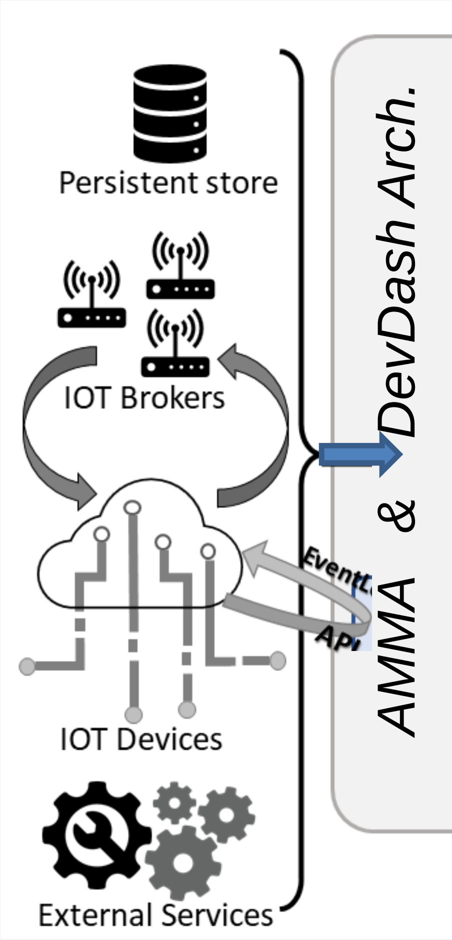
- The Snap4City system deals with large amounts of IoT devices generating a large number of communication and data flows
- It is necessary to monitor the proper working of the whole system and provide tools to understand potential malfunctions and recover the fully working conditions
- To this end, dedicated tools have been designed and implemented in the Snap4city platform:
  - **DevDash** and **AMMA**

Developer Dashboard (DevDash) tool

- Developer Dashboard (DevDash) tool is a data Value control tool aiming at:
  - collecting, enriching and indexing data coming from IoT devices
- Application & Microservices Monitoring and Analyzer services (AMMA) tool
  - is a data flow control tool for real-time monitoring and analyzing traffic flows
- DevDash and AMMA share the same back-end framework

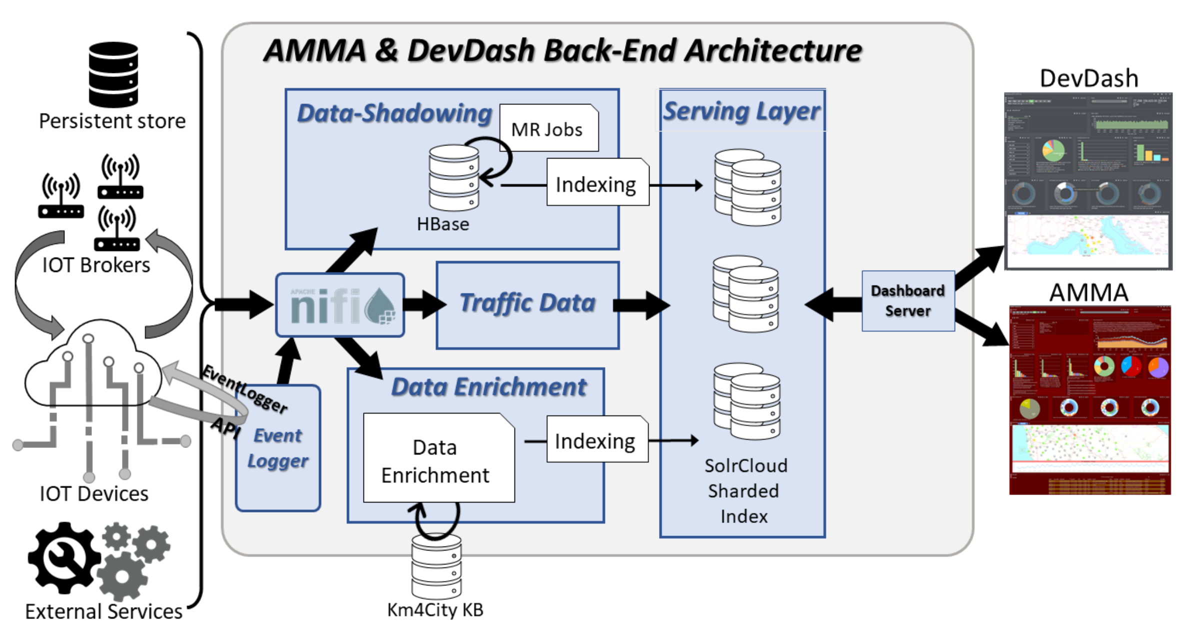
DevDash and AMMA back-end Architecture

- Input data are collected in real-time by:
  - Persistent storage (NoSQL database)
  - IoT Brokers (which store the current value of IoT device until it is consumed)
  - Directly from the IoT devices.



DevDash and AMMA back-end Architecture

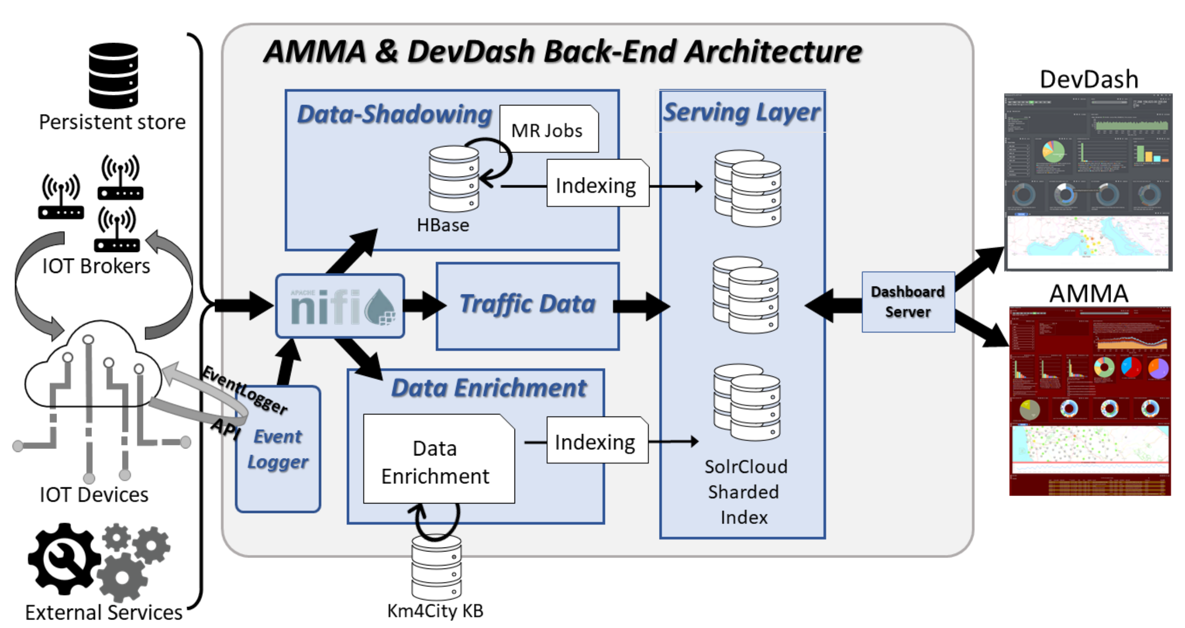
- The EventLogger role is to study the resource consumption of services and applications
- Each Snap4City application /service, finalized to data collection, is provided with a dedicated logging block sending event-driven or scheduled messages to the EventLogger (APIs exploiting the RSyslog protocol)



- All data the ingested are processed by a module exploiting the open source Apache NiFi tool

DevDash and AMMA back-end Architecture

- Apache NiFi is used to manage and optimize Big Data streams, operating also data transformation to properly prepare and adapt data for further processing, storage and indexing



- The obtained data stream is dispatched to Data-Shadowing, the Traffic Data and the Data Enrichment modules for: additional processing, storing (Apache HBase) and indexing
- The frontends are based on Banana Web-app, an open source data visualization tool developed as a port of Kibana

DD &AMMA – Visual Tools (1)

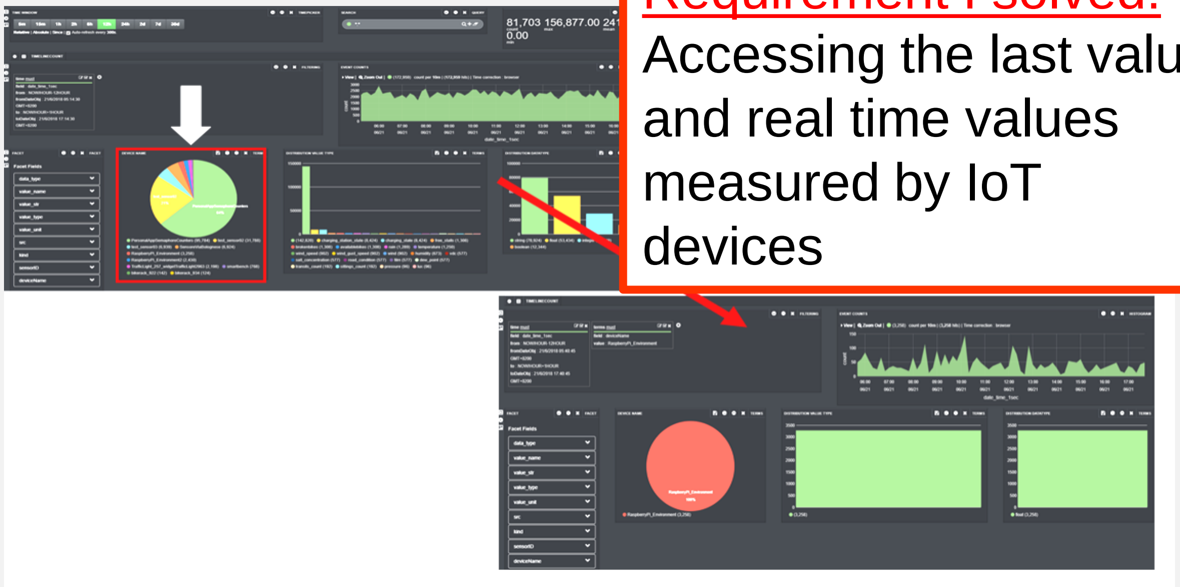
- DevDash:
  - Allows users to apply filters in succession, until they reach the data view of interest for their purposes: i) download data; ii) consult data details; iii) send data to Data Analytic tools
- AMMA
  - Monitors and controls all the communication activities in Snap4City, in terms of data flows and traffic
  - Allows to make analysis of the indexed EventLogger data for exploring distinct aspects of the data flows

DD &AMMA – Visual Tools (2)

- AMMA and DevDash includes a set of dashboard widgets:
  - histograms, time-pickers, filters, facet selection on the different kind of data managed, heatmaps, pie charts, tables, and also newly created panels, such as a SC linked map with geo-faceting graphical filtering capabilities
- All these widgets are useful to perform real-time drill down activities on the data flows:
  - panning/zooming in time, in space, and navigating in kind via faceted solution and indexes, searching in text in a certain context, in terms of relationships among entities, etc. to arrive at the end at precise selection, at the single value on the graph or table
- Solr facet search functionalities provides the real-time analytic processing layer which is required for producing dynamic visualizations and different views on data

DevDash Case Study (1)

- Check the status of IoT devices and related data traffic

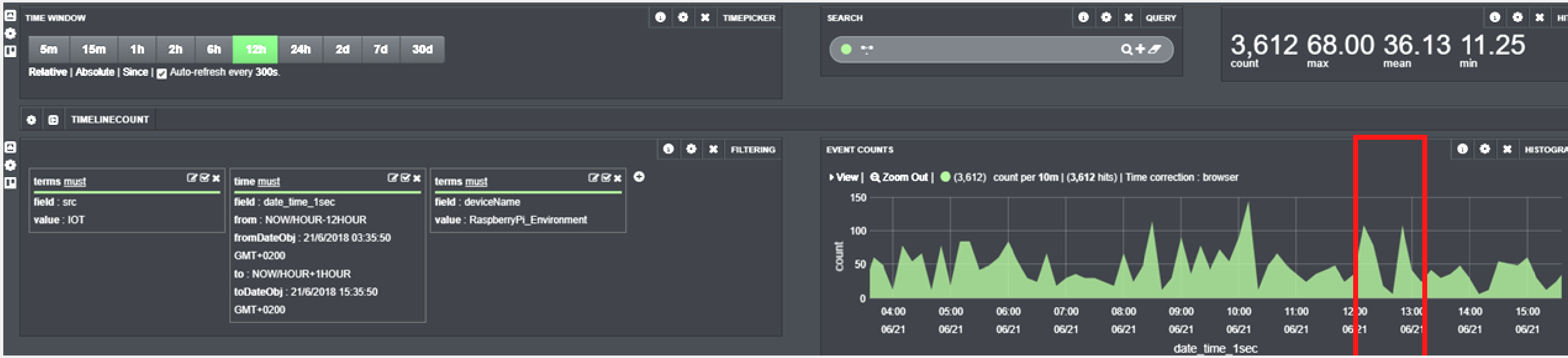


Requirement I solved: Accessing the last value and real time values measured by IoT devices

- Drill-down on single data related to a single IOT:
  - filtering on time: the single data portion corresponding to the unexpected data flow can be viewed

DevDash Case Study (2)

- Detect potential anomalies or disfunctions by inspecting the DevDash tool time trend

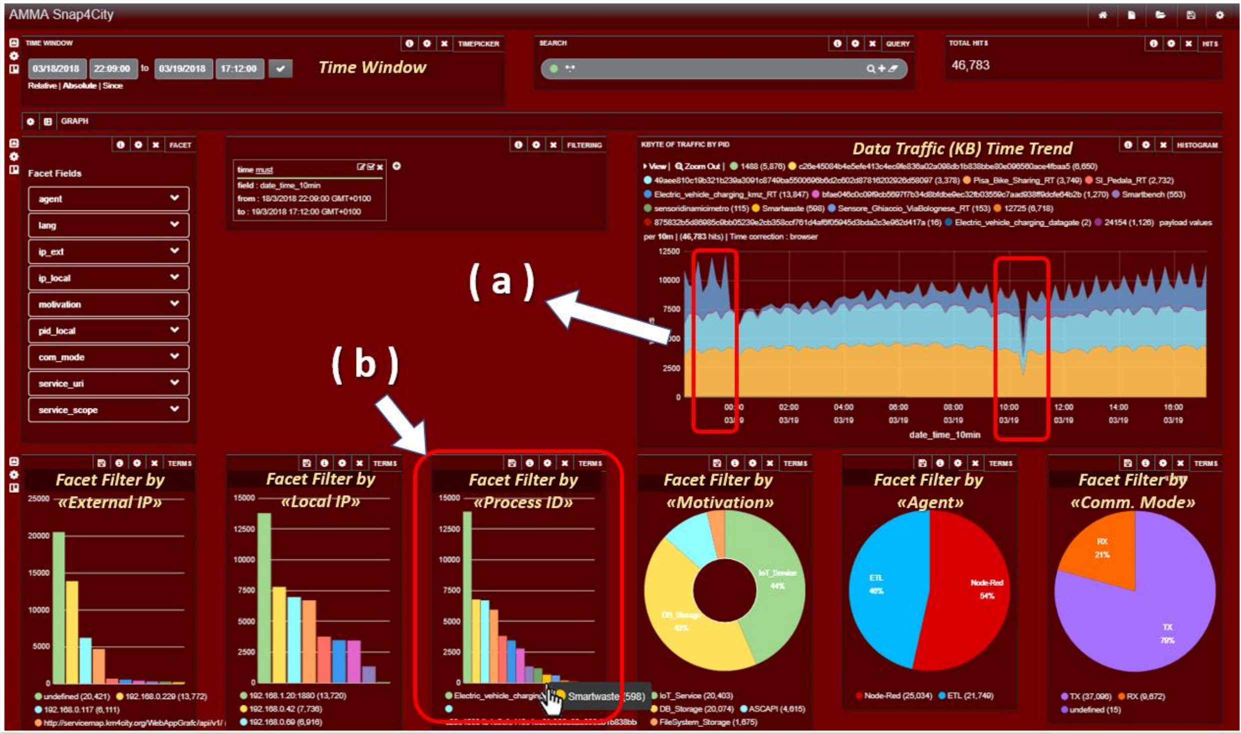


AMMA Case Study (1)

- Monitor data traffic flows among IoT devices, services, applications etc. and detect potential anomalies

Requirement II solved: quantitatively monitoring data/message traffic and flows

- Unexpected behaviours can be revealed by inspecting the data flow time trend:
  - a) detecting peaks or valleys in the trend
  - b) drill-down on data to identify single/more malfunctioning devices and/or services



AMMA Case Study (2)

- Make drill-down activities on data related to a single Process ID and check for unexpected behavior in the Time Trend panel:
  - **c)** Filtering data by the Process ID (e.g for example those related to a SmartWaste container)
  - **d)** Detect a peak with more data traffic than expected during its scheduled activity, by properly filtering on time, the single data portion corresponding to the unexpected data flow can be viewed
  - **e)** Locate on map the single involved device or service

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