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TM Forum {open}:hack, Nice France, May 14-16.

Vancouver Airwatch (in collaboration with Solent Airwatch)

Crowd sourced accurate air quality
measurements for smart ports and cities
using low cost IoT devices



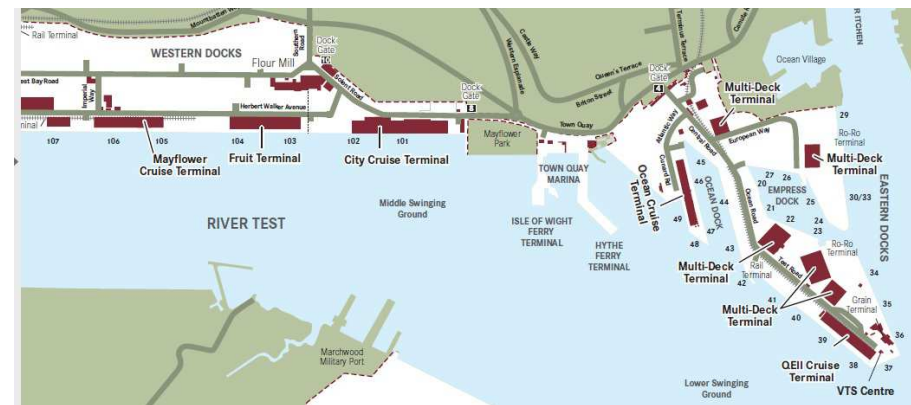
The Challenge



- 1. Demonstrate a Smart (sea) Port Proof of Concept
 - Product Catalogue to enhance the economic potential of a major port
 - Demonstrate a Generalised Product Catalogue IoT service lifecycle management solution
- 2. Address specific problem of Air Pollution Reduction
 - Cities hosting major ports (or airports) encounter significant air quality problems
 - Accurate legally enforceable pollution measurements expensive
 - Can we use neural networks to increase the accuracy of cheap crowd sourced smoke detectors
- 3. Demonstrate feasibility of crowd sourced IoT sensor devices
 - Generalised Crowd Sourced IoT management solution which can be used in ports and cities
 - Apply a generalised catalogue portal to lifecycle of crowd sourced air quality sensors
- 4. Build on Previous work
 - Port-O-Matic - Simulated Drone based IoT sensors for ports (TMForum Nice 2017)
 - Solent Airwatch 'Sniffy' crowd sourced air quality detectors

Southampton's (Smart) Port

- Previous work : port-o-matic
 - Addressing the 5G and Smart city challenge
- The UK's number one cruise port, which welcomes 1.7m passengers
- Each ship up to 6000 passenger and crew
- Ship turn around 1-2 days
- Increasing problem of air pollution due to generators running while ships in port
- Ships need dock side services including
 - Water, waste, electricity, communications
- Smart Ports
 - What is a Smart Port? no waste of space, time, money and natural resources
 - an integration of various infrastructures, both physical and IT. That includes different network technologies like radio, LAN, WAN and WLAN, RFID and positioning technologies.”
 - https://www.porttechnology.org/news/what_is_a_smart_port



(Smart) Port of Vancouver

- <https://www.portvancouver.com/>
- 27 major marine cargo terminals
- Port activities annually sustain:
 - \$24.2 billion in economic output
 - \$11.9 billion in gross domestic product (GDP)
 - \$7 billion in wages
 - 115,300 jobs in Canada
 - 96,200 jobs in British Columbia
 - \$1.4 billion per year in tax revenues
- Known problems with pollution
 - Ship Shore power saves 2656 tonnes CO₂



Solent Airwatch

- <http://www.solentairwatch.co.uk/>
- Community air monitoring project
- Not for profit charity run by Southampton volunteers
- With University of Southampton and Solent University
- Sniffy – version 1
 - <https://github.com/SolentAirWatch/sniffy>
 - Raspberry Pi Zero
 - Low cost laser Smoke detector
 - Ruggedized container



The Solent Airwatch Challenge



■ The problem

- ❑ Currently impossible to accurately monitor city wide pollution
- ❑ Legal enforcement of air quality requires calibrated sensors
- ❑ Commercial calibrated air quality sensors very expensive
- ❑ Cheap air quality sensors have wide variation in sensitivity and cant be used for enforcement

■ The solution

- ❑ Community sourced low cost air sensors
- ❑ Gamification – web site to show your sensor data and city wide view
- ❑ Engage schools, maker space groups , private citizens and city council

■ The Differentiator - Data Science

- ❑ Data Science makes low cost sensors viable for accurate measurements
- ❑ Peer reviewed experiment plan to validate the science behind data processing
- ❑ Big data processing of city wide sensor data
- ❑ Neural Network based calibration against commercial sensors

Crowd Sourced IoT Platform challenge



- The problem

- Lots of attention on platforms for IoT devices themselves – Apache Karaf, Eclipse Kura, OpenHab, NodeRED etc.
- Limited progress on common management services across a diversity of IoT devices and services

- Deployment and Maintenance of IoT software

- Cost of installation and change - maximise reuse of IoT devices for diverse applications
- Secure deployment – managing software and authenticating running instances
- Service Assurance – managing issues with remote devices
- Citizen science – managing the lifecycle of devices built by citizens but connected to our experiment

Java IoT Ecosystem

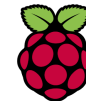
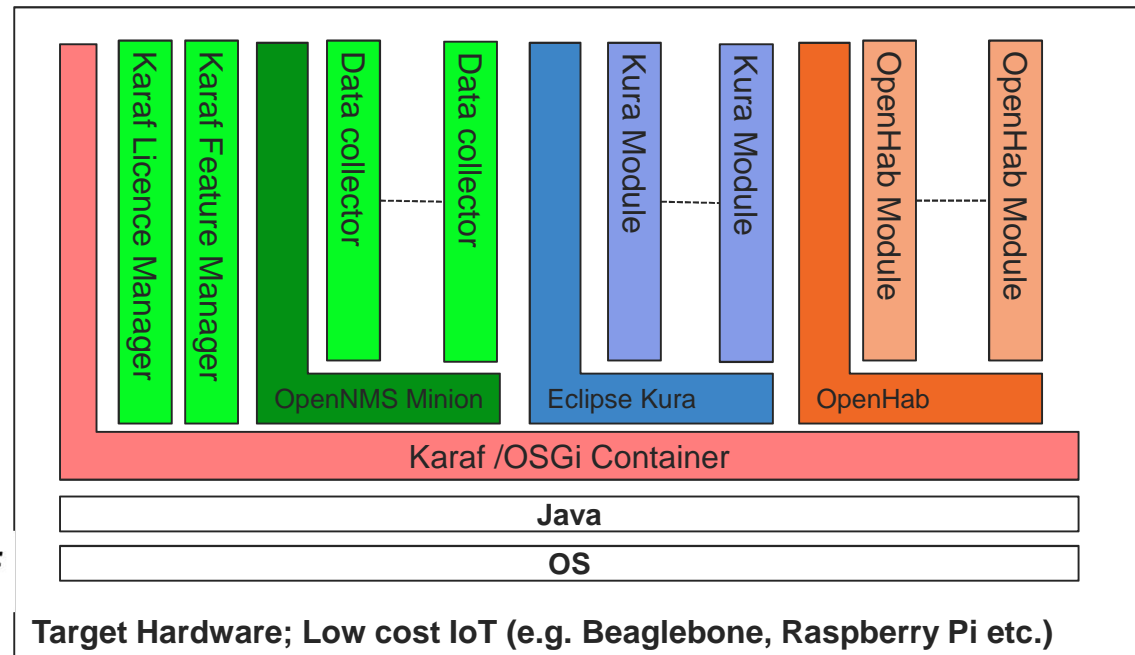


■ Java IoT Ecosystem

- ❑ Apache karaf
- ❑ Eclipse Kura
- ❑ OpenHab

■ OpenNMS Karaf Management

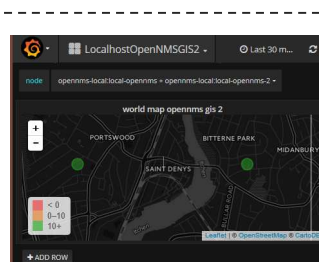
- ❑ Minions – remote data collectors
- ❑ Karaf Feature manager
- ❑ Karaf Licence manager
- ❑ Karaf Plugin Manager
- ❑ JMX Data collection



Architecture

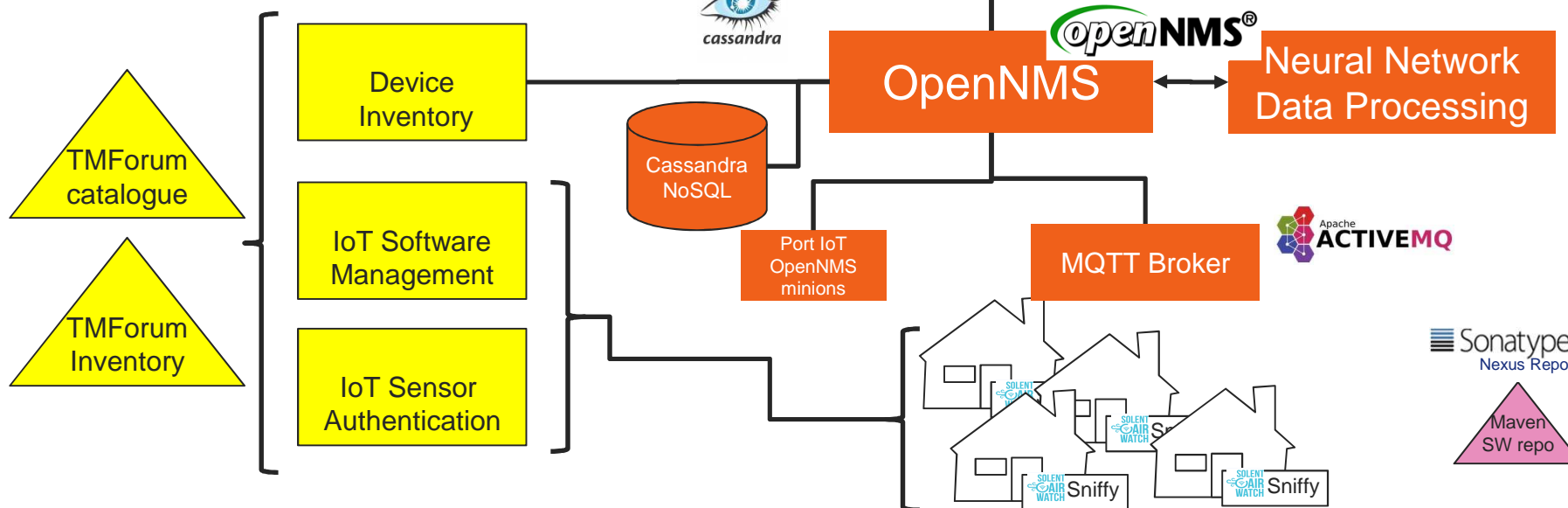
User Portal

Crowd Source
Datafill

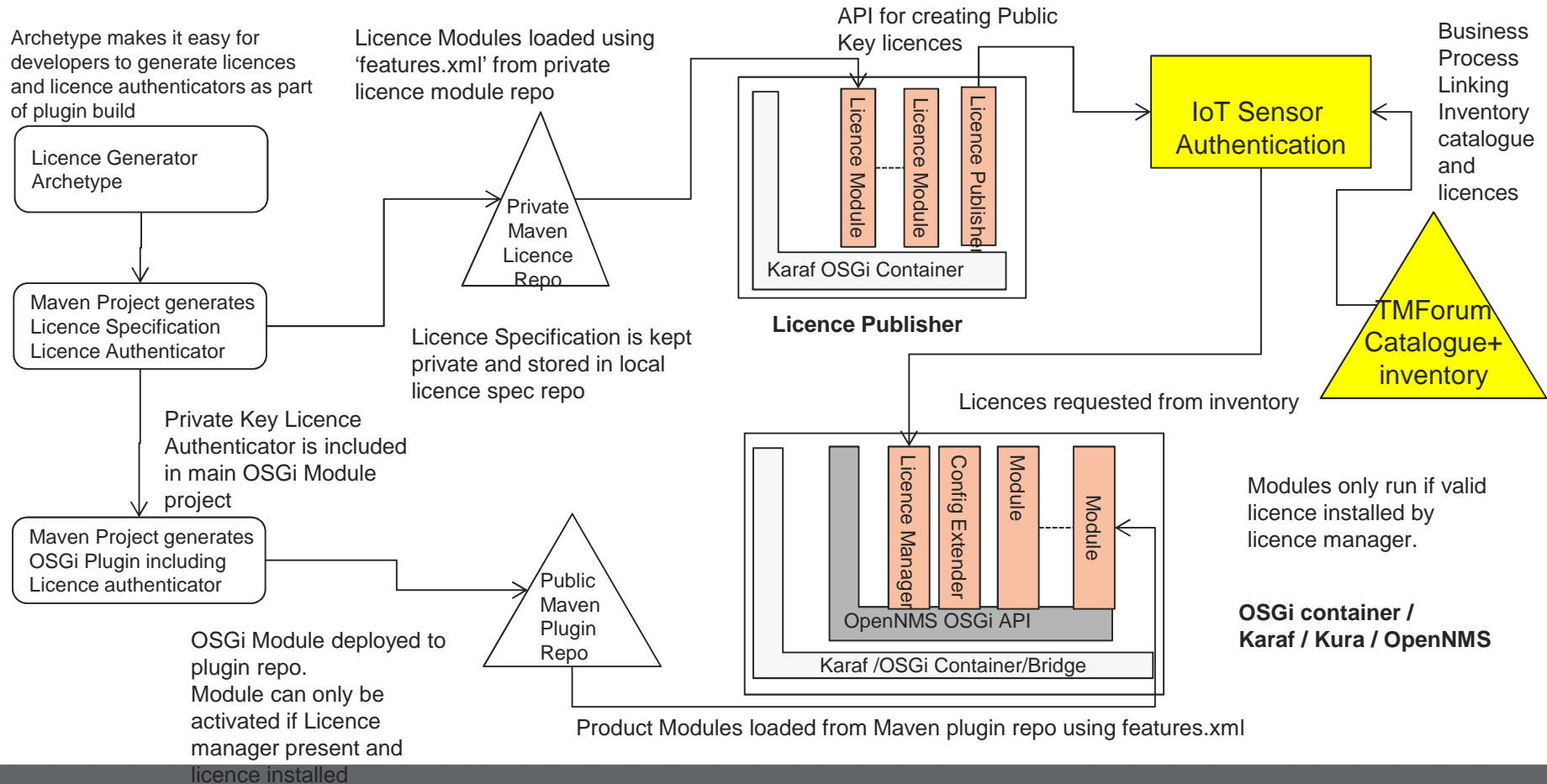


Data
Visualisation

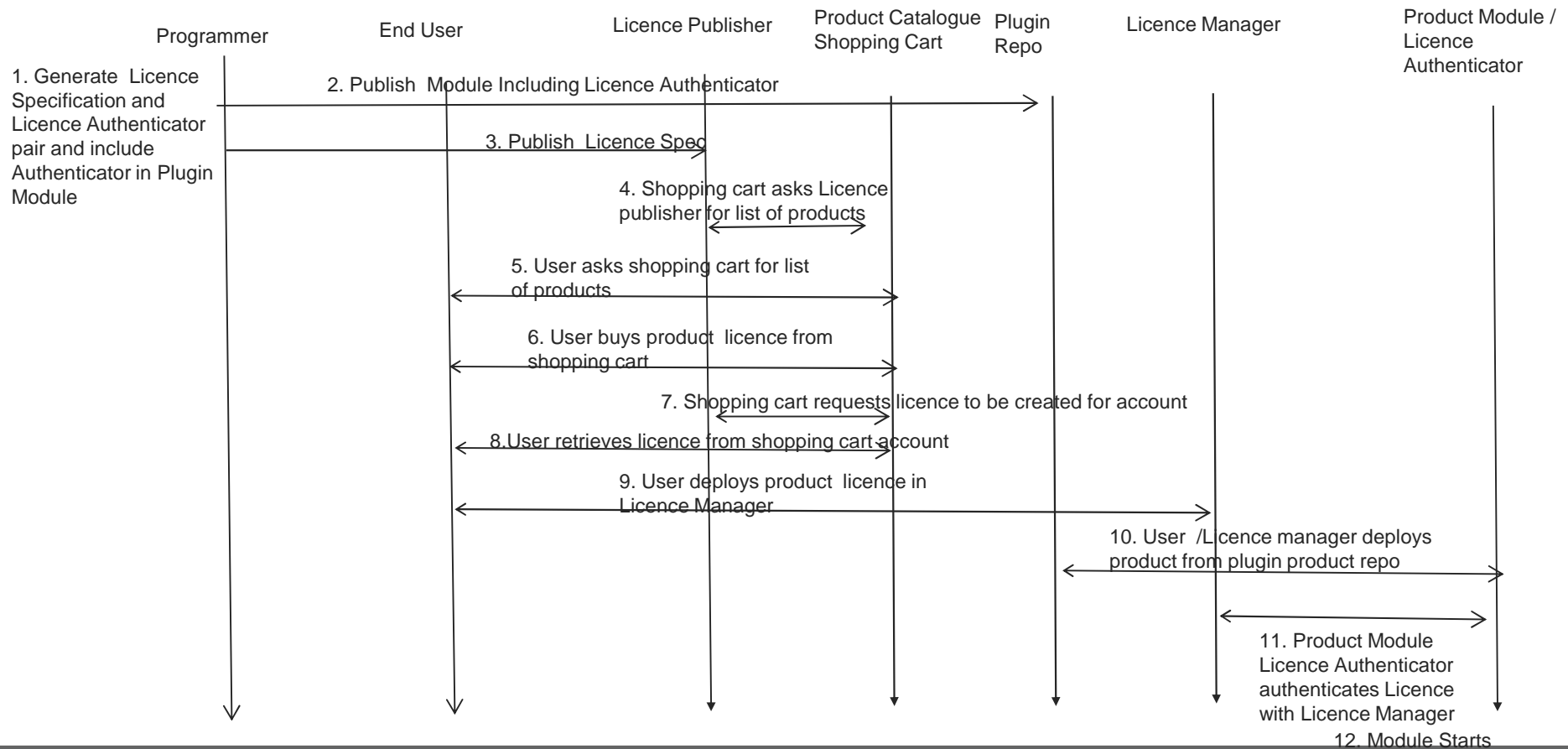
Measurements API



Plugin Authentication / Product Catalogue / Inventory



Workflow for Activating Module





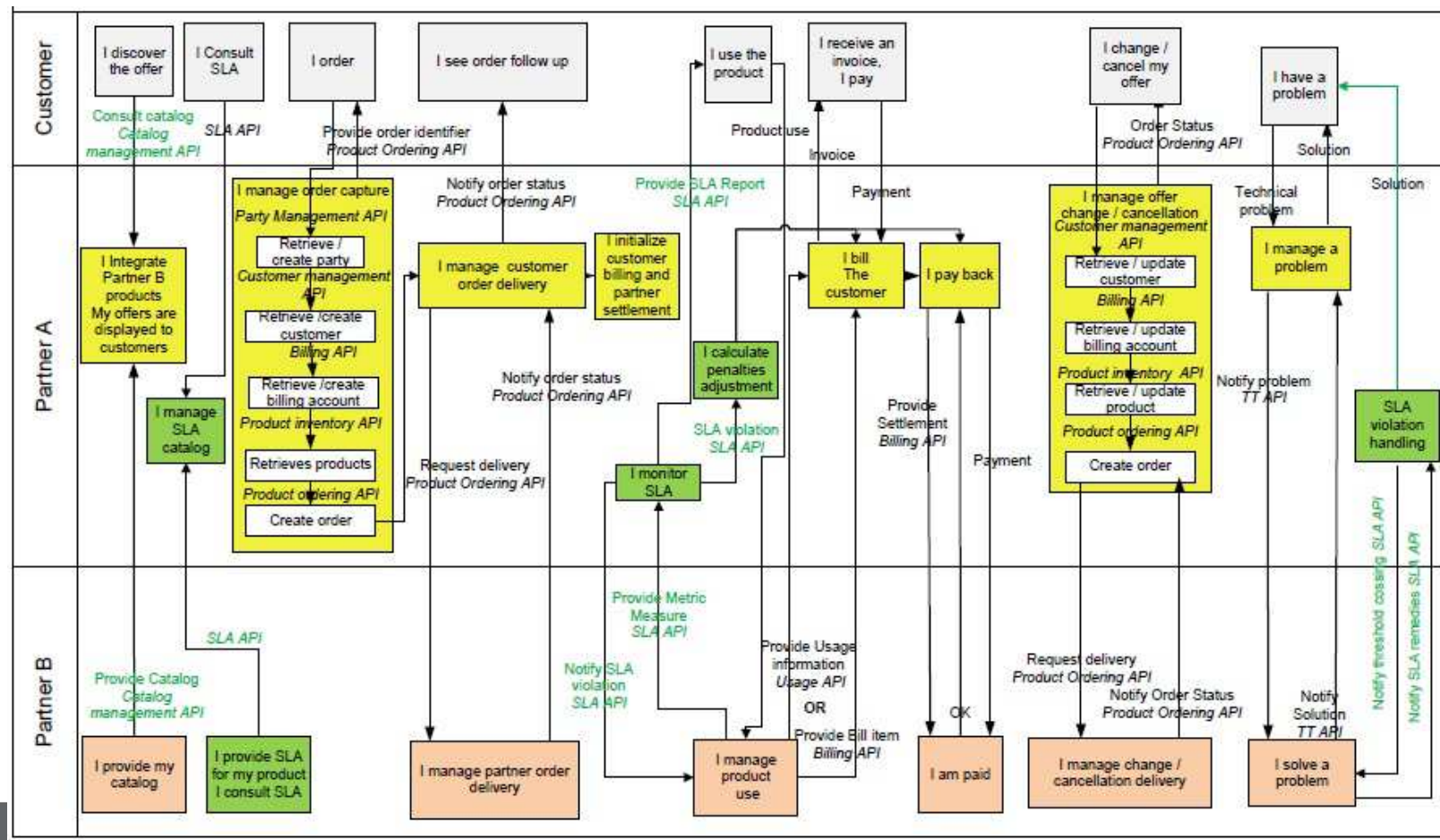
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backup

Typical Complex TMF API usage



TM Forum API's



Activation and Configuration API	The REST API for Activation and Configuration allows the user to retrieve, create, update, delete services and retrieve the monitor resource used to monitor the execution of asynchronous requests on specific resource. Although all the examples given in the API specification are relative to Services, the same API can be used to Activate and Configure Services or Resources.
Address API	The Address API is one of the Pre-Ordering Management APIs. The Address API provides a standardized client interface to an Address management system .It allows to look for worldwide addresses. It can also be used to validate address data, to be sure that it corresponds to a real address.
Agreement API	The Agreement API provides standardized mechanism for managing agreements, especially in the context on partnerships between partners.
Appointment API	The Appointment API is one of the Pre-Ordering Management APIs. The appointment API provides a standardized mechanism to book an appointment with all the necessary appointment characteristics. First, the API consists in searching free slots based on parameters, as for example a party. Then, the appointment is created. The appointment has characteristics such as nature of appointment, place of appointment...
Billing Management API	Provides standardized mechanisms for billing account, bill item and settlement note advice management either in B2B or B2B2C contexts.
Customer Management API	Provides a standardized mechanism for customer and customer account management, such as creation, update, retrieval, deletion and notification of events.
Onboarding API	The Onboarding API provides standardized mechanisms for managing an onboarding process. The API allows the retrieval, creation, update and deletion of partnership type and its owned sub- resources.The intention for partner onboarding in the Digital Ecosystem is to have a lightweight approach similar to an end-user signing-on to terms and conditions for downloadable applications. The onboarding of the "Party", the role can be Partner, Supplier, Developer, etc. The onboarding of the "Services" could be product offerings.
Party Management API	Provides a standardized mechanism for party management such as creation, update, retrieval, deletion and notification of events. A Party can be an individual or an organization that has any kind of relation with the enterprise.
Performance Management API	Provides a standardized mechanism for performance management such as the creation, partial or full update and retrieval of resources involved in performance management (Measurement Production Job, Measurement Collection Job, and Ad hoc Collection). It also allows notification of events related to performance.
Privacy API	The Privacy management API provides standardized mechanism for privacy profile types, privacy profiles and privacy agreements such as creation, update, retrieval, deletion and notification of events..
Product Catalog Management API	Provides a standardized solution for rapidly adding partners' products to an existing Catalog. It brings the capability for Service Providers to directly feed partners systems with the technical description of the products they propose to them.
Product Inventory Management API	Provides standardized mechanism for product inventory management such as creation, partial or full update and retrieval of the representation of a product in the inventory. It also allows the notification of events related to product lifecycle.
Product Ordering API	Provides a standardized mechanism for placing a product order with all of the necessary order parameters. The API consists of a simple set of operations that interact with CRM/Order negotiation systems in a consistent manner. A product order is created based on a product offering that is defined in a catalog. The product offering identifies the product or set of products that are available to a customer, and includes characteristics such as pricing, product options and market.
Quote API	The Quote API is one of the Pre-Ordering Management APIs. The customer Quote API provides a standardized mechanism for placing a customer quote with all of the necessary quote parameters.
Service Qualification API	Service Qualification API is one of the Pre-Ordering Management APIs. Service Qualification API goal is to provide service availability at Customer location.
SLA Management API	Provides a standardized interface for Service Level Agreement (SLA) life-cycle Management (SLA Negotiation, SLA configuration SLA Activation/enforcement, SLA Operations, SLA violation / consequence handling, SLA reporting) between a Customer and a Service Provider which provides offers (product with attached SLA in its catalogue) the customer can discover, browse, trigger and order.

TM Forum API's



Trouble Ticket API	Provides a standardized client interface to Trouble Ticket Management Systems for creating, tracking and managing trouble tickets among partners as a result of an issue or problem identified by a customer or another system. Examples of Trouble Ticket API clients include CRM applications, network management or fault management systems, or other trouble ticket management systems (e.g. B2B).
Usage Management API	Provides standardized mechanism for usage management such as creation, update, retrieval, import and export of a collection of usages. The API manages both rated and non-rated usage. For example, it allows a service provider to 1) retrieve usage generated by a partner service platform in order to rate it and 2) to provide rated usage to a partner for consumption follow up purposes.
Service Problem Management API (SPM)	The SPM API is used to manage service problems. Service problems are generated based on the information declared by a partner or the event information notified from infrastructure providers. The event information includes alarm information, performance anomaly information, trouble ticket information, SLA violation, maintenance information and prediction information.
Service Ordering API	The REST API for Service Order Management provides a standardized mechanism for placing a service order with all of the necessary order parameters. It allows users to create, update & retrieve Service Orders and manages related notifications.
Service Catalog API	The Service Catalog Management API allows the management of the entire lifecycle of the service catalog elements.
Service Test Management API	The Service Test API provides a standardized mechanism for placing a service test with all of the necessary test parameters. The API consists of a simple set of operations that interact with CRM/Service Management systems in a consistent manner. A service test is a procedure intended to check the quality, performance, or reliability of a service.
Change Management API	The Change Management API provides the standard integration capabilities between external applications and Change Management Application. The API consists of a simple set of operations that interact with Change Request in a consistent manner. A Change Request is an IT service management discipline.
Service Inventory API	The intent of this API is to provide a consistent/standardized mechanism to query and manipulate the Service inventory.
Loyalty Management API	The Loyalty API supports the management of loyalty program specifications, loyalty program members, their associated products and loyalty accounts with loyalty balances. The scope of the API also covers the management of loyalty rules and under what conditions the associated loyalty actions must be applied.
Service Quality Management API	Through this API, any Enterprise is able to access a Service Quality Management application and extract Service Level Specifications and associated Service Level Objectives (SLO) and their thresholds.
NFV Entity Provisioning API	REST API for NFV Entity Provisioning i.e. provisioning and lifecycle management of Network Services composed from Physical and Virtual Network Functions
Resource Ordering API	The REST API for Resource Order Management. It includes the model definition as well as all available operations. Possible actions are creating, updating and retrieving Resource Orders (including filtering). A Resource Order API provides a standard mechanism for placing a Resource Order with all necessary order parameters.
Resource Catalog API	The Resource Catalog Management API REST specification allows the management of the entire lifecycle of the Resource Catalog elements, the consultation of resource catalog elements during several processes such as ordering process, campaign management, sales management.
Prepay Balance Management API	REST API for Balance Management. It includes the model definition as well as all available operations for prepay balance management. Prepaid subscribers pay fees before using services. Therefore, the subscribers must have sufficient balances. Operators can provide multiple recharge channels for subscribers. Subscribers can pass credit between different subscriptions, therefore transferring balance from one account to another.

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