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Actility ThingPark
Appendix B - Technical Features List Product Functional Description

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Under NDA

NOTICE

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VERSIONS

Version	Date	Author	Details
5.0.1	2018/03/14	Shmulik Solomon	Version 5.0.1 updates
5.2.2	2019/04/26	Ramez Soss	Updates for TPW release 5.2.2
6.1	2020/05/27	Ramez Soss	Updates for TPW releases 6.0 and 6.1

REFERENCE DOCUMENTS

	Documents	Author
01	ThingPark Product Software Release Notes	Actility
02	Device Address Manager User Guide	Actility
03	ThingPark Radio Parameters User Guide	Actility
04	ThingPark Wireless release 6.0 LRCv2 Architecture	Actility
05	TP Wireless LRC-AS Tunnel Interface Developer Guide LoRaWAN	Actility
06	ThingPark Wireless Network Manager User Guide	Actility
07	ThingPark Wireless Device Manager User Guide	Actility

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ACRONYMS AND DEFINITIONS

Acronyms	Definitions
ABP	Activation By Personalization
ADR	Adaptive Data Rate
AES	Advanced Encryption Standard
AS	Application Server
ATM	Asynchronous Transfer Mode
BPM	Business Process Management
BS	Base Station
BSS	Billing Support Systems
CRC	Cyclic Redundancy Check
CSP	Communication Service Provider
DC	Duty Cycle
End Device	A sensor or actuator
ESP	Estimated Signal Power
ETSI	European Telecommunications Standards Institute
fNS	Forwarding Network Server
HAN	Home Area Network
HSM	Hardware Security Module
IaaS	Infrastructure As A Service
IEC	International Electrotechnical Commission
IoT	Internet of Things
ISM	Industrial Scientific Medical
GSCL	Gateway Service Capability Layer
GTM	Go To Market
KPI	Key Performance Indicator
LC	Logical Channel
LoRaWAN™	Long Range Wide Area NW
LPWAN	Low Power Wide Area Network
LRC	Long Range Controller
LRR	Long Range Relay
MAC	Media Access Control
M2M	Machine-2-Machine
MTBF	Mean Time Before Failure
NAT	Network Address Translation

Acronyms	Definitions
NW	Network
NSCL	Network Service Capability Layer. Also called RMS.
OBIX	Open Building Information Exchange
OSS	Operations Support Systems
OTA	Over The Air
PER	Packet Error Rate
PKI	Public Key Infrastructure
POC	Proof Of Concept
RAN	Radio Access Network
REST	Representational State Transfer
RF	Radio Frequency
RIT	Receiver Initiated Transmit
RSSI	Received Signal Strength Indicator
SaaS	Software as a Service
SF	Spreading Factor
SLRC	Secured LRC (VPN Concentrator)
SMP	System Management Platform
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SNR	Signal to Noise Ratio
sNS	Serving Network Server
SSH	Secure SHell
SSO	Single Sign On
TLS	Transport Layer Security
TWA	ThingPark Wireless Application
UNB	Ultra Narrow Band
VM	Virtual Machine
VPN	Virtual Private Network
WS	Web Service

1 SCOPE

This document provides a functional-level description of Actility's ThingPark Wireless product version 6.1.

2 THINGPARK SOLUTION OVERVIEW

2.1 ThingPark Solution Architecture Description

ThingPark is a **modular solution** enabling Network Operators to:

- Deploy LPWANs based on LoRaWAN™ or LTE with **ThingPark Wireless.**
- Manage, activate and monetize IoT bundles (Device, connectivity and application) with **ThingPark OS.**
- Provide value-added data layer services such as protocol drivers, cloud connectors and storage with **ThingPark X**.

ThingPark OS acts as the central System Management Platform (SMP), enabling all other ThingPark platform modules with base capabilities such as subscriber management, centralized authentication and access rights, and workflow management.

ThingPark Enterprise is an Internet of Things (IoT) platform that manages private LoRa® Networks. The ThingPark Enterprise edition is used by companies to support their specific business.

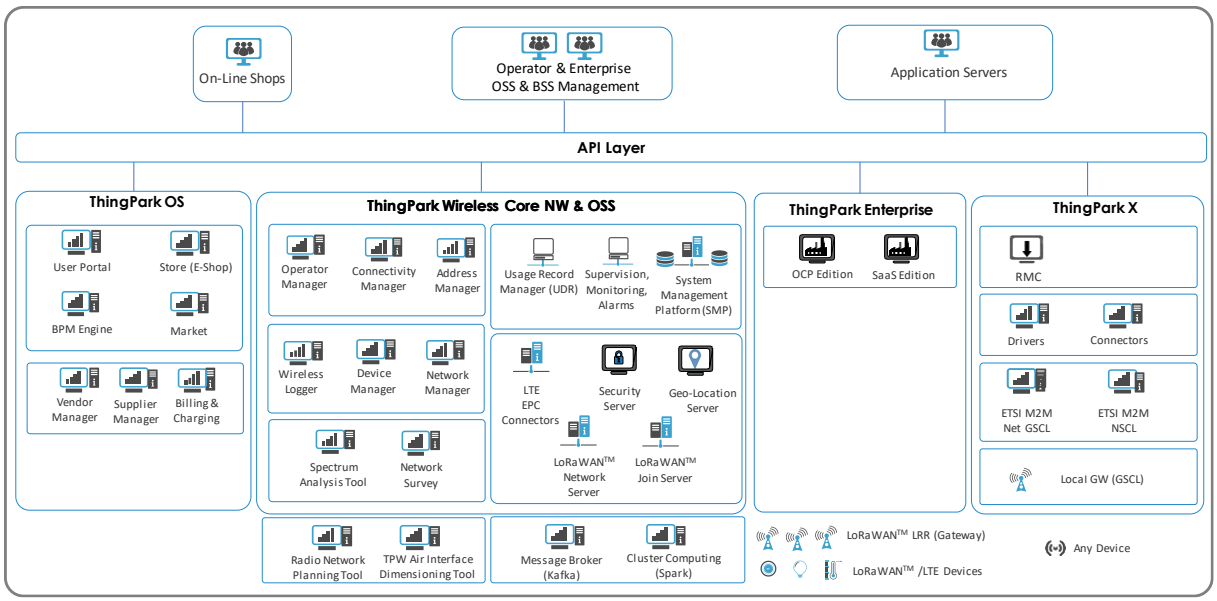

Figure 1 - ThingPark Solution Architecture Description High Level Product Illustration

Please note that the modules above may be representing a physical server, a function, a service or a business support layer as part of the overall ThingPark solution and not necessarily a physical HW server

3 TECHNICAL FEATURES LIST FUNCTIONAL KEY CAPABILITIES

3.1 Introduction

Actility ThingPark bridges Devices, Gateways, Network and Application Servers residing in an IoT network architecture, providing comprehensive functionality that ensures systems have a bi-directional communication channel with each other as effectively as possible. Device data is captured via Gateways, uploaded into the Network Server and then forwarded to the appropriate Application Servers. Application Server data is sent to Devices via downlink messages through the Network Servers and Gateways. Radio streams are optimized and enriched, which translates into better Device and Gateway performance and reduced costs for hardware, software and maintenance while providing new opportunities to differentiate and personalize services.

It also provides an advanced Marketplace and Store commercial functional framework enabling IoT Operators, Providers, Vendors and Developers to sell their offers to Subscribers. And for the later, to profit from an enriched dynamic IoT market offering.

ThingPark X gives additional dimension to ThingPark functionality, by enabling the support of different M2M Devices, share a given data stream with other applications and Data storage services. Through its set of drivers, ThingPark X allows decoding of application payload to provide ready-to-use payload in a readable format. Additionally, ThingPark X enriches the integration options with cloud connectors, supporting a wide variety of IoT Connectors such as AWS, Azure, ThingWorx, Cumulocity, generic MQTT connectors etc…

3.2 LoRaWAN features

Feature Category	Feature	Feature Description
LoRaWAN™	LoRaWAN™ Profile Class - A, B, C	Three different classes (A, B, C) of communication profiles are available in LoRaWAN™.
	Device activation	Both ABP and OTA modes supported.
	LoRaWAN™ MAC versions	■ LoRaWAN™ 1.0 ■ LoRaWAN™ 1.0.1 ■ LoRaWAN™ 1.0.2 ■ LoRaWAN™ 1.0.3 ■ LoRaWAN™ 1.1
	LoRaWAN™ Regional Profiles (PHY)	■ EU 863-870 MHz ■ EU 433 MHz ■ US 902-928 MHz ■ AU 915 – 928 MHz ■ AS923 ■ KR 920-923 MHz ■ CN 779-787MHz ■ CN 470-510 MHz ■ IN 865-867MHz ■ RU 864-870 MHz
	LoRaWAN™ Backend interfaces	Compliant with version 1.0.
	Passive Roaming	The possibility to transfer a packet from one network operator to another in a transparent way while keeping the MAC layer management in hosting network.
Downlink Messaging	Unicast	A single messaging mechanism (point to point) between a sender (AS) and a receiver (Device).
	Multicast	A multi messaging mechanism (point to multi-point) between a sender (AS) and receivers (Devices) for LoRaWAN™ Class B and C.
Reliable Multicast (RMC) Service	Firmware Update Over the Air	Update Device firmware.
	General-purpose multicast	Efficient management of multicast mode by supporting application-layer configuration of the multicast group/session parameters via Actility's RMC-Server.

3.3 Base Station (LRR) features

Feature	Feature Description
Multi-vendor support	LRR software is compatible with most gateway vendors: Kerlink, Ufispace, Cisco, Multitech, Tektelic, Gemtek, Oi, Stimio and others…
Multi-OS support	LRR software is compatible with Linux and FreeRTOS types of base stations.
Security: VPN tunnelling	Both IPSEC and TLS tunnelling options between LRRs and ThingPark core network, allowing secure authentication of LRR to LRCs.
LRR VLAN	Provides a higher security level.
IPv4 and IPv6	Both supported.
Downlink transmission	▪ Provide reliable transmission status of each downlink frame to Application Servers, with associated transmission failure cause (duty cycle issue, LBT, RF modem busy…etc.) ▪ Native retry mechanisms in case of failure (e.g. on RX2 for class A, next pingslot for class B, ASAP for class C).
Listen before Talk (LBT)	Support LBT mechanism to allow radio transmitters to sense the radio environment before it starts a transmission (mandatory in some Asian countries).
Real-Time Buffering capabilities	▪ Buffering capabilities to prevent packet lost in case of temporary backhaul disconnection. ▪ Graceful dequeue after connection reestablishment to avoid flooding core network.
Multi-board base stations	Besides mono-board base stations, ThingPark supports multi-board hardware; used for tri-sector configurations and/or extended capacity to support > 16 RF channels.
Antenna Diversity	Support two receiving antennas to boost diversity. Only relevant for macro gateways following Semtech's V2 reference design.
Remote RF spectrum scan	RF noise measurements by the base station to assist RF channel planning and optimize radio performance. Measurement results are easily accessible via ThingPark's Spectrum Analysis tool.
Backhaul redundancy and interface failover	▪ Primary/Secondary backhaul interfaces among the following connectivity options: ethernet, cellular (3G/4G), WiFi, satellite. ▪ Automatic switchover to secondary interface once primary interface falls.

Efficient backhaul data usage	Optimized use of backhaul traffic between LRR and core network to minimize signal overhead and limit cellular/satellite data consumption: ■ Use of efficient binary encoding of application data. ■ Configurable signaling overhead (keep-alive, ICMP messages, periodic reports with radio/WAN/system statistics). ■ 3 different bandwidth profiles (configurable from LRR UI): no-constraint, limited, very-limited.
LoRaWAN packet filtering at base station level	To optimize backhaul resources (especially for cellular/satellite types of connectivity), the LRR supports filtering of LoRaWAN frames by their NwkID; only authorized frames shall be forwarded to the Network Server.
Reporting of BS statistics	Periodic reporting of BS statistics: ■ Radio stats (packets in CRC-Error etc…) ■ Backhaul stats (latency, bitrate, traffic volume, interface status, cellular heath check…) ■ System stats (RAM, CPU, file system, GPS status…)
Support and Maintenance tools	■ Secured remote access to BS (Reverse SSH, SFTP) ■ Remote configuration & commands ■ Remote software upgrade ■ Safe update of BS configuration with automatic rollback ■ BS defence mechanisms (watchdog, auto-reboot…) ■ Local LRR console UI (also known as SUPLOG) Backup & restore of LRR configuration from Network Manager User Interface.

3.4 Core Network (LRC) features

Feature Category	Feature	Feature Description
LRC Network Server	High Availability	▪ Geo-Redundant / fault tolerant architecture for disaster recovery. ▪ Automatic failover/failback between primary and secondary LRCs: cold restart with database auto-resynchronization. ▪ Active/standby architecture for LRCv1. ▪ Active/active architecture for LRCv2. NOTE: LRCv2 is ready for PoC. For more details please refer to [4].
	Scalability	▪ Up to 50K LRR connections per LRC cluster. ▪ Up to 1500 frames/sec (after message deduplication). ▪ Fully horizontally-scalable architecture in LRCv2, with up to 500K (Macro BS) + 10 Million (Pico BS) and 150K messages/sec.
	Multi-tenancy traffic segregation	▪ Multi-tenancy: same LRC cluster can operator multiple Operators. ▪ Traffic segregation feature allows isolating the LoRaWAN traffic between the different Operators sharing the same LRC cluster (uplink frames for Operator-B cannot be routed through Operator-A's RAN except in case of roaming agreement).
	MAC Layer Management	Implements the LoRaWAN MAC layer between devices and core Network Server: ▪ Device activation (combined NS/JS mode). ▪ LoRaWAN MAC commands (including optimized retransmission mechanisms). ▪ Self-organizing Adaptive Data Rate. ▪ Downlink scheduling and asynchronous UL/DL processing (sending AS response to class A uplinks within the same transmission cycle). ▪ Optimum selection of the device's receive window (RX1/RX2) via RX2 Optimization algorithm (based on link budget, downlink capacity and backhaul latency). ▪ Multiple RX2 and pingslot channels per LRR base station (RF channel load balancing).

LRC Network Server		▪ Queuing of applicative downlink frames for class A devices. ▪ Uplink frame deduplication (macro-diversity, device repetitions…): Ensures that uplink frames received by multiple Base Stations will be notified only once to the application servers. ▪ MAC-level acknowledgments. ▪ Replay attack detection and mitigation.
	Self-organizing ADR	▪ Sophisticated and highly-optimized Adaptive Data Rate algorithm that considers a joint optimization of TX Power, Spreading Factor and number of Transmissions; based on the target uplink quality metrics (Packet Error Rate and coverage overlap criteria). ▪ Automatic adaptation of overlap criterion according to the dynamic network geolocation mode (TDoA or RSSI). ▪ Flexible configuration at Operator level to trade-off reactivity with stability and trade-off battery optimization with packet error rate.
	Downlink Best-LRR selection	In the aim to efficiently transmit a downlink packet, the LRC chooses the best LRR according to its proximity to the device, link budget, duty cycle capacity and connection status.
	Optimized transmission of device's MAC commands	Learning algorithm to optimize the retransmission of MAC commands that are either not answered or rejected by the device.
	RF Region Management	Handling of LoRaWAN™ regional parameters + enforcement of local regulatory limits (duty cycle, payload size control, dwell time limits…)
	Interfacing with Application Servers	▪ Secure exchange of outgoing/incoming reports with Application Servers, via HTTPS protocol ▪ AS authentication Mechanism via application-layer report signature through a shared LRC/AS key ▪ Delivery of the following type of reports to AS (For more details, please refer to [5]): ○ Uplink Frame Report: uplink payload with rich set of metadata.

LRC Network Server		○ Downlink Frame Sent Report: Delivery status of each DL frame (with failure cause in case of failure). ○ Device Notification events: in case of JOIN event, reporting of device's battery status… ○ Location Reports (if Network Geolocation feature is activated). ○ Multicast Summary Reports. ■ Flow control of outgoing traffic towards HTTP applications, to mitigate slow-responding AS through temporary blacklisting.
	Passive roaming	Implements fNS and sNS behavior for stateless passive roaming
	Multicast	■ Management of multicast clustering to mitigate collision risk ■ Retry mechanisms in case of transmission failure ■ Delivery of multicast summary reports to Application Server
	Traffic rate regulation	■ Implementation of token bucket mechanism to control uplink/downlink traffic rates according to Connectivity Plan settings. ■ Out-of-profile packets are either marked as "overflow" (and reported to TPW backend for UDR generation) or dropped (depending on the regulator policy defined in Connectivity Plan).
	Record/replay tools	Allows recording customer-specific test scenarii to be added to Actility non-regression test library to ensure best-in-class software quality.
Security	HSM - On premises	On-site Hardware Security Module.
	HSM – SaaS	Cloud-based Hardware Security Module.
	Software Security Mode (SSM)	End-to-end data confidentiality (i.e. encrypted payload) between device and AS without physical HSM.
Join Server (JS)	LRC JS + Key Manager application	A Join Server to enable secure OTAA Device activation process. ■ Enhanced Key Manager Application to provision OTAA device information and their Application Server keys.

		■ Both HSM and SSM security modes supported. ■ Compatible with the following Secure Element manufacturers: STM, Microchip, Idemia and Trusted-Objects.
Network Geolocation	TDoA-based geolocation	Location estimation using triangulation algorithms based on the time of arrival and received signal characteristics of uplink frames at the receiving base stations. Only relevant when fine-timestamps are generated by the base station (need Semtech's v2 reference design) with nanosecond accuracy.
	RSSI-based geolocation	Location estimation is based on the received signal strength level, valid for any base station model (even when GPS/fine timestamp is not available) but has less accuracy than TDoA mode.
	Combined TDoA/RSSI mode	A sophisticated geolocation algorithm supporting a combination of TDoA and RSSI to leverage the strength of both methods and improve the overall location accuracy.

3.5 Operations Support System (OSS) features

Feature Category	Feature	Feature Description
Operator Management	Network Partner Management	Create and manage Network Partners: typically network planning and rollout teams (accountable for base station management).
	Connectivity Supplier Management	Create and Manage Connectivity Suppliers: typically business modelling and marketing teams (defining service profiles).
	Vendor Management	Create and manager Vendors: typically sales teams / boutiques (bundling a connectivity plan with a set of applications into an offer). The vendor also creates the subscriber account.
	Supplier Management	Create and manage Device/Application/BS Suppliers.
	IoT Ecosystem Management	Management of Base Station, Device and RF Region catalogues + creation of custom profiles if required.
	Dashboard wizard and KPIs	Highly scalable Operator KPI engine, providing real-time aggregation of Operator's main metrics (with up to 1500 messages/sec), based on Apache Kafka and Spark solutions. Wide range of radio and system KPIs, presented in graphical reports and available through webservices. ■ Time series graphs up to the last 3 years. ■ Pie chart distribution reports. ■ Top-N or Worst-N device or BS lists.
Connectivity Supplier role	Connectivity Manager	Manages technical offers and related Connectivity Plans (also known as Service Profiles), bundling value-added services into Service classes: ■ "Confirmed Message" Mode ■ Network geolocation ■ Passive roaming ■ Class B ■ Multicast ■ HSM security ■ Intra-operator Traffic Segregation ■ Enriched Application Server Reporting.

Vendor role	Vendor Manager	■ Creates and operates a variety of commercial offer bundles. ■ Create and manage subscribers.
Supplier role	Supplier Manager	Creates and operates a variety of products.
Heterogenous network deployments	Complementing public LoRaWAN coverage through Managed Customer Networks (indoor/outdoor deployments)	Enable Operators to offer dedicated LoRaWAN™ networks. A Managed Customer Network is a set of Base Stations deployed by the operator on the customer premises for his own usage. An all-you-can-eat billing policy may be applied by the Operator to the LoRaWAN traffic routed through the Managed Customer Network. The discrimination is performed according to the best Base Station for uplink frames and according to the selected Base Station for downlink frames.
Off-the-shelf catalogues	Device Profile catalogue	Ready-to-use catalogue of Device Profiles including generic profiles + vendor-specific models from over 25 LoRaWAN device manufacturers.
	Base Station catalogue	Ready-to-use catalogue of Base Station Profiles supporting BS models from all the major gateway manufacturers.
	RF Region catalogue	Ready-to-use catalogue of Regional Profiles supporting all the ISM bands standardized by LoRa Alliance; including optimized RF channel plans and radio configuration parameters.
Usage Details Records (UDR)	Operator usage detail reports	Monthly report generated by Operator including: ■ Passive Roaming Network Activation records ■ Passive Roaming Network Traffic records ■ Application Server Activation Records.
	Network Partner Reports	Monthly Network Traffic Records for each Network Partner.
	Connectivity Supplier Reports	Monthly reports generated for each Connectivity Supplier, including: ■ Network Subscription records ■ Network Activation records ■ Network Traffic records.

OSS Network Management	Network Manager application	Provision, configure, administrate and supervise LoRaWAN Base Stations. Several administrative roles: full-administrator vs. viewer (ready-only) modes. For more information, please refer to [6].
	Statistics and KPIs	Rich set of hourly and daily metrics/graphs to monitor radio, WAN backhaul and system performances. ▪ Radio metrics: On-time vs. Late uplink frame distribution, Downlink success vs. failed distribution (with error causes), beacon transmission status, duty cycle and RF statistics (SNR, RSSI, Estimated Signal Power (ESP) per RF Logical Channel… ▪ WAN backhaul metrics: round-trip latency and traffic volume/bitrate per network interface (for both uplink and downlink) … ▪ System metrics: RAM/CPU/Filesystem statistics.
	Base Station Alarm Management	Alarm notification by SNMP and email for base station malfunction situations: connector error, GPS down, beacon transmission failure, high usage of CPU/RAM/Disk resources, saturation of radio capacity, replay attack detection…
	Remote Base Station administration	▪ Secured remote access through Network Manager application (through reverse SSH) ▪ Remote upgrade of LRR software. ▪ Remote backup and restore, LRR restart, BS reboot, configuration of logging level…
	RF cell coverage	Map and list views of devices connected to a given base station, with their RF statistics. Very useful to build Network Coverage Heatmaps.
	Downlink Sent Indication	Provide reliable data for billing of downlink frames so that downlink messages, which did not reach the destination Device, are not charged by the billing system.
	Traffic segregation per Network Partner	Intra-operator traffic segregation/isolation through white/blacklisting of authorized Network Partners (via Connectivity Plan).
	Wireless Logger	Packet logger at network partner level, providing a handy way to troubleshoot network performances (including roaming-out traffic forwarded by fNS).

OSS - Device Management	Device Manager Application	Provision, configure, administrate and supervise LoRaWAN and LTE-M/NB-IoT Devices. For more details, please refer to [7].
	Application Management	Provision and configure Application Servers and their associated routing profiles. The following AS types are natively supported: ▪ HTTPS, including application-level authentication through a shared key between ThingPark and AS. ▪ Kafka (packet broker): fault-tolerant and latency insensitive. **Support of MQTT and cloud-based application connectors (AWS, Azure, Watson, ThingWorx, Cumulocity…) is ensured by ThingPark X IoT Flow.** **ThingPark X IoT Flow also allows delivering decoded/ready-to-use application payloads to Application Servers through an extensive list of drivers covering the most widely used LoRaWAN device manufacturers.**
	Statistics and KPIs	Rich set of hourly and daily metrics/graphs to monitor device performance. ▪ Radio metrics: On-time vs. Late uplink frames, Downlink success vs. failed status, RF statistics (Packet Error Rate, SNR, RSSI, Estimated Signal Power (ESP)) ▪ Device health: active/connection error, battery status…
	Device Alarm Management	Alarm notification by SNMP and email for device station malfunction situations: weak battery, devices exceeds the traffic rate defined in their Connectivity Plan, device does not respect ADR commands, device continuously rejects (or does not answer) a specific MAC command, replay attack detection…
	Flexible update of the device subscription	Device can easily switch from one subscription to another via Device Manager application, for instance to activate roaming or geolocation.
	Authentication, Provisioning and Security	Secure provisioning of OTA devices through asymmetric cryptography: RSA public/private key pair to securely provision the device's root keys into ThingPark core network/HSM.

OSS - Device Management	Multicast Management	Configuration and supervision of multicast groups for both class B and class C modes.
	Wireless Logger	Packet logger at subscriber level, providing a handy way to troubleshoot device performances. ■ LoRaWAN decoding, e.g. MAC commands, MAC header… ■ Application payload decoding, displayed in human-friendly format.
	Subscriber KPI Dashboard	Scalable set of radio and network KPIs aggregated at subscriber level: ■ Time series graphs up to the last 6 months. ■ Pie chart distribution reports. ■ Top-N or Worst-N device list based on specific criteria (battery level, packet error rate…).
	User Portal	■ After-sale self-care portal, acting as a single portal to all applications/offers purchased by the Subscriber. ■ Enables the management and creation of End-Users.
Device Address Management	Device Address Manager Application	Manage the allocation of LoRaWAN™ End-Device addresses (DevAddr) and LoRaWAN™ End-Device EUI (DevEUI) to Suppliers and for B2B/B2C Subscribers.
OSS - API	REST API	■ Authentication, authorization and usage management for all user's roles. ■ Swagger contracts for easy integration with Application developers.
LoRaWAN™ Network Tools	Wireless Logger	Packet logger used for troubleshooting of device/network performances.
	Spectrum Analysis	Base Station Radio Frequency scan analysis
	Network Survey	A LoRaWAN™ drive test analysis tool with easy-to-use cartography options.
	Air Interface Dimensioning	Enables a quick assessment of the radio coverage/capacity estimation by providing link budget/capacity analysis.
Cartography/ Mapping services	Google Maps	A service allowing to locate Devices and Base Stations on a Google Map.

	Open Street Maps	A service allowing to locate Devices and Base Stations on an Open Street Map.
	Baidu Maps	Typically used for Chinese markets.
Platform	Deployment models	■ On-customer premise (OCP). ■ SaaS, hosted on Actiltity's regional datacenters. ■ Hybrid mode (LRC core network OCP + OSS backend on SaaS).
	High Availability	■ Ensures Carrier-grade best-in class service level agreement. ■ Redundancy of critical components and functions of the platform with the intention of increasing its reliability. ■ Disaster Recovery for IaaS implementations. ■ Apache Kafka message broker for internal interfaces to guarantee data resilience.
	Scalability	■ Horizontally scalable multi-threaded components. ■ Database sharding. ■ Self-organizing networks with base station densification. ■ Highly scalable message broker technology based on Apache Kafka.
	SNMP Traps	Alert messages in SNMP protocol to an Operator NOC.
	Platform Monitoring	Supervised by Nagios: a GUI-powered tool enabling Operators or NOC teams to monitor the health of servers, databases and software applications…

3.6 ThingPark Orchestration Service (OS)

Feature	Feature Description
User Management	■ Service orchestration and role management. ■ User password policy manager. ■ Multi Role Administrators: Association of Administrator role to different Supplier and Vendor accounts. ■ User Action Logs: Enables a user action log (audit trail), made for the Operator user, to log all user actions modifying ThingPark application objects.
Integration with Keycloak	■ Leverage Keycloak as an Identity Provider to offer best-in-class Single Sign-On (SSO), support two-factor authentication and simplify third-party application integration with ThingPark ■ Use of standard OAuth V2 / OpenID Connect authentication flows to authenticate end-users and applications in ThingPark.
Supply Chain Management	Enables Device Suppliers to configure Device keys via a web-service during Device on boarding process.
Personalization of platform configuration	■ Personalization of email templates: Support different user notification messages customized by the Operator. ■ Multi-language User Interface: Via labels' localization and configuration. ■ Operator Login Disclaimer: Operator-personalized disclaimer pop-up window after a successful user login in all ThingPark Web Applications.
Billing	■ CDRs/UDRs – for Post-paid billing managed activation subscriptions. ■ Invoice Manager – Invoicing and Payments. ■ Charging. ■ Supplier Management. ■ Offer & Order Management. ■ BPM – Workflow Management. ■ BSS (Self Activation) via Actility On-Line Store.

4 ABOUT ACTILITY

Actility is an industry leader in LPWAN (Low Power Wide Area) large scale infrastructure with ThingPark™, the new generation standard-based M2M communication platform. Actility's ThingPark Wireless™ network provides long-range coverage for low-power sensors used in SmartCity, SmartBuilding and SmartFactory applications. Actility also provides the ThingPark X which provides big data storage for sensor data and exposes sensor function through an open API allowing developers to provide vertical applications on top of rolled out sensors. To help vendors transform their sensors, Actility provides the ThingPark IoT platform which include embedded software solutions and cloud solutions to help Devices connect to innovative applications. Via the ThingPark Market, an online marketplace engine dedicated to the IoT sensors, applications and network solutions, Actility enables the roll-out of new innovative IoT services for sensor vendors and network solution vendors. Actility is a founding member of the LoRa Alliance™: the largest, most powerful standards-based effort to enable the Internet of Things (IoT). Visit https://www.actility.com/.