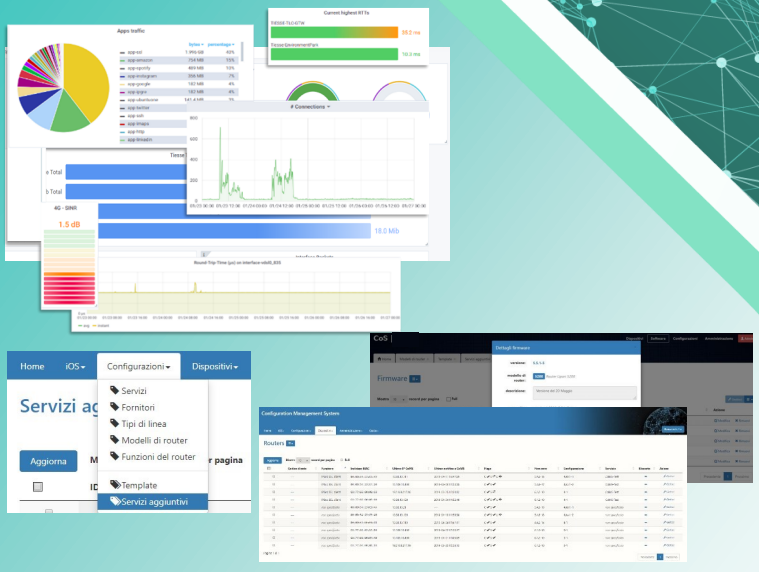
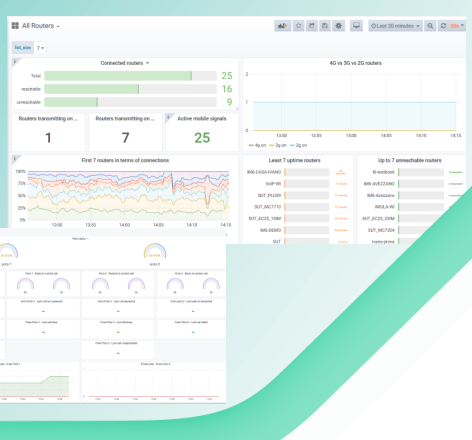
Tiesse

Innovation made in Italy

TNA

Tiesse Network Architecture





Solution Brief

www.tiesse.com

Summary

TNA

Introducing Tiesse Network Architecture

TNA (Tiesse Network Architecture) is the software suite consisting of three modules, whose main goal is to enable the realization of a **Zero Touch Provisioning** network architecture, including:

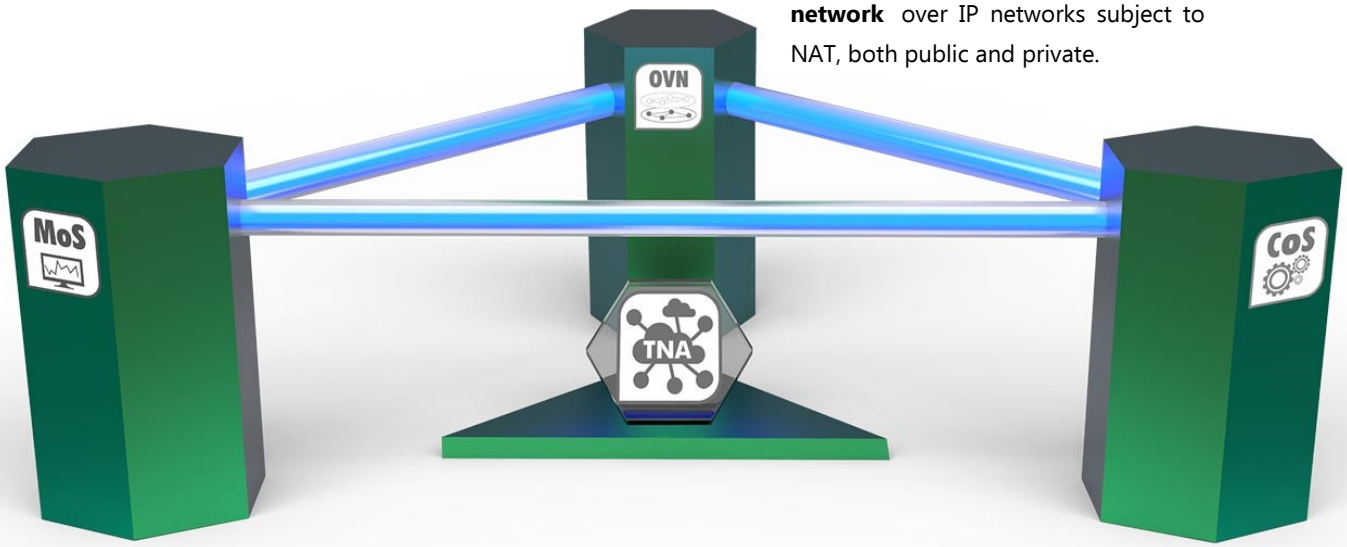
- **monitoring** of equipment and network status
- **displaying** of aggregated data
- **automatic management** of configuration **updates** according to user-set policies, triggers, or data-based information from all devices.

Another feature of the **TNA** suite is the ability to carry out **traffic engineering** functions, in order to transparently select the link that best fits the performance requirements of the applications.

In addition, the TNA suite allows you to connect remote sites by dynamically creating an **overlay network** on the public Internet.

The TNA suite is a modular and flexible solution and consists of the **MoS**, **CoS** and **OVN** modules.

OVN is the module that allows to create and manage an **overlay network** over IP networks subject to NAT, both public and private.



MoS is the monitoring and analysis module that collects data related to the behaviour and status of both network and individual devices.

CoS is the module that allows to inventory, configure, manage and update centrally networks of remote routers and IoT devices, both on IP public and private networks.

MoS

Monitoring System

MoS module periodically collects the data to be monitored on the Tiesse routers, CPEs and peripheric IoT devices, then it sends them to the main Server/Controller via TCP or TLS connection. The reading intervals are configurable for each single data or globally also.

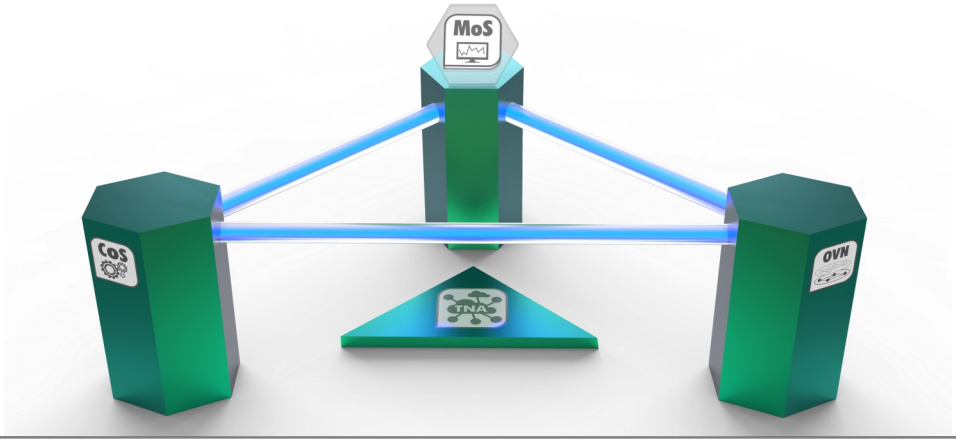
The data, exportable and displayable, can vary depending on the type of the peripheral device - presence of cellular network connection or voice ports - or depending on the usage scenario as overlay network architecture or other application scenarios.

MoS is specifically integrated with Grafana® software, which allows to execute queries, display information about the link signal status over cellular network, throughput and total amount of traffic, round trip delay, memory and CPU usage of individual devices, as well as detailed information about the operation status of VoIP and the overlay network.

What can be monitored - examples

- Uptime of peripheral network devices and any time interval reboots
- Bitwise throughput per second and by number of packets per second for all physical, virtual, and tunneling network interfaces
- If the connection is via primary link and those on secondary link
- Signal strength on 2G, 3G and 4G network
- In the case of multi-sim routers if the connection is via primary or secondary SIM
- Number of active connections (TCP/UDP) and number of devices connected to the Wi-Fi network
- Nexthop Round trip time for all interfaces
- Round trip time to an arbitrary destination with a sending protocol of choice between HTTP, ICMP, UDP, and TCP
- CPU usage and equipment memory
- Application-based traffic and network overlay data
- VoIP scenario data (routers with FSX interfaces)
- Data consumption per network interface
- Equipment Reachability and MoS Server/Controller

All metrics and all data can be viewed as well as individually in the form of aggregated data such as the number of devices that transmit or receive on a specific network interface, the router with the higher number of active connections as a percentage, or the devices with metrics below a certain threshold: combinations and analyses are almost unlimited.



GRAPHIC INTERFACE FEATURES

Views — MoS has a wide range of display options to simplify data comprehension.

Multi-channel alerts — Multi-channel notification system, independent from the graphic interface, extensible to other channels in addition to the predefined ones. It limits the "alarm fatigue" phenomenon.

Aggregation — You can group and aggregate the data on a single dashboard.

Open — MoS allows rapid integration and customization thanks to the use of the different plugins available for Graphana technology, which is an open source platform.

Extensions — Create hundreds of dashboards and plugins to expand the data management experience

Navigation — Data can be explored thanks to ad-hoc query and dynamic drill-down.
It is possible to compare different periods of data collection time and queries

Collaboration — Thanks to the agile sharing of the data and dashboards offered by Grafana® software, you can create and expand a culture based on network data.

Authentication — Authentication mechanisms such as LDAP, Google Auth, Grafana.com and Github are supported.

Organization — MoS supports multi-tenancy. Multiple organizations can be managed with their own administrators and users, rules, and dashboards.

Preferences — MoS allows administrators to select backgrounds (dark or light theme) of the dashboard, change time zones, and more to suit their specific needs and preferences.

Ad-hoc filters — Ad-hoc filters allow new real-time filter keys/values to be created, and they are automatically applied to all queries using the data source.

MULTI-CHANNEL ALERT SYSTEM

The multi-channel alert system is a **real-time notification system**, independent but still integrated into the graphic interface. It is efficient and able to support complex settings thanks to its own independent database.

Alerts can be sent on different channels: the most used are e-mail, Slack, Pushover and HTTP calls; it is possible to add others, as well as to set events to be notified based on even complex parameters.

The MoS multi-channel alert system also has the **"fatigue alarm" protection** feature. It is not uncommon that in notification systems there may be moments of tilt due to the complexity of the trigger event settings which consequently generate hundreds of alerts, creating the risk of losing important notifications in the amount of those received: multi-channel alert system is able to limit this problem thanks to the "throttling" function.

The system checks how many alerts are sent every hour and if the ones generated by the same trigger event exceed a certain quantity: if so, the sending frequency is revised in order to improve their reception and they are automatically grouped into a single message.

Thanks to the multi-channel alert system, the operator will no longer be dependent on the monitor and graphs for information on events and conditions of interest, but will receive notifications on the channels set.

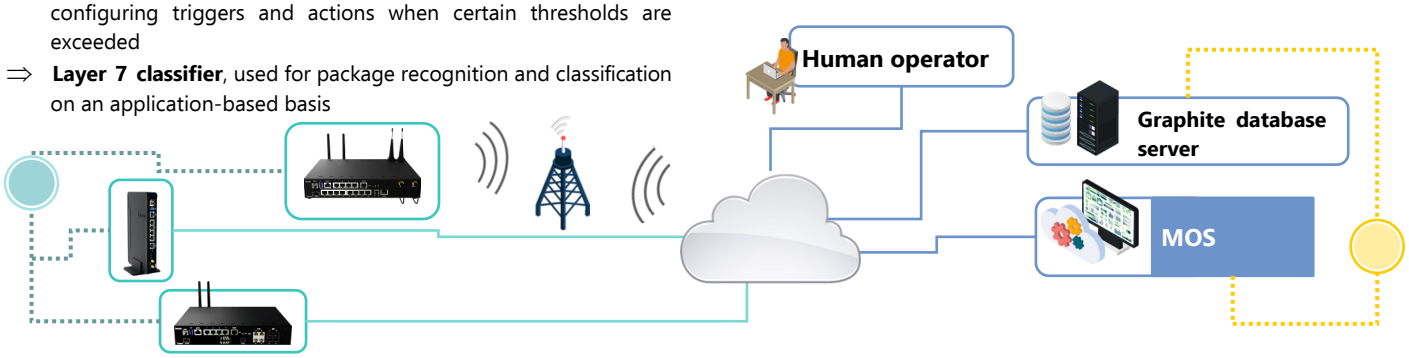
ARCHITECTURE

CPE and Tiesse equipment side (access network)

- ⇒ **Agente MoS** (collectd) installed on Tiesse routers and devices; it is composed of a set of plugins, each of which collects data and information
- ⇒ The **Responder Time Reporter (RTR)** service measures network running performance and traversal times (round trip delay) to an IP address, a specific TCP/UDP port, or a specific URL, while configuring triggers and actions when certain thresholds are exceeded
- ⇒ **Layer 7 classifier**, used for package recognition and classification on an application-based basis

Server / Controller

- ⇒ **Load Balancer** and relay nodes, to manage up to 10 million metrics per minute
- ⇒ **Database** time-series and backend series
- ⇒ **Front end**, which displays data and allows to use them (system based on Grafana® software GUI)



DASHBOARD

The dashboard is flexible and can be customized to the user's specific needs directly by the administrators themselves or it can be first adapted by Tiesse.
However, the product comes with a default dashboard that includes the following areas.

Router Panel

Monitoring and views of key resources for **each individual device** (Router, CPE, IoT).

- Router reachability
- Connectivity towards a target/internet network (primary, backup, other)
- Reboot count
- Uptime
- RTT - Round Trip Time
  - last mile
  - towards an internet target
- Router load based on current and queued activities on the system
- CPU and memory usage
- Number of active connections
- Throughput - inbound/ outbound, per interface
- Traffic - inbound/ outbound, per interface
- Traffic classification by application type for the specific device
- Number of connected devices to the Wi-Fi network/s
- GPON optical connection:
  - Uptime
  - Optical power inbount/ outboung
  - Transceiver temperature
- Radio cellular connection
  - Signal power for each connection type (4G/3G/2G e SINR, RSRP, RSSI, RSCP, EC/IO)
  - Current SIM
- xDSL connection:
  - Uptime
  - Connection status
  - Signal attenuation
  - SNR (signal-to-noise ratio)
  - CRC errors (Cyclic Redundancy Check)

All Routers

Aggregate Monitor and View.

- Total number of routers, including all which can be reached and which cannot, depending on the uptime
- Number of routers transmitting on a specifice interface
- Total number of the routers with an active mobile connection
- Number of active routers grouped by connection type (primary, backup, other)
- First 5 active routers by number of connection
- Number of router connected on 4G, 3G and 2G networks
- Classification by time of the last connected routers and those no longer reachable
- Classification of devices by response time (highest and lowest RTT) to a given destination
- Reachable and unreachable devices, as a function of uptime, in a specified time range

OVN

Overlay Network data monitoring and views.

- Number of nodes (edges) with which the router has an open peer-to-peer channel
- Bytes and number of network overlay protocol packets
- Total bytes and packets transmitted/received by the router in the network overlay
- Total data transmitted/ received via supernod (unicast, multicast and broadcast)
- Bytes and packets transmitted/received via peer to peer
- For each router with which a peer-to-peer data exchange has taken place, the following are:
  - amount of bytes/packets passed both in receive and in transmission
  - amount of data exchanged with the router via supernodo
  - data exchanged via supernoots divided by type (unicast, multicast and broadcast)

VoIP

Monitor and view data for **Voice over IP** (VoIP) scenarios.

- Date and time of last response call, unanswered, busy, failed, congested
- Total Response Call Duration
- Total call total and total divided by answers, unanswered, busy, failed, congested, and total
- Line usage based on active and concurrent calls
- Connection status for each VoIP server (not registered, registered, rejected)
- For each registered VoIP server, the total number of calls from it is shown, divided by type (answers, unanswered, congested, busy and failed), date and time
- For each individual FSX port (pots) on the router, the following are:
  - the operational status
  - bytes and packets number for calls in progress
  - last response, unanswered, failed, busy and congested calls, total number of calls
  - last outgoing answered call, unanswered, failed, busy and congested, total number of calls
- Tension and current values

Intelligent routing - Advanced Traffic Engineering

Thanks to its modules (CoS, MoS, OVN) and their features, the **TNA** suite allows you to perform "Intelligent routing", i.e, the intelligent routing of data according to the state of the network and of the devices that compose it. The features most involved are:

- Policy Based Routing
- L7 classifier
- Responder Time Reporter (RTR)
- Overlay Network Management (OVN module)

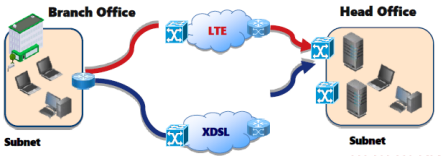
Thanks to the joint use of these and other features, the devices are able to dynamically change the used configurations and routes.

In this way you get the use of a complete distributed SDN solution, ready to react to changes in network and link states, managing them in an advanced and intelligent way.

Example - HTTP traffic intelligent routing

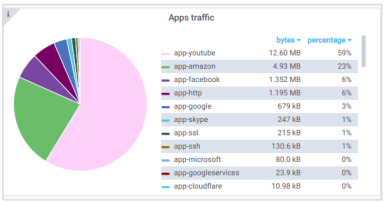
In this scenario, the xDSL connection is used to connect the main office with the branch ones.

By setting an event relating to HTTP traffic, it is possible to automatically divert web traffic to a mobile radio connection when the detected values do not fall within the threshold-values set by the user.



L7 CLASSIFIER

MoS has **L7 classifier module**, used for the classification of the applications and protocols mostly used thanks to an accurate and detailed traffic inspection (DPI).



For each application, the total of data and recognized packages are reported. All data can also be used to implement any user-defined policies.

In addition, the L7 classifier allows for advanced QoS policies within the **TNA** suite..

SCALABILITY

The MoS Module Server/Controller component is based on **GOLANG**, the language created by Google for cloud computing infrastructure.

The use of resources by MoS is optimized to make it highly scalable; the sizing of these resources is a function of the routers to be monitored, as well as the number of metrics per router, data storage time, and the granularity with which data is monitored over time: the system hosting the Server/Controller will then need to be properly configured with these values in mind. A single instance of Dual Processor Server equipped with 8GB RAM can support up to 500,000 metric per minute.

MoS therefore offers high scalability, availability, and efficie ncy.

The architecture is also based on micro-services and can be run on **kubernetes** for reliability and scalability.

RTR - Responder Time Reporter

MoS is completed by the **Responder Time Reporter (RTR) module**, which provides the ability to measure both network performance and crossing times.

RTR sends periodically probe packets towards a specific recipient (probe type are HTTP request, ICMP Echo, UDP Echo, TCP syn, TWAMP - RFC 5357), collecting for earch measurement:

- **Round Trip Time**
- **Packet loss**
- **Errors number**

You can set thresholds on packet loss and Round Trip Time, which allows you to enable specific events when the detected values are outside the set threshold, thus enabling the implementation of advanced traffic engineering. For example, the user can perform an automatic connection change by sertting an event: when the detected values are not included in the defined threshold, the connection is moved transparently and automatically.

ANOMALY DETECTION

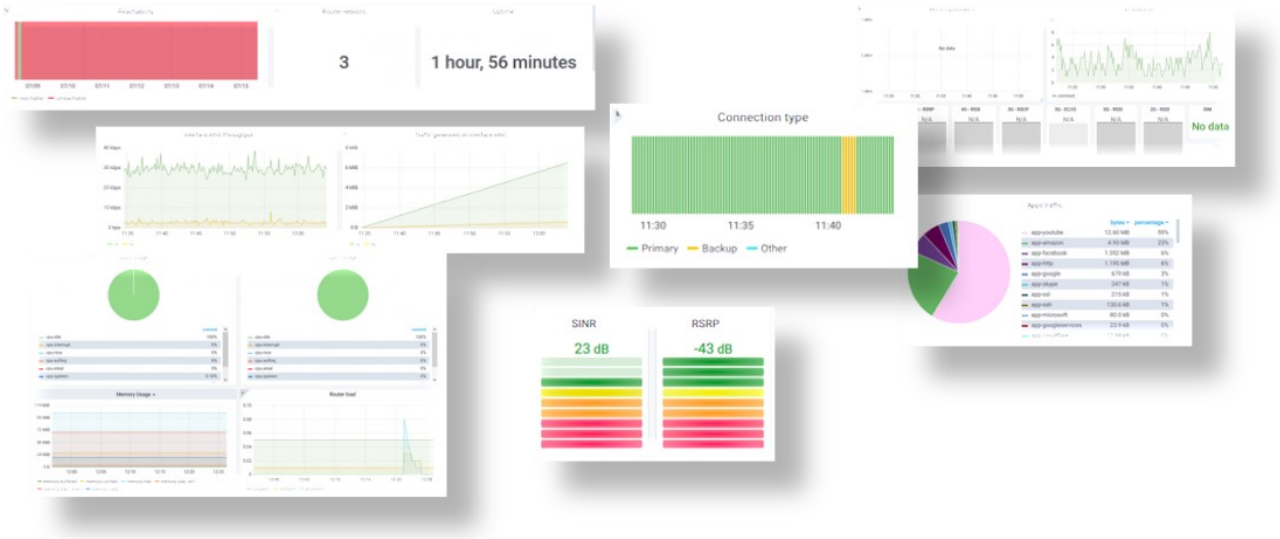
MoS is able to recognize the presence of anomalies thanks to a specific data analysis component; it catches network and traffic anomalies both to routers and to central systems.

The system uses the APIs of **Machine-Learning Keras/Tensorflow** to autonomously build anomaly thresholds (without human intervention, there is no need to configure or set anything). These thresholds are then updated according to an incremental learning model.

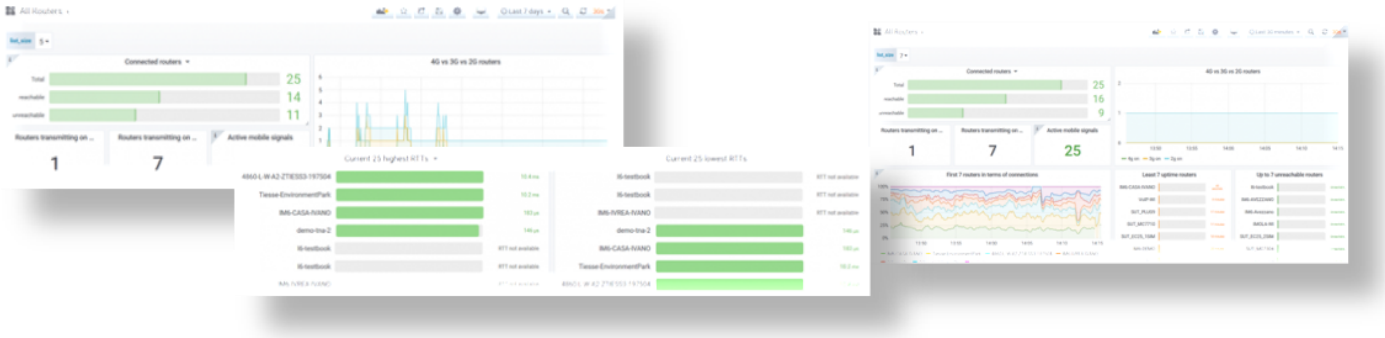
When one of these values is exceeded, the network administrator is immediately alerted by appropriate alarms.

DASHBOARD EXAMPLES

Router

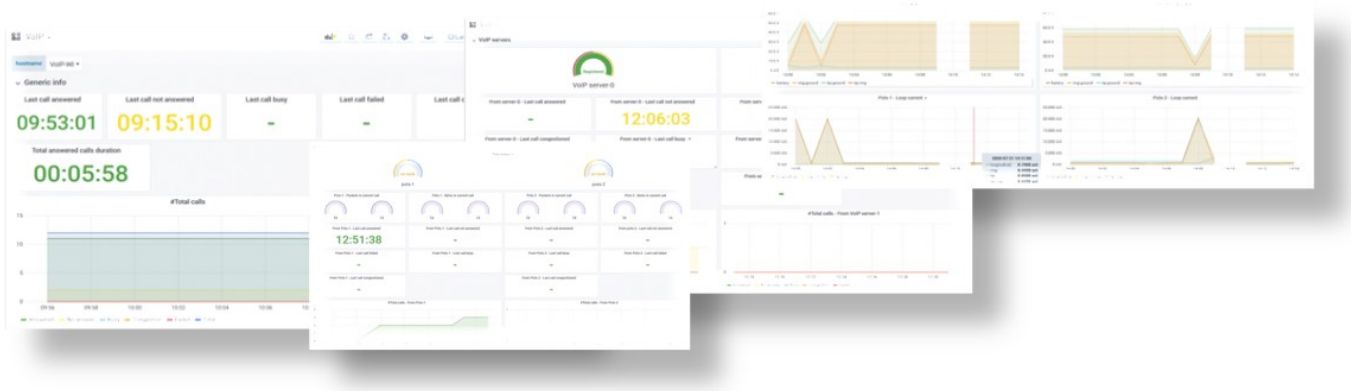


All Routers



OVN

VoIP



xDSL

CoS

Configuration management system

CoS is a component of the TNA (Tiesse Network Architecture) a web-based centralized management platform.

TNA (Tiesse Network Architecture) is the software suite consisting of three modules, whose main goal is to enable the realization of a **Zero Touch Provisioning** network architecture, including:

- **monitoring** of equipment and network status
- **displaying** of aggregated data
- **automatic management** of configuration **updates** according to user-set policies, triggers, or data-based information from all devices.

Another feature of the **TNA** suite is the ability to carry out **traffic engineering** functions, in order to transparently select the link that best fits the performance requirements of the applications.

KEY BENEFITS

Setting up devices one-by-one require manual work, and implies the possibility of human errors, which increases the deployment time.

Tiesse's **CoS**

- **reduces the effort**
- **limits the errors**
- **cutting the costs**

by allowing the users to modify multiple devices configurations at once, as well as to upload firmware to different Tiesse routers and appliances, copy configurations, planning updates with just one click.

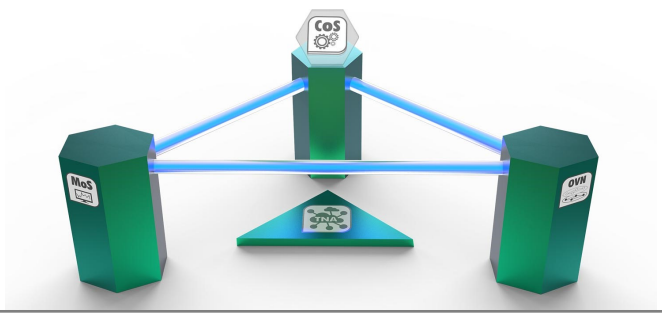
⇒ Fast configuration deployment and reduced setup time

⇒ Greater deployment efficiency

⇒ Reduction of risks due to the overall administration of the network

⇒ Easy integration of new remote site

⇒ Long life installations, supporting easy configuration migration



FEATURES

- **Automate** network discovery and inventory
- **Display information** about configurations and firmware versions
- **Update firmware and configurations** manually by an operator or **planned** by setting time slots
- Create and deploy network **devices configuration templates**
- **Classify** the devices and create multiple groups
- Set the network parameter in **bulk**, with few simple steps
- **Set commands** for specific services activation or deactivation, for specific carriers or types of connection
- Support **self-provisioning configurations**
- Display and download **reports** for each scheduled update
- Define **user accounts with different privilege** levels from read only mode up to administrator. Each level of user has specific restriction, like setting updates, creating and modifying templates, managing additional services and exceptions, modifying and creating user accounts and manage global settings.

HOW IT WORKS

COS's server process (cosd) communicates with the **COS** part installed on Tiesse routers (named **CoMS agent**).

Each device periodically sends a notification to the server process containing the information on current firmware and configuration. After receiving them, the server process compares the current versions installed on the routers to the desired ones and so determines if the devices need to be updated (configuration, firmware or both).

The process manage the updating process by contacting each single router on a specific web page. When this phase starts, the router contacts the **CoS** web server to ask which versions should be updated and applied. Server process continues to monitor the notifications to check the success or the failure of the update and then provides a report for each scheduled one.

The update on a single router can be performed by an operator or in the set time slot previously authorized via web gui.

CoS server achieves routers data via XML files in the Router Directory (SAR).

CoS is available both in Italian and English.

It is customizable with specific customer information and it allows, via API, the export of data to be used in the customer's monitoring platforms.

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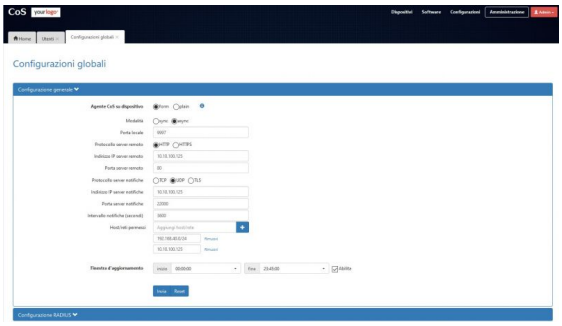


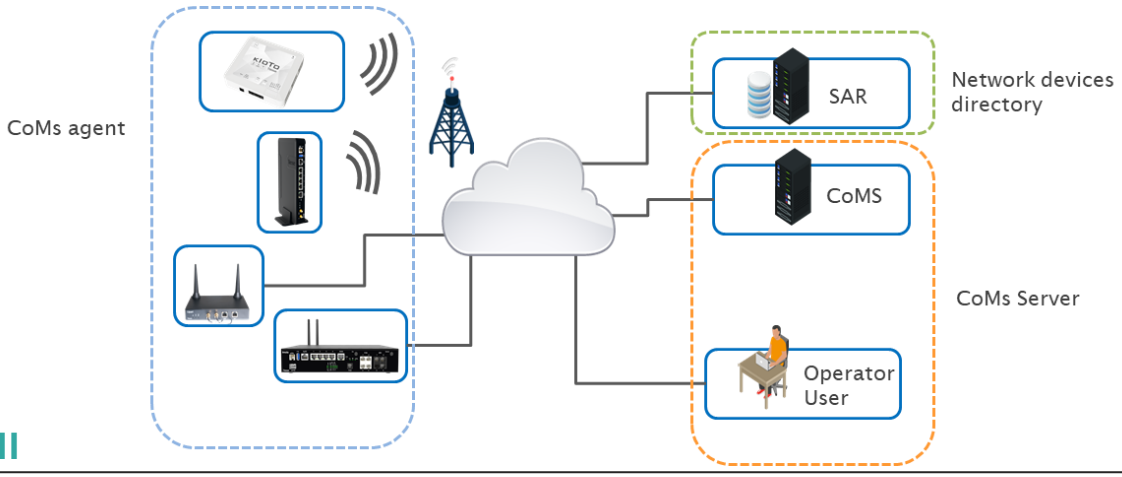
SCENARIO

CoS consists of three elements:

⇒ **Tiesse routers and M2M/IoT network appliances** equipped with CoS agent

⇒ **CoS server** which manages both control and update processes. The application represents the CoS system core and is in charge of listening to the messages/notifications sent from the network devices. A web interface allows interactions between operators and users.

⇒ **The Router Directory (SAR)** in which the data related to the administrative status of each devices and the configuration parameters are stored in XML file format.



WEB GUI

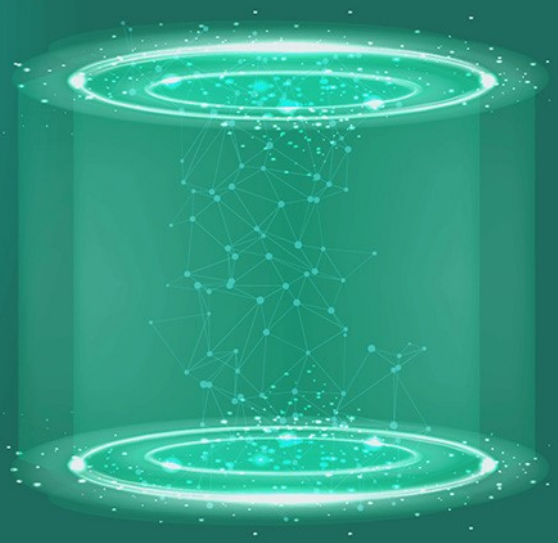
The web interface is accessible with the proper level of authentication (via Radius server). The interface is organized by tabs grouped by functionalities as well as subdivided in specific sections.

Main Group Functionalities	Sections
iOS	Firmware
Devices	Groups Routers Router Exceptions
Admin	Global Settings Users Process Log

Main Group Functionalities	Sections
Configurations	Services Carriers Line Types Router models Router functions Templates Add-on Servizi

OVN

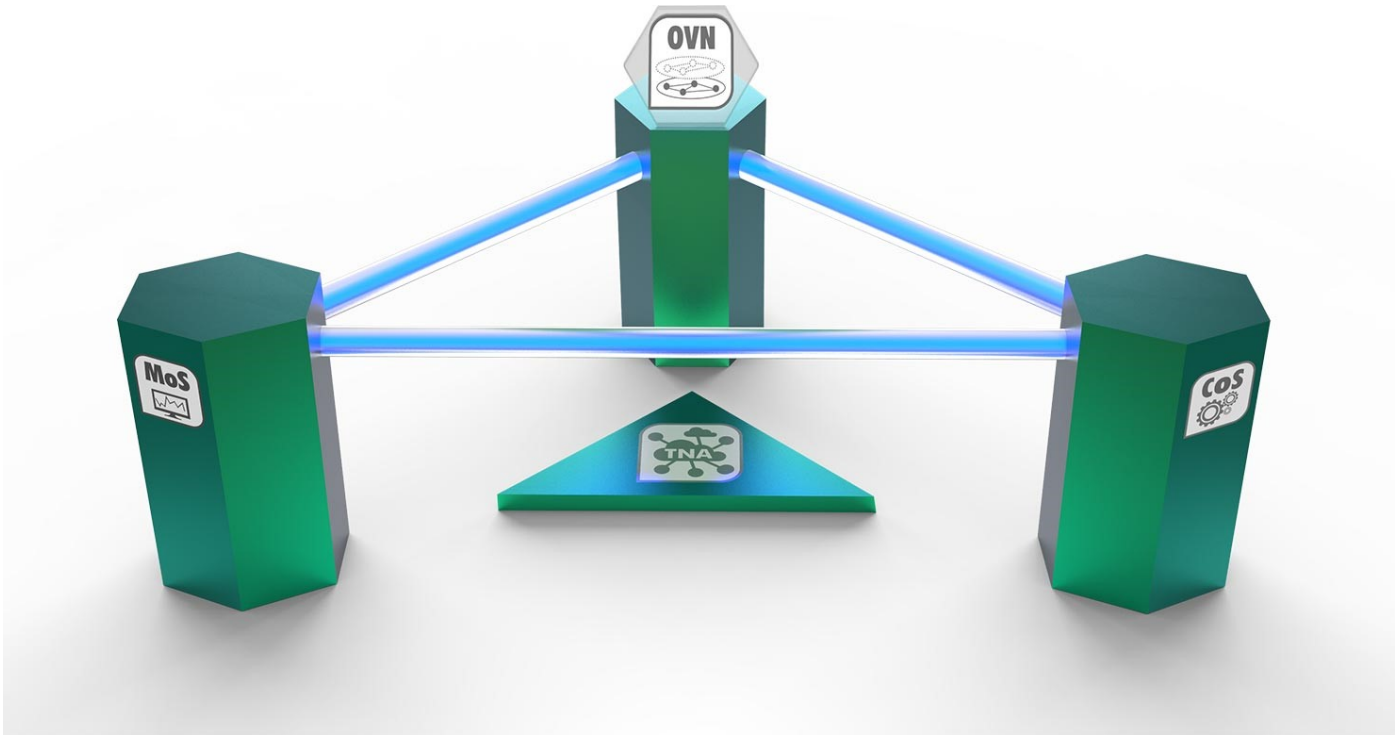
Overlay network management module



OVN (Overlay Virtual Network) is the module that allows you to create and manage an Overlay network on both public and private IP networks subject to NAT.

This function allows you to build a virtual multilevel stratification with respect to the physical network, obtaining great levels of security.

OVN is integrated with Grafana® software, which allows you to monitor registered nodes, data traffic, connected users and much more



Tiesse

Innovation made in Italy

Tiesse is a 100% italian company which has more than 20 years of expertise in designing, developing, and manufacturing M2M/IoT and network devices. The products series IMOLA, LIPARI and LEVANTO, which are innovative, competitive and certified, are present in the largest distributed national networks (from gas stations to large retailers, insurance companies and banks) as well as in the largest networks of the main gaming operators and energy sector.

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