



PHICUS
TECNOLOGIA

KRILL-WiMAX

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1- Introduction.

PHICUS is an engineering company oriented to the telecommunications operator. Develops software and conducts network consulting. Experts in DOCSIS, GPON and WiMAX technologies, provides qualified technical support 24/7.

KRILL has the following advantages:

- **MULTI-TECHNOLOGY:** It makes it possible to unify the provision, monitoring and control of a network with DOCSIS, GPON and / or WiFi / WiMAX technologies. It allows the management of all customers in a unified way.
- **MULTI-BRAND.** Compatibility with different manufacturers, both in CPEs and in header equipment (CMTS, OLT, AP). It gives the operator the freedom to choose the architecture of its network.
- **ALARMS OF THE NETWORK IN REAL TIME IN THE MOBILE:** Notifies the problems by classifying them by their severity. It allows to speed up the resolution of incidents and to have control of the network in an agile manner.

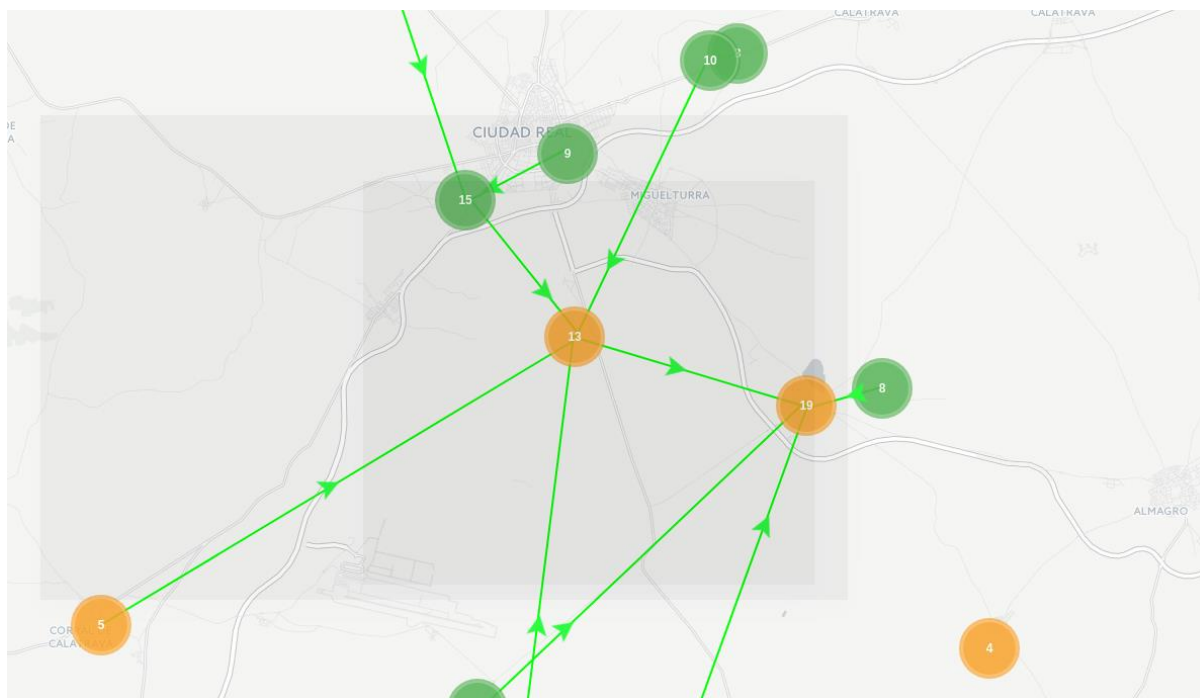
This document briefly states the monitoring, checking and reporting capabilities of the KRILL-WiMAX module.

Version: October 2018.

2- Topology / hierarchical definition of access equipment.

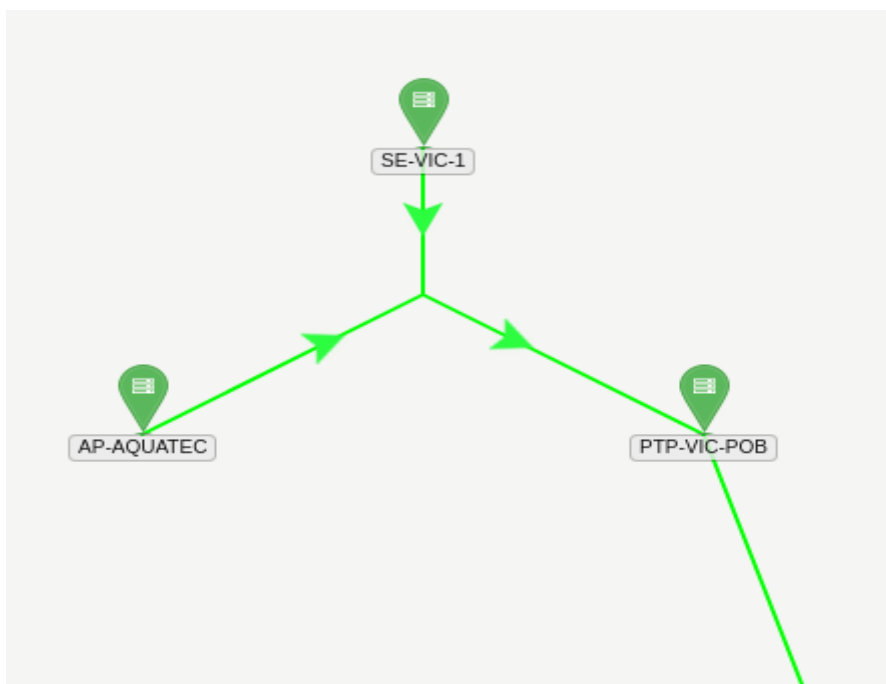
Each base station (AP) is assigned to a location and with a hierarchical dependency. Therefore, notices become selective. If, for example, a PTP falls on which 2 other links, 2 switches and 15 base stations depend, instead of issuing 20 alerts / resets, only one is issued, and as it is a single message, the location and resolution is simplified and streamlined of the fault.

Map of hierarchical dependence between nodes:



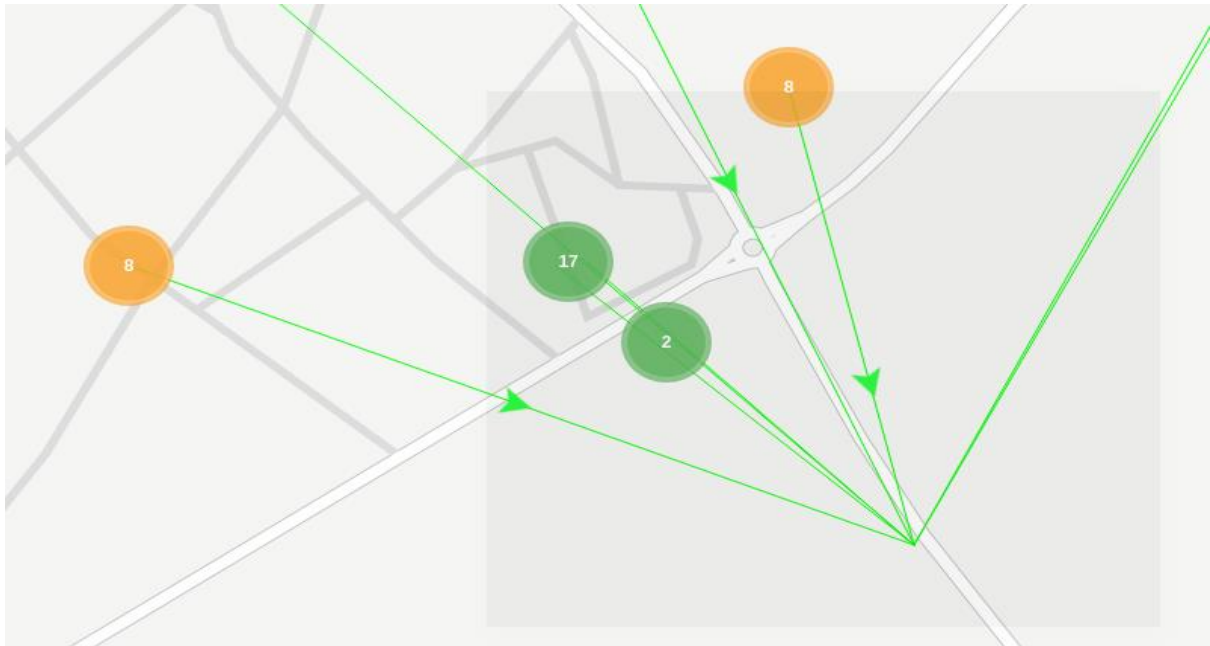
- The arrows mark the exit route of each node.
- Colors indicate if there is any warning and its severity:
 - **GREEN - OK** (Without alarms).
 - **YELLOW - WARNING** (warning level).
 - **RED - CRITICAL** (Critical level).

Detail map of tower with sector orientation:



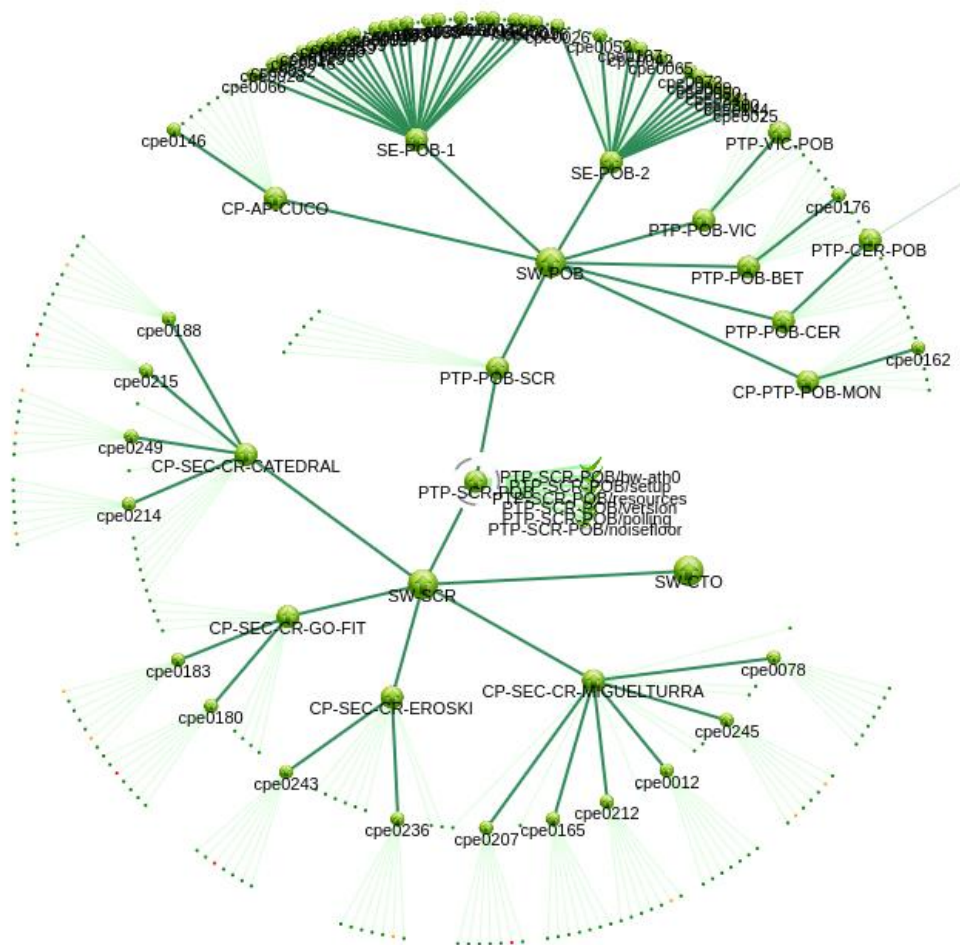
- Orientation by station.
- Dependencies intra-node and with other nodes.

Map of stations (STAs) registered in a base station (AP):



- Detection of STAs with angle away from the maximum radiation of the station.
- STAs candidates to find you station.
- Registration distances.

Dependency view:



- At the click of a mouse, it goes through the dependency tree between stations, switches and PTPs in the network.
- Vision of areas affected by a hypothetical incidence

STAs matrix per station:

		qos	downstream	version	radio	upstream	pppoe	alignment
 cpe000	[redacted] 6/1	↑	↑	↑	↑	↑	↑	↑
 cpe002	[redacted] 10/1	↑	↑	↑	↑	!	↑	↑
 cpe0057	[redacted] 8/1	↑	↑	↑	↑	↑	↑	↑
 cpe0059	[redacted] 8/1	↑	↑	↑	↑	↑	↑	↑
 cpe006	[redacted] 5/1	↑	↑	↑	↑	↑	↑	↑
 cpe008	[redacted] 10/1	↑	↑	↑	↑	↑	↑	↑
 cpe010	[redacted]	↑	↑	↑	↑	!	↑	↑
 cpe0126	[redacted]	↑	↑	↑	↑	↑	↑	↑
 cpe0182	[redacted]	⚠	!	↑	↑	↓	↑	↑
[redacted]	[redacted]							
 cpe0197	[redacted]	↑	↑	↑	↑	↓	↑	↑
 cpe0211	[redacted]	↑	!	↑	↑	↓	↑	↑
 cpe02	[redacted]	↑	↑	↑	↑	↓	↑	↑

- Verification if there is any problem common to these neighbors.
- Station saturation diagnosis.

3- Report and check by base station (AP).

All monitored services of each equipment (AP) are displayed in the web interface for easy diagnosis of problems.

Host	Service	State	Duration	Output
AP-AQUATEC		UP	1h 11m	PING OK - Packet loss = 0%, RTA = 4.7...
	bw-ath0	OK	1w 4h	in: 1478.45bps # out: 4784.02bps # fillE...
	noisefloor	OK	N/A	OK - noisefloor=-101dBm
	polling	OK	1M 22h	OK - polling_lapse=0.0sec
	radio	OK	N/A	OK - airtime=0.0%
	resources	OK	1M 22h	OK - memfree=44264kB loadavg1m=0.1...
	setup	OK	4d 17h	bw=40 MHz
	stagg	OK	2M 2w	OK - stasnum=1
	version	OK	1M 22h	

Connectivity:

Service: Ping continued to the team.

Description: Monitoring of the state of the equipment if it is active and Krill has connectivity with it. Delay graphing and percentage of lost packets.

Warning for **loss of connectivity** and restoration.

Uptime:

Service: Uptime.

Description: Without graphing.

Notice by reset and reset.

Bandwidth:

Service: bw-<_interfaz_name>

Description: Up and down graphing of the monitored interface.

Chanel noise:

Service: Noiseflor.

Description: Metric for monitoring the interference level of the radio.

Warning for channel interference and reset.

Radio Saturation:

Service: Airtime.

Description: Airtime graphs.

Notice per **saturated station** and **reset**.

Resources:

Service: Resources.

Description: Load and memory graphing.

Notice of **overload / lack of memory** and reset.

Configuration:

Service: Setup.

Description: Report of SSID, frequency and bandwidth.

Without graphics.

Notice for uptime less than 30 minutes or incorrect configuration:

OK Correct configuration with uptime greater than 30 minutes.

WARNING Configuration with slight problems or uptime less than 30 minutes.

CRITICAL Configuration with serious problems.

UNKNOWN Unknown or the configuration could not be verified.

Registered antennas:

Service: Stag.

Description: Graphs per registered STAs.

Alarm for excess of customers.

Versión Firmware version:

Service: Version.

Description: Firmware version report. Check that the CPE has the firmware version recommended by the manufacturer.

OK Version updated to the version recommended by the manufacturer.

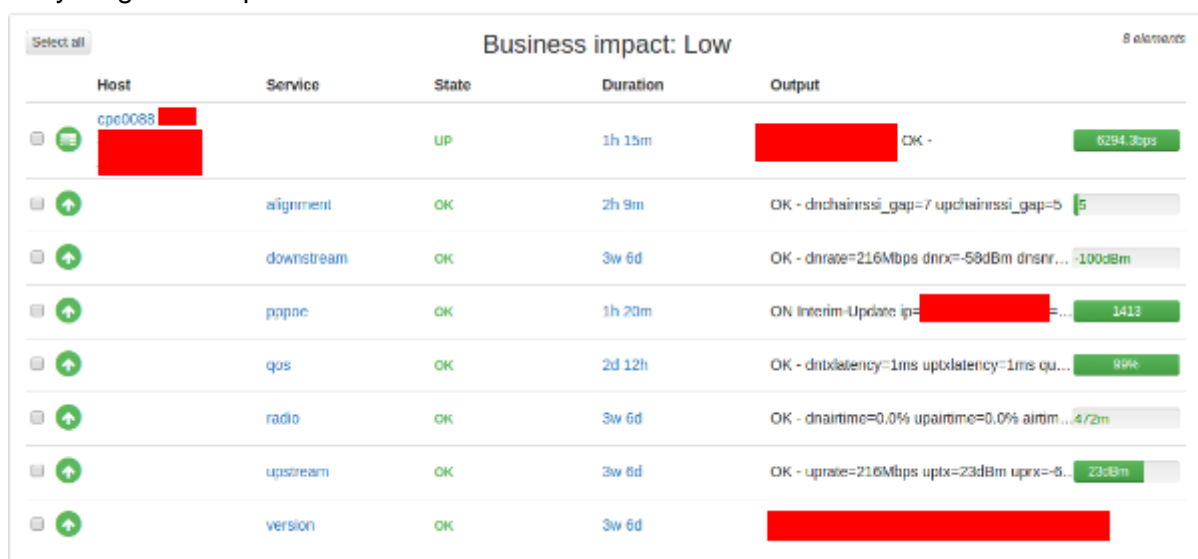
WARNING Outdated or inadequate version.

CRITICAL Vulnerable version or with recognized security problem.

UNKNOWN The version could not be obtained.

4- Report and check by station (STA).

All the monitored services of each client team (CPE) are displayed in the web interface for easy diagnosis of problems.



Select all		Business impact: Low			8 elements
Host	Service	State	Duration	Output	
cpe0088		UP	1h 15m	OK - [redacted] 6294.3bps	
	alignment	OK	2h 9m	OK - dnchainrssi_gap=7 upchainrssi_gap=5 5	
	downstream	OK	3w 6d	OK - dnrate=216Mbps dnrx=-58dBm dnshr...-100dBm	
	pppoe	OK	1h 20m	OK Interim-Update ip=[redacted] 1413	
	qos	OK	2d 12h	OK - dnlatency=1ms uptlatency=1ms qu... 99%	
	radio	OK	3w 6d	OK - dnairtime=0.0% upairtime=0.0% airtim...4/2m	
	upstream	OK	3w 6d	OK - uprate=216Mbps uptx=-23dBm uprx=-8... 23dBm	
	version	OK	3w 6d	[redacted]	

Registration:

Description: Reports whether or not it is online, and the station where it is registered. Only warns of fall / reset if notifications are enabled for the client in question.

Alignment:

Service: Alignment.

Description: Graphing the estimation of bad orientation of the antenna.

It only notifies of alignment / restoration problem if notifications are enabled for the client in particular.

Transmission AP->STA:

Service: Downstream.

Description: Graphification of noise-floor, rate, power received in the STA and SNR in the AP-> STA sense.

It only warns of bad parameters and **reset if notifications are enabled** for the client in particular.

Transmission STA->AP:

Service: Upstream

Description: Graphification of noise-floor, rate, power emitted by the STA and received in the AP and SNR in the AP-> STA direction.

It only warns of bad parameters and reset if notifications are enabled for the client in particular.

Quality of service:

Service: QOS.

Description: Graphing of ccq, dntxlatency, quality and uptxlatency. Only warns of SLA breach and reset if notifications are enabled for the client.

DHCP (optional):

Service: OOS.

Description: Registration of the dynamic obtaining of the ip by the CPE (depends on the topology of the operator).

PPPoE (optional):

Service: PPPoE..

Description: Record of the dynamic obtaining of the IP by the NAT (Radius) and graphing of bandwidth according to RADIUS accounting messages (depends on the topology of the operator).

PPPoE connection / disconnection warning if the alarms are enabled for that CPE.

Detail of the monitoring parameters of a CPE:

Service	Metric	Value	Warning	Critical	Min	Max	UOM	
Host check	dnbw	7943.5					bps	
	upbw	3015.7					bps	
radio	airtime	0	20	30	0	100	%	
	distance	315	20000	50000	0	100000	m	
	dnairtime	0	20	30	0	100	%	
	upairtime	0	20	30	0	100	%	
downstream	dnnoisefloor	-100	-90	-80	-120	-70	dBm	
	dnrate	216	40	15	0	500	Mbps	
	dnrx	-58	-72	-82	-120	30	dBm	
	dnsnr	38	30	20	0	75	dB	
upstream	upnoisefloor	-102	-90	-80	-120	-70	dBm	
	uprate	216	40	15	0	500	Mbps	
	uprx	-61	-72	-82	-120	30	dBm	
	upsnr	35	30	20	0	75	dB	
qos	uptx	23	28	35	-5	30	dBm	
	ccq	99	95	80	0	100	%	

5- CORE module. Check and report of the main elements of the network.

In addition to the WiMAX module and the monitoring and parameterization of the AP and STA equipment, the status of other critical equipment for the network is also monitored, such as: SWITCHES, core ROUTERS, PTPs that link different zones.

PTP:

The two teams involved are monitored: the sender and receiver, being able to view their services separately or using the same view to quickly see the status of the link.

The screenshot displays five status cards, each with a green upward arrow icon and a star icon, indicating that all services are operational. The cards contain the following information:

- backup (★) is OK since 1w 1h:** /home/shinken/wimax_backups [redacted] backup_2018_10_07.cfg created!
- info (★) is OK since 2w 6d:** laddress: [redacted] lrunmodel: [redacted] raddress: [redacted] rrunmodel: [redacted] nfreq:5145 dnchan:20 dntx:24.0 upfreq:5145 upchan:20 uptx:24.0
- itfs (★) is OK since 1w 4h:** 0 interfaces monitored
- radio (★) is OK since 3d 42m:** dncapacity=104Mbps upcapacity=71Mbps dnairtime=3.0% upairtime=0.3% dnrx0=-65.0dBm dnrx1=-65.0dBm uprx0=-67.0dBm uprx1=-65.0dBm
- setup (★) is OK since 5d 5h:** luptime=4:49:16.550000 lversion=[redacted] lrunmode=[redacted] lnspeed=1000Mb/s-Full lcpu=3 rrunaddress=None ruptime=12:50:39.920000 rversion=[redacted] runmode=[redacted] rnspeed=100Mb/s-Full rcpu=4

Backup: A backup of the equipment is automatically created in Krill. The service checks the backup status and shows the route where it has been saved.

Info: Shows relevant information of the equipment: IP, equipment models, link parameters, frequencies ...



ITFS: The status of the different interfaces of the equipment is shown.

Radio: The parameters related to the radio are shown: capacity of descent and rise, noise, powers ...

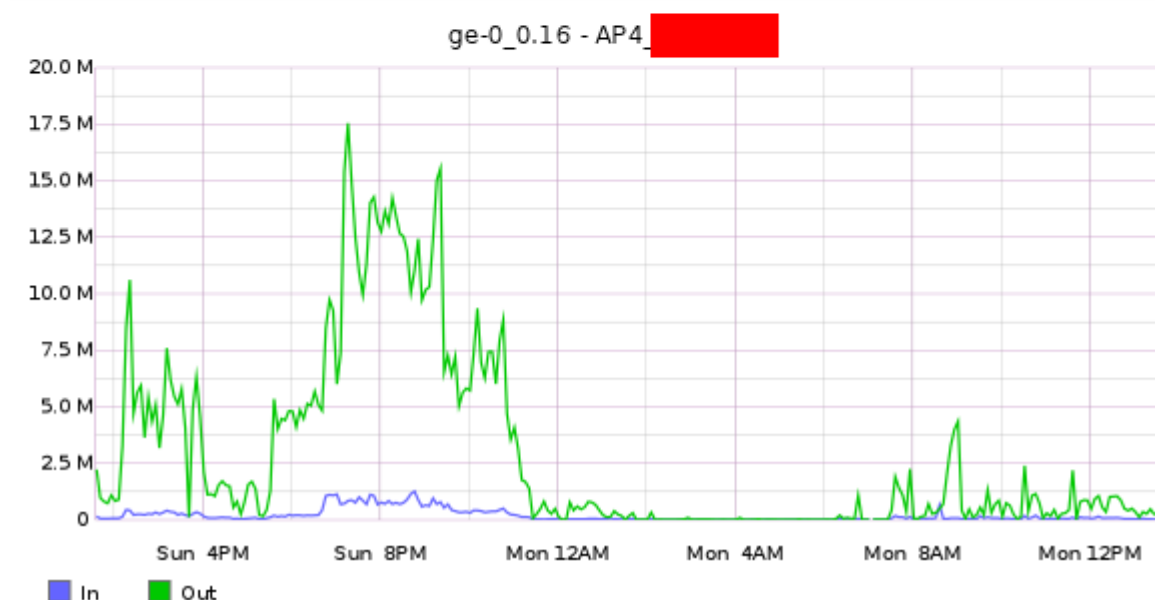
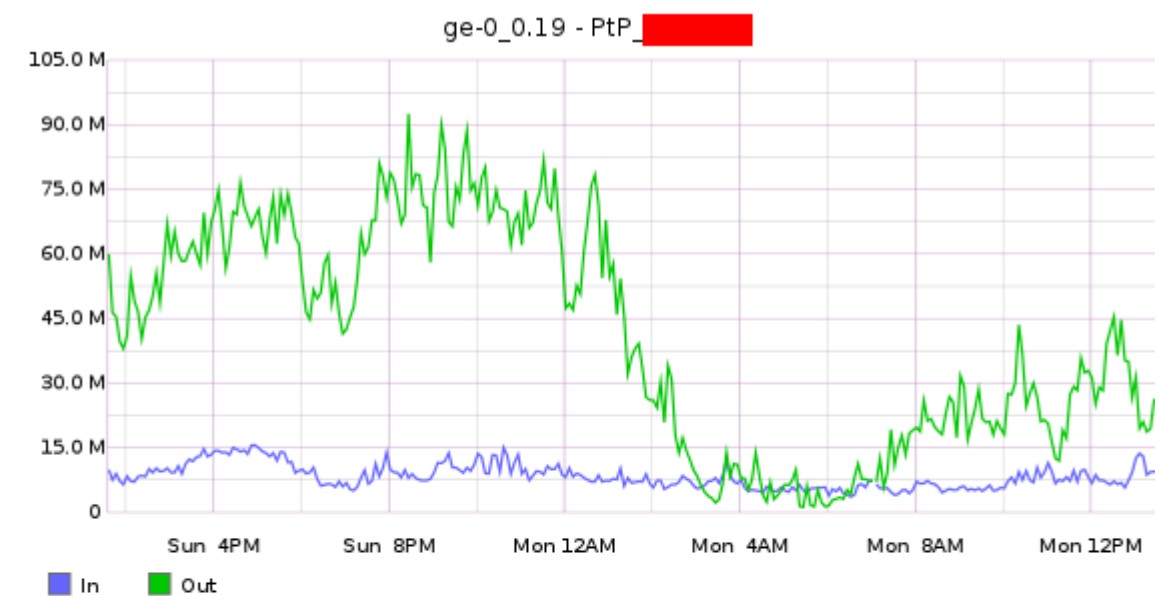
Setup: It shows configuration information of the equipment: Firmware version, status of the equipment's ethernet ports, uptime, CPU and RAM usage ...

SWITCH:

As a main part of the network, the switches are also monitored, both the switch and its interfaces.

Host	Service	State	Duration	Output
		UP	4d 21h	PING OK - Packet loss = 0%, RTA = 8.90 ms 0%
	info	OK	4M 5d	sysdescr:Juniper Networks, Inc. ex2200-24t-4g Ethernet Switch, kernel JUNOS 15.1R5.5, Build date: 2016-11-2...
	ifs	OK	1w 5d	10 interfaces monitored 9448409 80184pps
	setup	OK	1w 5d	0%

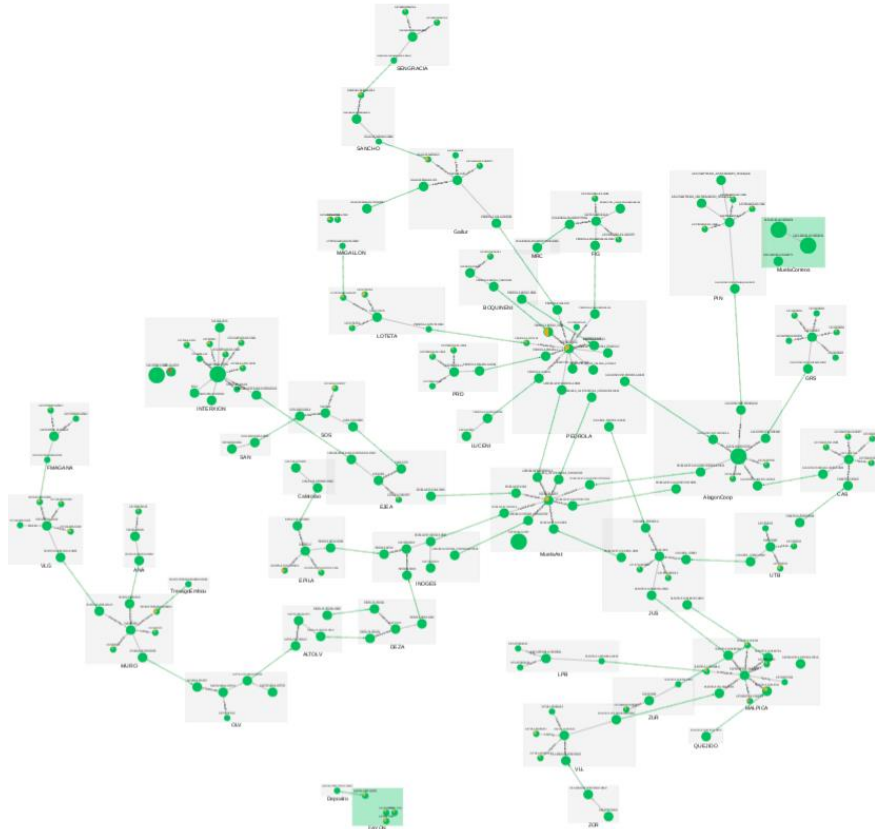
A first glance allows us to know the status quickly, and then we can access the graphs and parameters of each interface:



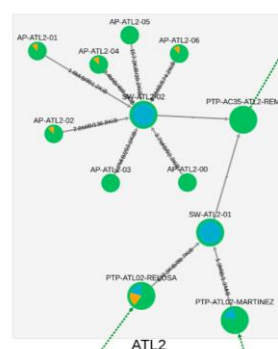
We will show the traffic information for each one of the interfaces of the switch with its description.

6-Trivial view.

We have developed a view of the inventory that we have called Trivial, allows at a glance and dynamically visualize through "boxes, circles and arrows" the network, with the necessary parameters to determine if there is a problem in any point of the network or just to get a quick idea of its structure.



According to the color of the team we can, for example, know if a PTP has fallen from the area following our core or which areas are affected by a power outage ...



Each team defined and displayed in the view defines its related links: access to the file, graphics, dependencies ...

7-Matrix view.

In contrast to the generalized view of Trivial, Matrix has been developed as a view with a large amount of data, similar to a spreadsheet that allows, at a glance, to detect common problems of one or several equipment, thanks to the color code in function of the defined parameters of the different services.

An example would be: to a certain AP we collect different parameters from the antennas that are connected to it, and thanks to the joint view, we can have an idea of the state of it.

The screenshot shows the Shinken Matrix view for the host 'reg-AP-MONAKO-01'. The table displays various performance metrics for 16 different antennas (cpe2913 to cpe3410). The metrics are color-coded: green for good, yellow for warning, and red for critical. The columns are grouped into radio, downstream, qos, upstream, and host categories.

Host	radio			downstream			qos		upstream				host		
	dnair	ai	upair	dnrx	dnrat	dnsnr	ul	dl	uprx	uprat	upsnr	upbc	upbw	dnbw	reg
cpe2913	0%	0%	0%	-52	58	24	0	0	-56	58	25	21	-	-	AP-MONAKO-01
cpe2921	0%	0%	0%	-64	58	24	0	0	-67	58	22	23	-	-	AP-MONAKO-01
cpe2922	0%	0%	0%	-57	58	23	0	0	-59	58	23	23	-	-	AP-MONAKO-01
cpe2943	0%	0.1%	0%	-51	58	26	0	0	-55	52	26	18	7.9kb	19.9kb	AP-MONAKO-01
cpe2948	0%	0%	0%	-64	58	24	0	0	-66	39	21	23	-	-	AP-MONAKO-01
cpe2956	0.5%	0.5%	0%	-72	52	21	0	0	-79	52	10	23	-	-	AP-MONAKO-01
cpe2961	0.1%	0.1%	0%	-65	58	23	0	0	-66	58	21	23	-	-	AP-MONAKO-01
cpe3103	0%	0%	0%	-68	58	26	0	0	-68	58	19	23	-	-	AP-MONAKO-01
cpe3241	0%	0%	0%	-60	58	24	0	0	-63	39	22	23	-	-	AP-MONAKO-01
cpe3242	0%	0%	0%	-50	58	25	0	0	-54	52	24	21	-	-	AP-MONAKO-01
cpe3246	0%	0%	0%	-52	58	24	0	0	-55	58	24	21	-	-	AP-MONAKO-01
cpe3301	4.4%	4.5%	0.1%	-64	58	23	0	0	-67	58	20	23	-	-	AP-MONAKO-01
cpe3326	3.1%	3.2%	0.1%	-65	58	23	0	0	-68	58	21	23	-	-	AP-MONAKO-01
cpe3410	0%	0%	0%	-58	58	24	0	0	-62	52	24	23	-	-	AP-MONAKO-01

The results obtained by each view are exportable to different types of files in order to facilitate their printing or sharing.

8- CLI for advanced diagnostics.

Additionally, Krill has an accessible CLI for the operator with advanced functions such as AP / CPE update, advanced metric viewer, massive configuration management, etc ...

```

aphost [REDACTED]
address [REDACTED]
distance 4950
mode ap
uptime 4755337
platform [REDACTED]
version [REDACTED]
antenna AM-SG19-120 - 19 dBi
noise fl -93

-----
mac cpe id qua coq dista / rate tx rx snr noi chg bw / rate tx rx snr noi chg bw
[REDACTED] cpe0024 3 11 92 4050 / 78.0 27 -76 20 -105 2 1695 / 78.0 23 -78 18 -93 4 1591 0 0 - 0.0 0.0
[REDACTED] cpe0085 9 82 94 4950 / 104.0 27 -65 31 -102 2 1150 / 104.0 23 -70 26 -93 6 1129 0 0 - 0.0 0.0
[REDACTED] cpe0166 5 83 96 4800 / 104.0 27 -63 33 -103 2 656 / 104.0 23 -67 29 -93 6 689 0 0 - 0.0 0.0
[REDACTED] cpe0244 10 52 89 1800 / 78.0 27 -62 34 -104 1 1594 / 78.0 5 -75 21 -93 6 1610 0 0 - 0.0 0.0
[REDACTED] cpe0037 4 75 95 4650 / 78.0 27 -64 32 -103 1 1214 / 104.0 23 -67 29 -93 3 1521 0 0 - 0.0 0.0
[REDACTED] cpe0135 8 48 96 4950 / 78.0 27 -70 26 -102 1 1209 / 78.0 23 -75 21 -93 2 1291 0 0 - 0.0 0.0
[REDACTED] cpe0084 1 83 98 3900 / 104.0 27 -61 35 -105 0 399763 / 104.0 23 -67 29 -93 1 14816 0 0 - 1.1 0.0
[REDACTED] cpe0148 7 81 95 4200 / 104.0 27 -66 30 -92 4 689 / 104.0 23 -65 31 -93 6 1036 0 0 - 0.0 0.0
[REDACTED] cpe0208 2 41 94 4200 / 52.0 27 -69 27 -104 2 652 / 119.5 5 -84 12 -93 5 958 0 0 - 0.0 0.0
[REDACTED] cpe0247 6 82 95 2100 / 104.0 27 -62 34 -105 -3 15139 / 130.0 5 -67 29 -93 2 73590 0 0 - 0.0 0.2
SW downlink 423761 uplink 98230 total 521992
% AIR 1.4

-----
aphost [REDACTED]
address [REDACTED]
distance 2400
mode ap
uptime 4755336
platform [REDACTED]
version [REDACTED]
antenna AM-SG19-120 - 19 dBi
noise fl -90

-----
mac cpe id qua coq dista / rate tx rx snr noi chg bw / rate tx rx snr noi chg bw
[REDACTED] pe0173 2 85 97 1950 / 104.0 11 -60 36 -104 3 1044 / 78.0 5 -69 27 -90 0 1241 0 0 - 0.0 0.0
[REDACTED] pe0071 1 91 98 180 / 104.0 11 -60 36 -101 -10 1408 / 104.0 27 -57 33 -90 -12 1768 0 0 - 0.0 0.0
SW downlink 2452 uplink 3009 total 5461
% AIR 0.0

```