Wansight 7.1 User Guide

- Console
- Sensors (Packet Sensor, Flow Sensor, SNMP Sensor, Sensor Cluster)

Revision 7.13

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Traffic Monitoring and IP Accounting with Wansight

Andrisoft Wansight is an award-winning enterprise-grade software which delivers to NOC and IT teams the functionality needed for monitoring the traffic of large WAN networks. Andrisoft Wanguard extends Wansight with advanced anomaly detection and DDoS mitigation capabilities. If you also need these capabilities, you can upgrade to Wanguard simply by uploading a Wanguard license key.

Key Features & Benefits

- ✔ **FULL NETWORK VISIBILITY** – Supports all major IP traffic monitoring technologies: packet sniffing, NetFlow version 5, 7 and 9; sFlow version 4 and 5; IPFIX and SNMP
- ✔ **FAST, SCALABLE & ROBUST** – Designed to run on commodity server hardware by leveraging high-speed packet capturing technologies such as DPDK, Sniffer10G, PF_RING Vanilla, PF_RING ZC and Netmap. Can run as a cluster with its software components distributed across multiple servers
- ✔ **ENTERPRISE-GRADE WEB CONSOLE** – Provides consolidated management and reporting through a highly-configurable multi-tenant web portal with customizable dashboards, user roles, and remote authentication
- ✔ **PACKET SNIFFER** – Saves packet dumps using a distributed packet sniffer that can be deployed on different network entry points. Displays packet details in a Wireshark-like web interface
- ✔ **FLOW COLLECTOR** – Contains a fully-featured NetFlow, sFlow, and IPFIX collector that saves flow data in a compressed format for long term storage. Flows can easily be searched, filtered, sorted, and exported
- ✔ **COMPLEX ANALYTICS** – Generates complex reports with aggregated data for hosts, departments, interfaces, applications, ports, protocols, countries, autonomous systems, and more
- ✔ **REAL-TIME REPORTING** – Bandwidth graphs are animated and have a short-term accuracy of just 5 seconds
- ✔ **HISTORICAL REPORTING** – You can view reports from the last 5 seconds to the last 10 years by selecting any custom time period. Bandwidth histograms contain 95th-percentile values for burstable billing
- ✔ **SCHEDULED REPORTING** – Generates PDF and HTML reports and sends them automatically by email to the interested parties at preconfigured intervals of time
- ✔ **COMPLETE REST API** – All configurations and collected data can be easily queried and referenced via a fully-featured RESTful API which exposes hundreds of internal parameters, graphs and tops

All configurations are stored in an SQL database that is easy to backup and restore.

Software Components

Wansight Sensor provides in-depth traffic analysis, traffic accounting, and bandwidth monitoring. The collected information enables you to generate complex traffic reports, graphs, and tops; instantly pin down the cause of network incidents; understand patterns in application performance and make the right capacity planning decisions.

Wansight Console provides a multi-tenant web graphical user interface that functions as the administrative core of the software. It offers single-point management and reporting by consolidating data received from all Wansight Sensors deployed within the network.

For brevity, Wansight Sensor is sometimes referred to as the Sensor, and Wansight Console as the Console.

Choosing a Method of Traffic Monitoring

This chapter describes the traffic monitoring technologies supported by Wansight Sensor.

There are four Wansight Sensor “flavors” that differ only in the way they obtain traffic information:

- **Packet Sensor** analyzes packets. It can be used on appliances that are either deployed in-line (servers, firewalls, routers, bridges, IDSes, load-balancers) or connected to a mirrored port or TAP.

  In switched networks, only the packets for a specific device reach the device's network card. If the server running a Packet Sensor is not deployed in-line, in the main data path, then a network TAP or a switch or router that offers a “monitoring port” or “mirroring port” must be used. In this case, the network device sends copies of data packets traveling through selected ports or VLANs to the monitoring port. Packet Sensor inspects every packet it receives and conducts packet-based traffic analysis

- **Flow Sensor** analyzes flows. It is used for monitoring NetFlow® (jFlow, NetStream, cflowd), sFlow® and IPFIX flow packets.

  Many routers and switches can collect IP traffic statistics and periodically send them as flow records to a Flow Sensor. Because the flow protocol already performs pre-aggregation of traffic data, the flow data sent to Flow Sensor is much smaller than the monitored traffic, and this makes Flow Sensor a good option for monitoring remote or high-traffic networks. The main downside of flow-based traffic analysis is that pre-aggregating traffic data adds a delay of at least 30 seconds to collecting real-time traffic statistics

- **SNMP Sensor** monitors the bandwidth usage of routers and switches on a port-by-port basis.

  When this technology is used, an SNMP Sensor queries the device (e.g. router, switch, server) for the traffic counters of each port with small data packets. These are triggering reply packets from the device. Compared to other bandwidth monitoring technologies, the SNMP option is very basic and offers no IP-specific information. SNMP creates the least CPU and network load

- **Sensor Cluster** aggregates pre-existing Sensor traffic data into a single, unified IP graphing domain.

  Sensor Cluster sums up the traffic data collected by Packet Sensors, Flow Sensor and SNMP Sensor interfaces and performs the same tasks as the other Sensors (IP graphing, IP accounting, etc.)

For redundancy, high availability and to be able to view packet traces and flow dumps, you can deploy Flow Sensor(s) and Packet Sensor(s) simultaneously.

Comparison between Packet Sniffing, Flow Monitoring, and SNMP Polling

Packet Sensor is recommended when the speed of detecting attacks is critical or when there is a need for capturing raw packets for forensics and troubleshooting. Because every packet entering the network is inspected, Packet Sensor needs to run on servers with powerful CPUs.

Flow Sensor analyzes pre-aggregated traffic information sent by routers or switches, therefore it can monitor the traffic passing through multiple 10G/40G/100G interfaces even when it is running on a low-end server. Flow Sensor has a few disadvantages:

- ✗ it exhibits reduced speed in processing real-time traffic information because flow exporters aggregate traffic data over time, with delays of 30 seconds or more
- ✗ it provides slightly less accurate traffic readings because in most cases the packets or flows are sampled
- ✗ enabling the flow exporter functionality may result in an increased CPU load on the network device, if the flow collection is not performed in hardware
- ✗ flows can be dropped if a powerful spoofed DDoS attack fills the TCAM of the network device

It is recommended to use SNMP Sensor only for devices that cannot export flows or mirror packets, or to compare flow and SNMP-derived statistics in order to ensure the flow data accuracy.

	Packet Sensor	Flow Sensor	SNMP Sensor
Traffic Monitoring Technology	• Sniffing packets passing an in-line appliance • Port mirroring (SPAN, Roving Analysis Port) • Network TAP	• NetFlow version 5, 7 and 9 (jFlow, NetStream, cflowd) • sFlow version 4 and 5 • IPFIX	• SNMP version 1 • SNMP version 2c • SNMP version 3
Maximum Traffic Capacity per Sensor*	40 GigE	multiples of 100 Gbps	multiples of 100 Gbps
DDoS Detection Time**	≤ 1 seconds	≥ flow export time (≥ 30 seconds) + 5 seconds	≥ 5 seconds, no details on sources or destinations
IP Graph Granularity	≥ 5 seconds	≥ 20 seconds	N/A
Traffic Validation Options	IP classes, MAC addresses, VLANs, BPF	IP classes, Interfaces, AS Numbers, Ingress/Egress	Interfaces
Packet Tracer	Yes	No	No
Flow Collector	No	Yes	No

* The number of connections between IPs is not limited
** Wanguard Sensor can detect which destination is under attack. The sources of the attack are detected only by Wanguard Filter.

Wansight Installation

Installing Wansight does not generate negative side effects on the network's performance. Full installation and configuration may take less than an hour.

Wansight runs exclusively on Linux platforms. To install and configure the software you need basic Linux operation skills and at least medium computer networking skills. If you encounter software installation issues or if you have questions about the system requirements listed below contact support@andrisoft.com.

System Requirements

Wansight 7.1 can be installed on the following 64-bit Linux distributions: Red Hat Enterprise Linux 6 or 7 (commercial), CentOS 6 or 7 (free, Red Hat-based), Debian Linux 6 to 9 (free, community-supported), Ubuntu 12 to 18 (free, Debian-based). The REST API is compatible with PHP 5.6 or newer.

The most recommended Linux distribution for Wansight 7.1 is Ubuntu 18.04 LTS.

Wansight was designed to be completely scalable, so it can be installed either on a single server that has adequate hardware resources or on multiple servers distributed across the network.

It is highly recommended to install the software on dedicated servers and not on Virtual Machines, mainly for the following reasons:

- Having fast and uninterrupted access to the hard disk is a critical requirement of the Console
- The resources must be provisioned in a predictable and timely manner
- Some virtualized environments do not have a stable clock source

Importance of HW resources	CPU Speed (> GHz/core)	CPU Cores (> cores)	RAM Size (> GB)	HDD Size (> GB)	HDD/SSD Speed (> Mbytes/s)	Network Adapter (Vendor, Model)
Console	*High*	*High*	*High*	*Very High*	*Very High*	*Very Low*
Packet Sensor	*Very High*	*High*	*Medium*	*Low*	*Low*	*Very High*
Flow Sensor	*Low*	*Low*	*High*	*Medium*	*High*	*Very Low*
SNMP Sensor	*Very Low*	*Low*	*Very Low*	*Very Low*	*Very Low*	*Very Low*
Sensor Cluster	*Medium*	*Medium*	*Medium*	*Very Low*	*Very Low*	*Very Low*

Legend	*Very High Importance*	*High Importance*	*Medium Importance*	*Low Importance*	*Very Low Importance*

Minimum System Requirements for Console

Capacity	10+ components (Sensors, Filters, BGP Connectors)
Architecture	64-bit x86
CPU	1x 2.4 GHz quad-core Xeon
RAM	1 x 4 GB
NICs	1 x Fast Ethernet for management
HDDs	2 x 7200 RPM HDD (SSD highly recommended), RAID 1, 350 GB

The Console server stores the database and centralizes all operational logs, graphs and IP accounting data.

Its performance is determined by its settings, as well as the performance of the I/O and the performance of the applications it relies on: MySQL/MariaDB, Apache HTTPD and PHP.

To access the web interface, use one of the following web browsers: Google Chrome, Firefox 3.5 or later, Safari 3.0 or later, Internet Explorer 8 or later. JavaScript and cookies must be enabled. Java and Adobe Flash are not required. For the contextual help you may need to install Adobe PDF Reader.

For the best experience use Google Chrome and a 1280x1024 or higher resolution display.

Minimum System Requirements for Packet Sensor

Capacity	10 Gbit/s, 14 Mpkts/s	40 Gbit/s, ± 30 Mpkts/s
Architecture	Intel Xeon 64-bit, dedicated server	Intel Xeon 64-bit, dedicated server
CPU	1x 2.4 GHz Xeon E5-2640v4	1 x 2.4 GHz Xeon E5-2680v4
RAM	4 x 2 GB DDR4 (quad channel)	4 x 4 GB DDR4 (quad channel)
NICs	1 x 10 GbE adapter (Myricom, Intel 82599+ or PF_RING/DPDK-supported chipset) 1 x Fast Ethernet for management	1 x 40 GbE adapter (Intel XL710+ or other DPDK-supported chipset) 1 x Fast Ethernet for management
HDDs	2 x 5400 HDD, RAID 1, 10 GB (including OS)	2 x 5400 HDD, RAID 1, 10 GB (including OS)

Packet Sensor can run load-balanced over multiple CPU cores with the following hardware or Capture Engines:

- Intel 82599 chipset network adapters, such as Intel X520, Intel X540, HP X560 or Silicom PE310G4DBi9-T
- Myricom network adapters having a Sniffer 10G license
- PF_RING (with or without ZC) high-speed packet I/O framework
- Netmap high-speed packet I/O framework and it's supported NICs
- Data Plane Development Kit (DPDK) and all it's supported NICs

To scale the capacity above 40 Gbit/s you can configure packet sampling on the switch/TAP, or you can define a Sensor Cluster which aggregates multiple Packet Sensor instances running on different servers equipped with 10-40

Gbit/s network adapters.

Minimum System Requirements for Flow Sensor

Capacity	15000 flows/s
Architecture	64-bit x86
CPU	1 x 2.0 GHz dual-core Xeon
RAM	1 x 8 GB
NICs	1 x Fast Ethernet for management
HDDs	2 x 7200 RPM HDD, RAID 1, 60 GB

Flow Sensor does not have a limit on the number of interfaces it can monitor or a limit of how many flows per second it can process. Each Flow Sensor can handle the flows of a single flow exporter. A server with enough RAM can run tens of Flow Sensors. For this type of Sensor, the amount of RAM is much more important than the CPU speed.

Flow Sensor can store flow data on the local disk in a highly compressed binary format.

Minimum System Requirements for SNMP Sensor

Capacity	20+ devices
Architecture	64-bit x86
CPU	1 x 1.6 GHz dual-core Xeon
RAM	1 x 1 GB
NICs	1 x Fast Ethernet for management
HDDs	2 x 5200 RPM HDD, RAID 1, 20 GB

Each SNMP Sensor can monitor a single device with an unlimited number of interfaces.. A server can run an unlimited number of SNMP Sensors.

Minimum System Requirements for Sensor Cluster

The hardware requirements for Sensor Cluster are very low because the traffic information is pre-aggregated by the associated Flow Sensors, Packet Sensors or SNMP Sensors. It is recommended to run it on the Console server if it's not very loaded.

Software Installation

The download link is listed in the email containing the trial license key. The latest software installation instructions are listed on the Andrisoft website.

A trial license key activates all features for 30 days. You can install the trial license key on any number of servers. To switch to a full, registered version, apply a license key purchased from the online store.

Opening the Console

Wansight Console provides a web interface and centralized system through which you can control and monitor all other components. If you have correctly followed the installation instructions, from now on you will only need to log in to Console to manage and monitor servers and software components. SSH access may only be needed for updating the software.

Open the Console at http://<console_hostname>/wansight. If the page cannot be displayed, make sure that the Apache web server is running and the firewall does not block incoming traffic on port 80 or 443. You can also access it securely via HTTPS if the Apache web server was configured to serve pages over SSL/TLS.

If you have not licensed Wansight, you will be asked to do so. Upload the *trial.key* file sent to you by email by clicking the key icon. The license key contains encrypted information about the licensed capabilities of the software. You can replace the license key in Configuration » General Settings » License Manager.

Log in to the Console using the default username/password combination: **admin**/**changeme**.

If the Console is installed on a public server, you should immediately change the default password of the “admin” account. To do so, click the **Admin** menu at the top-right corner of the browser window and select [**Change Password**]. From the same menu you can change the Console layout and theme.

To understand how to navigate within the Console, read the dedicated chapter on page 14.

Licensing Procedure

When the trial period is over you will have to purchase as many Sensor and Filter licenses (annual subscriptions) as the number of Sensors and Filters configured and enabled in Configuration » Components.

- You will need to purchase as many Sensor licenses as the number of flow exporters (usually border or edge routers) monitored by Flow Sensors. There is no limit on the number of interfaces a Flow Sensor can monitor.
- You will need to purchase as many Sensor licenses as the number of interfaces (ports) listened by Packet Sensors. Multiple Packet Sensors listening to the same interface (e.g. when using a multi-queue NIC) use a single Sensor license. Packet Sensor can monitor an unlimited number of IPs/domains
- You can mix Wanguard Sensor licenses together with Wansight Sensor licenses
- Sensor Cluster does not require licensing
- Console does not require licensing

You can distribute the licensed Sensors on any number of servers without additional licensing costs. The license key must contain the hardware keys listed under Configuration » General Settings » License Manager » Requirements. The minimum licensing period is 12 months and the maximum licensing period is 48 months.

Quick Configuration Steps

➔ Estimate storage requirements, review decoders and IP graph settings – page 16

➔ Add your IP address ranges and important hosts to an IP Zone – page 22

➔ Configure a Packet Sensor – page 26, Flow Sensor – page 30, or SNMP Sensor – page 35

➔ Watch the event log. Receive error notifications by email – page 41

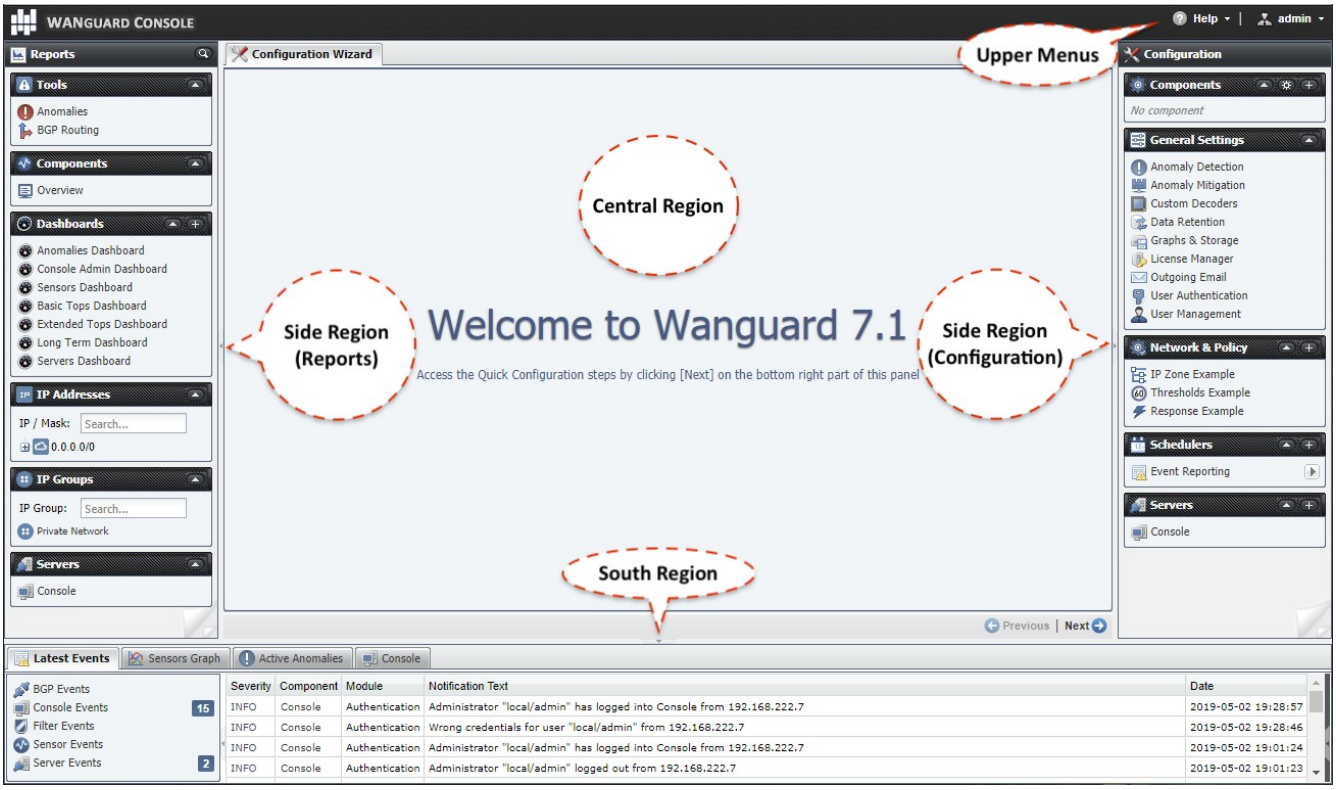
➔ Create personalized Console accounts for your staff or customers – page 43

➔ Create dashboards and add widgets containing useful information – page 61

Basic Concepts of Wansight Console

Please read this chapter in order to understand the basic premises required to properly operate the software. The next chapters cover the software configuration, while the last chapters cover the reporting features.

To understand how to operate the Console web interface you should be aware of its structure:



Side Region

Side Region is used for navigating throughout the Console. It is located at the east and/or west edge of the browser's window, according to the user's preference. If it is not visible, it has been either collapsed or hidden by an administrator. Clicking the edge of regions expands or collapses them.

Side Region contains 2 sections – Reports and Configuration – that can be collapsed or expanded by clicking the title bars or by pressing Ctrl+R. Both sections contain multiple panels that can also collapse or expand, with such state being maintained between sessions. These panels are constantly updated.

Reports section title bar contains a “Quick Search” button. Keyboard shortcut: Ctrl+S.

Central Region

Each report, dashboard or tool you select in the Side Region opens a tab (page) in the Central Region. You can switch between (sub-) tabs with a mouse or with the keyboard shortcut (Alt+) Ctrl+→ and (Alt+)Ctrl+←. You can close all tabs except for the Landing Tab (initially set as the Configuration Wizard). To change the Landing Tab, edit your user profile in Configuration » General Settings » User Management.

South Region

South Region provides a quick way to view live data: events (system logs), animated traffic graphs, and statistics from all software components. It is located at the bottom of the browser's window. By default, it is collapsed; to expand it, click the thin line near the lower edge or press Ctrl+E.

Upper Menus

These are located in the top-right part of the Console window.

The Help menu contains links to the User Guide, various helper tools, Software Updates, and the About window. Dependent on context, the User Guide opens the chapter describing the last-opened window or tab.

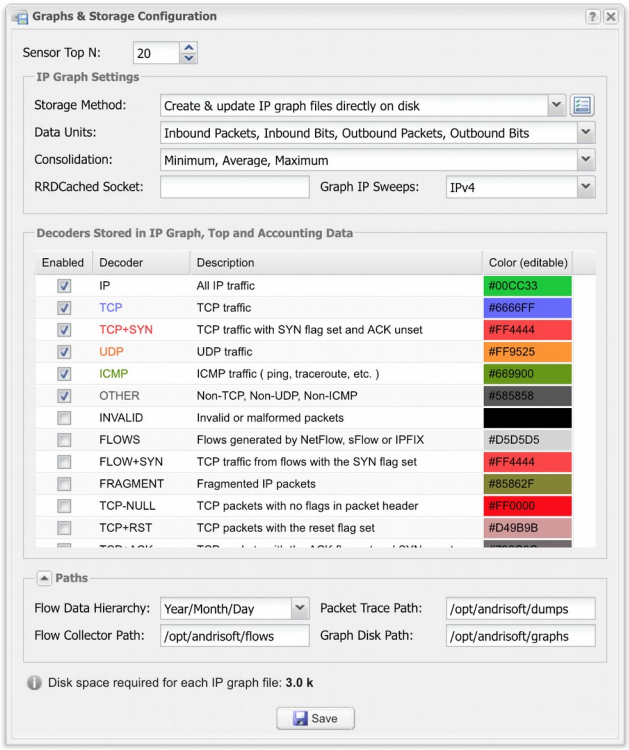
The User menu provides a Log Out option and lets you quickly change the password and a few user preferences.

Configuration » General Settings » Graphs & Storage

A very important initial step in configuring Wansight is to make sure that the server(s) the software runs on have enough resources to process and store IP graphs, flows and packet dumps.

In a later chapter, you will be able to configure Sensors to generate traffic graphs, tops and accounting data for every IP that belongs to the monitored network. If you intend to use this feature, you may want to change the default IP storage settings, as changing these later will reset all existing IP graphs, tops and accounting data.

Storage-related settings can be tuned by editing Configuration » General Settings » Graphs & Storage.



Sensor Top N (default: 20) specifies the maximum number of items stored for ordered sets of data, such as top Talkers, External IPs, ASNs, Countries, TCP/UDP ports, IP protocols, and so on.

Storage Method allows you choose how the software creates and updates IP graph files. Click on the options button from the right to configure the selected method.

- **Create & update IP graph files directly on disk** – This method optimizes the long-term storage of IP graph data by allowing up to three **Round Robin Archives**. The values within the Round Robin Archives determine the granularity of the graphs and the interval of time they are saved. These entries specify for how long, and how accurately data should be stored. A smaller data average (5 seconds minimum) generates a very accurate graph, but requires more disk space, while a bigger data average is less accurate and uses less disk space.

  On non-SSD drives, the disk seek time may be too high to update thousands of IP graph files every few

minutes. If this is the case, configure the **RRDCached Socket** to increase the I/O performance of the Console server (KB article link). If the speed of updating IP graph files is till not fast enough, consider the other method described below

- **Create IP graph files in RAM and move them periodically to disk** – This method is not optimal for long-term storage because it allows a single Round Robin Archive per IP graph file. The files are created and updated in **Graphs RAM Path**, and moved periodically onto a larger, albeit slower disk. Select this method when the previous method configured with RRDCached is not fast enough to sustain updating thousands of very high-granularity IP graphs

Data Units lets you choose the data units stored inside IP graph files.

Consolidation lets you choose how to build consolidated values for Round Robin Archives. If you are interested in traffic spikes, check MAXIMUM. If you are interested in average values, check AVERAGE. For low traffic values, check MINIMUM.

Graph IP Sweeps option can prevent creating IP graph files for IPv4 and/or IPv6 addresses that receive traffic without sending any traffic in return. Do not set it to "Off" when monitoring unidirectional links or asymmetric traffic.

Decoders represent internal functions which differentiate and classify the underlying protocols of each packet and flow. Each enabled decoder increases the size of IP graph, top and accounting data, and causes a small performance penalty. It is recommended to enable only the decoders you are interested in. You can define your own decoders in Configuration » General Settings » Custom Decoders. Built-in decoders:

DECODER	DESCRIPTION
IP	Matches all IP packets, irrespective of higher protocols. Always enabled
TCP	Matches TCP traffic
TCP+SYN	Matches TCP traffic with SYN flag set and ACK unset. Flow Sensor counts one packet per flow
UDP	Matches UDP traffic
ICMP	Matches ICMP traffic
OTHER	Matches IP protocols that differ from TCP, UDP and ICMP
INVALID	Matches TCP or UDP port set to 0, or IP protocol set to 0
FLOWS	Matches flow records and replaces packets/s with flows/s. Works only with Flow Sensor
FLOW+SYN	Matches flow records with SYN flag set. Flow Sensor counts all packets per flow
FRAGMENT	Matches fragmented IP packets. Works only with Packet Sensor
TCP-NULL	Matches TCP traffic without TCP flags, indicative of reconnaissance sweeps
TCP+RST	Matches TCP traffic with RST flag set
TCP+ACK	Matches TCP traffic with SYN flag unset and ACK set
TCP+SYNACK	Matches TCP traffic with SYN flag set and ACK flag set
NETBIOS	Matches TCP traffic on source or destination port 139
QUIC	Matches Google's QUIC protocol on UDP port 80 and 443
UDP-QUIC	Matches UDP traffic not part of the QUIC protocol
MEMCACHED	Matches UDP traffic on port 11211
HTTP	Matches TCP traffic on source or destination port 80

HTTPS	Matches TCP traffic on source or destination port 443
MAIL	Matches TCP traffic on source or destination ports 25, 110, 143, 465, 585, 587, 993, 995
DNS	Matches UDP traffic on source or destination port 53
SIP	Matches TCP or UDP traffic on source or destination port 5060
IPSEC	Matches IP traffic on IP protocol 50 or 51
WWW	Matches TCP traffic on source or destination ports 80, 443
SSH	Matches TCP traffic on source or destination port 22
NTP	Matches UDP traffic on source or destination port 123
SNMP	Matches UDP traffic on source or destination ports 161, 163
RDP	Matches TCP or UDP traffic on source or destination port 3389
YOUTUBE	Matches IP traffic going or coming from Youtube AS 43515, 36561, or from Youtube subnets
NETFLIX	Matches IP traffic going or coming from Netflix AS 55095, 40027, 2906, or from Netflix subnets
HULU	Matches IP traffic going or coming from Hulu AS 23286, or from Hulu subnets
FACEBOOK	Matches IP traffic going or coming from Facebook AS 54115, 32934, or from Facebook subnets

Packet Sensor saves packet dumps on the local disk in the path configured for **Packet Traces**. Flow Sensor saves flow data on the local disk in the path configured for **Flow Collectors**. When the Console is not installed on the same server that runs the Sensor, export these paths towards the Console's file system using an NFS share (KB article link). If you do not, the Console is not able to display data saved on remote servers.

All graph files are stored by the Console server, in the **Graphs Disk Path**. Graph files are optimized for storing time series data and do not grow over time. All IP graph options described below have a direct impact on the storage space required on the Console server.

The size of each IP graph file is listed on the bottom of the window in the ***Disk space required for each IP graph file*** field. When Sensor Clusters are not used, the maximum number of IP graph files that could be generated can be calculated with the formula: ((number of Packet Sensors) + (number of Flow Sensor interfaces)) x (number of IPs contained in subnets with IP Graphing set to “Yes” in the IP Zone).

It is highly recommended to automate the deletion of old data and to monitor the disk usage of IP graphs in Configuration » General Settings » Data Retention.

Sensor and Applications Graph Troubleshooting

- ✔ Ensure that all Sensors run correctly by verifying the event log and by viewing live statistics from Reports » Components » Overview. The troubleshooting guide for Packet Sensor is located on page 28, for Flow Sensor on page 33 and SNMP Sensor on page 37
- ✔ Discontinuous Sensor graphs can be caused by enabling IP Accounting for too many/large subnets when there is a slow connection between the Sensor and the MySQL/MariaDB running on the Console server

IP/Subnet Graph Troubleshooting

- ✔ Ensure that all Sensors run correctly by verifying the event log and by viewing live statistics displayed in Reports » Components » Overview. The troubleshooting guide for Packet Sensor is located on page 28, for Flow Sensor on page 33 and SNMP Sensor on page 37
- ✔ Generating IP graph data causes the biggest impact on the load of the Console server. Enable each feature (IP graphing, IP accounting) sequentially for each subnet, after making sure that the Console server can handle it. The storage requirements for each subnet are listed in the IP Zone, and the current disk usage in Configuration » General Settings » Data Retention
- ✔ The internal process used for saving IP graph data is */opt/andrisoft/bin/genrrds_ip*. If it is overloading the Console server or the event log contains warnings such as "Updating IP graph data takes longer than 5 minutes", use RRDCacheD, RAM/SSD updating method, faster disk drivers, enable IP graphing for fewer subnets, or deploy a Sensor Cluster configured to aggregate IP graph data
- ✔ The internal process used for generating IP or subnet graphs is */opt/andrisoft/bin/gengraph_ip*. Console users launch the process for each requested IP or subnet graph. If the Console server gets too loaded by gengraph_ip, execute "killall gengraph_ip" and configure RRDCacheD. When launched, the process stops only when the graph is generated. This process can be slow when users request subnet graphs for subnets not specifically defined in the IP Zone. It is not possible to throttle the number of graphs requested by users

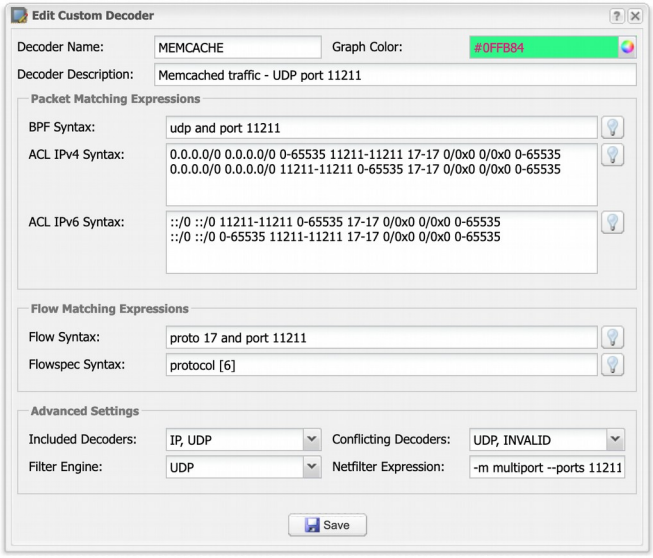
AS and Country Graph Troubleshooting

- ✔ Ensure that all Sensors run correctly by verifying the event log and by viewing live statistics from Reports » Components » Overview. The troubleshooting guide for Packet Sensor is located on page 28, for Flow Sensor on page 33 and SNMP Sensor on page 37
- ✔ To enable AS and Country graphs, set the Stats Engine parameter to either "Extended" for Flow Sensor, or "Full" for Packet Sensor
- ✔ SNMP Sensor is not able to generate AS graphs or Country graphs

Configuration » General Settings » Custom Decoders

Decoders represent internal functions that differentiate and classify the underlying protocols of each packet and flow. The predefined decoders are listed in the "Graphs & Storage" chapter on page 16. If you do not need to define custom decoders, you may safely skip this section.

To manage user-defined decoders go to Configuration » General Settings » Custom Decoders.



Each custom decoder is defined by:

- **Decoder Name** – A short name to help you identify the decoder. This field is mandatory
- **Graph Color** – The color used in graphs for the decoder. The default color is a random one, which can be changed by entering a different HTML color code or by clicking the drop-down menu
- **Decoder Description** – An optional short description of the decoder
- **BFP Syntax** – This syntax is used by Packet Sensor and Packet Filter when the Capture Engine option is not set to DPDK. Click the light bulb icon on the right to see details about the correct syntax. Examples:
  - To match TCP packets with the SYN flag set, enter *tcp[tcpflags] & tcp-syn!=0*
  - To match UDP packets with the destination port under 1024, enter *proto 17 and dst portrange 1-1023*
  - To match memcached packets, enter *proto 17 and port 11211*
- **ACL IPv4/IPv6 Syntax** – This syntax is used by Packet Sensor and Packet Filter when the Capture Engine option is set to DPDK. Click the light bulb icon on the right to see a few examples and get all the details about the correct syntax.
- **Flow Syntax** – This syntax is used by Flow Sensor and Flow Filter. Click the light bulb icon on the right to see the correct syntax. Examples:
  - To match TCP flows having only the SYN flag set, enter *flags S and not flags AFRPU*

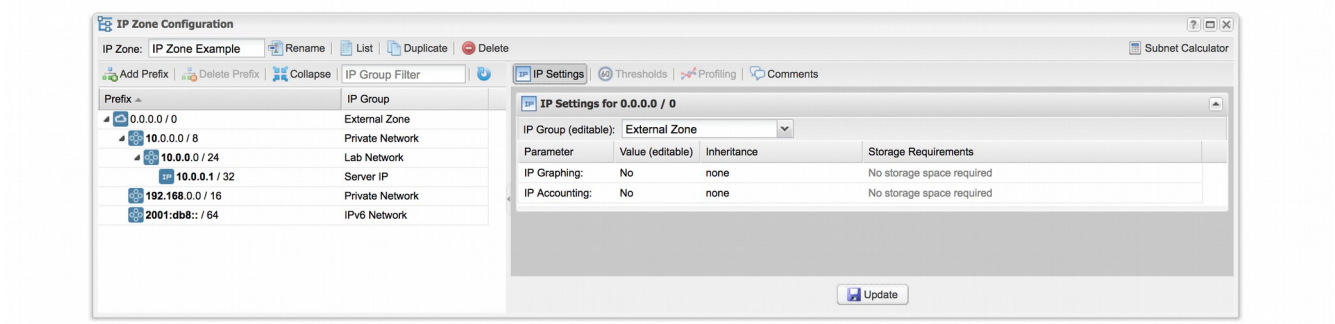
    - To match flows with the MPLS label0 set to 2, enter *mpls label0=2*
    - To match memcached packets, enter *proto 17 and port 11211*
- **Flowspec Syntax** – Enter a Flowspec expression if you intend to use BGP Flowspec for traffic redirection or DDoS mitigation. Click the light bulb icon on the right to open a window that shows you the correct syntax. Example:
    - To match memcached packets, enter *port 11211; protocol 17;*
- **Included Decoders** – Required if you plan to use the decoder for IP graphing. Select the decoders that include the matched traffic, or choose IP if not sure
- **Conflicting Decoders** – Required if you plan to use the decoder for IP graphing. Select the decoders that might match same traffic, but not always. The option is used only for displaying stacked decoders inside IP graphs

Configuration » Network & Policy » IP Zone

IP Zones are hierarchical, tree-like data structures used by Sensor to extract per-subnet settings and to learn your network's boundaries.

In most configurations, you will have to add your IP blocks to the IP Zones listed in Configuration » Network & Policy. There are several ways to add prefixes (IPs/IP blocks/subnets/ranges): using the web interface, the REST API by accessing *http://<console_ip>/wanguard-api-ui*, or by executing the command *php /opt/andrisoft/api/cli_api.php* on the Console server.

To add a new IP Zone, go to Configuration » Network & Policy » [+] and select [IP Zone]. You only need more than one IP Zone when you want to use different per-subnet settings for different Sensors. If this is the case, it may be easier to open an existing IP Zone that already includes your IP address ranges, and duplicate it by pressing the [**Duplicate**] button. A new IP Zone will be created with the same name and the word "(copy)" attached and containing the same prefixes and IP groups as the original.



The IP Zone Configuration window is divided into two vertical sections. The buttons that manage prefixes are located in the upper part of the left-hand section. When a new prefix is added the tree below automatically updates itself. The right-hand section contains panels with user-provided settings for the selected prefix.

To enter IP addresses or IP blocks, use the CIDR notation. To enter individual hosts in IP Zones, use the /32 CIDR mask for IPv4 and /128 for IPv6. For more information about the CIDR notation consult Appendix 1 on page 67.

Every IP Zone contains the network 0.0.0.0/0. Because it's CIDR mask is /0, this "supernet" includes all IP addresses available for IPv4 and IPv6. For an easier configuration, every new prefix that you define inherits by default the properties of the most-specific (having the biggest CIDR mask) IP class that includes it.

The **IP Settings** panel in the right-hand section provides the following parameters:

- **IP Group** – Set a short description of the selected prefix, or the name of the customer that uses it. When you set the same IP group on multiple prefixes you will be able to generate aggregated traffic reports. This combo box is editable
- **IP Graphing** – Set to "Yes" to be able to generate graphs for every IP contained in the selected prefix. The **Graph IP Sweeps** option from Configuration » General Settings » Graphs & Storage can be used to prevent generating graph data for IPs that only receive traffic without sending traffic in return. IP Graphing is always enabled for the subnets explicitly defined in the IP Zone. Do not enable this option on

many/large subnets without a performance impact assessment

- **IP Accounting** – Set to "Yes" for the Sensor to generate daily accounting data for each IP contained in the selected prefix. IP Accounting is always enabled for the subnets explicitly defined in the IP Zone. Do not enable on many/large subnets without a performance impact assessment

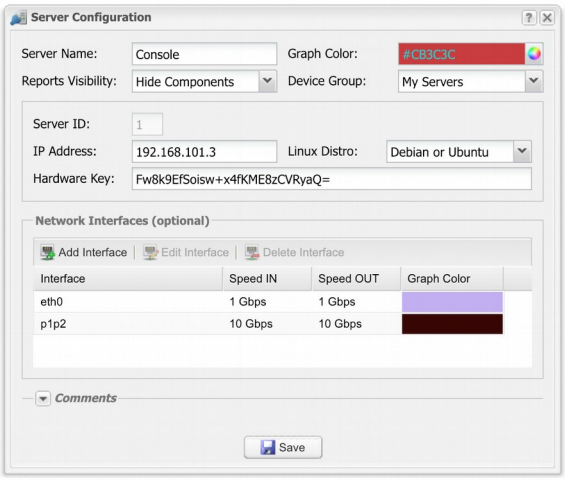
The **Storage Requirements** column indicates the disk space needed by each Packet Sensor and Flow Sensor interface to store the generated data. Enabling IP graphing and IP accounting for very large prefixes (e.g. 0.0.0.0/0) might generate data that could overload the Console server and fill the disk space.

The **Comments** panel allows you to enter a comment for the selected prefix. It is not visible elsewhere.

Configuration » Servers

Any server running a Wansight component must be added under Configuration » Servers. The Console server is automatically added during installation.

To add a new server, click the [+] button from the title bar of the Configuration » Servers panel. To change the configuration of an existing server, go to Configuration » Servers and click its name.



- **Server Name** – A short name to help you identify the server
- **Graph Color** – The color used in graphs for this server. The default color is a random one, which can be changed by entering a different HTML color code or by clicking the drop-down menu
- **Reports Visibility** – Enable if Reports » Servers should contain icons of the components the server runs
- **Device Group** – Optional description used within Console to group servers by location, role, etc.
- **Server ID** – Unique identifier of the server, used when exporting NFS shares
- **IP Address** – An IP address defined on the server. Can be public or private, IPv4 or IPv6
- **Linux Distro** – The Linux distribution installed on the server
- **Hardware Key** – Read-only string used for licensing purposes. The hardware key field is updated each time the WANsupervisor service starts and the hardware, IP or hostname changes. If the hardware key is unregistered, send it to sales@andrisoft.com
- **Network Interfaces (optional)** – The WANsupervisor service can monitor packets/s, bits/s, errors and dropped frames for each server interface. The data is available in Reports » Servers » [Server] » Server Graphs » Data Units = Server Interfaces. These stats are provided by the Linux kernel
- **Comments** – These observations are not visible elsewhere

Server Troubleshooting

- ✔ For the server to be operational, make sure it always runs the WANsupervisor service and that its clock is synchronized with NTP. You can verify the operational status of each server and component in Reports » Components » Overview » Servers
- ✔ The WANsupervisor service stops when the MySQL service running on the Console server is restarted or unavailable even for a short amount of time (e.g. during a network outage). In this case, either restart WANsupervisor manually or use automated tools such as systemd, monitd or similar
- ✔ You can discover performance-related issues by monitoring Reports » Server » [Server] » Server Graphs and Reports » Server » [Server] » Server Events
- ✔ If the DB crashes (usually due to power failures) execute */opt/andrisoft/bin/WANmaintenance repair_db*

Distribute the Software over Multiple Servers

For load and geographical distribution, or high-availability and redundancy, you can distribute Sensors and Filters over multiple servers by following the steps listed below.

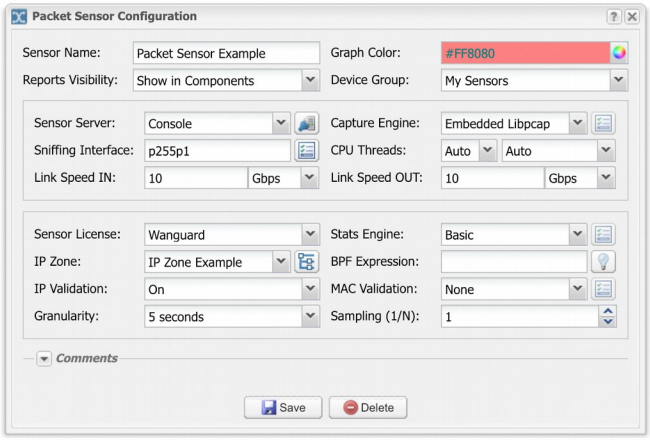
1. Add the new server in Console, under Configuration » Servers, set its IP and a relevant Server Name
2. Install the software on the new server by following the installation instructions from the link contained in the response mail to the evaluation request
3. When executing */opt/andrisoft/bin/install_supervisor* enter the IP of the Console server and the Console database password
4. Start the WANsupervisor service on the new server
5. Make sure that NTP is running on the server and that the status is OK in Reports » Components » Overview
6. During the trial period you don't have to register any server. Outside the trial period, you have to register the server's hardware key, which is visible in Configuration » Servers » [New Server] after starting the WANsupervisor service. Hardware registration is free by emailing sales@andrisoft.com
7. Define a new Sensor and set its Sensor Server parameter accordingly
8. Start the new Sensor from Configuration » Components
9. Watch the event log to see if there are any errors or warnings

Configuration » Components » Packet Sensor

In switched networks, only the packets for a specific device reach the device's network card. If the server running the **Packet Sensor** is not deployed in-line in the main data path, a network TAP, or a switch/router that offers a “monitoring port” or “mirroring port” must be used. In this case, the network device sends copies of data packets traveling through selected ports or VLANs to the monitoring port. Packet Sensor inspects every packet it receives and conducts packet-based traffic analysis. The advantages and disadvantages of packet-based traffic monitoring are listed on page 7.

For instructions on how to configure switches or routers for port mirroring, consult their documentation.

To add a Packet Sensor, click the [+] button from the title bar of the Configuration » Components panel. To modify an existing Packet Sensor, go to Configuration » Components and click its name.



- **Sensor Name** – A short name to help you identify the Packet Sensor
- **Graph Color** – The color used in graphs for the Packet Sensor. The default color is a random one, which can be changed by entering a different HTML color code or by clicking the drop-down menu
- **Reports Visibility** – If the Packet Sensor should be listed inside Reports » Components
- **Device Group** – Optional description used within Console to group up components (e.g. by location or role). It can be used to restrict the access of Guest accounts
- **Sensor Server** – The server that runs the Packet Sensor. The configuration of servers is described on page 24
- **Capture Engine** – Select the preferred packet capturing engine. LibPcap requires no additional setup but it is often too slow for multi-gigabit sniffing and it does not run on multiple threads. Netmap and PF_RING are much faster but both require the installation of additional kernel modules. DPDK provides the fastest packet capturing engine and allows packet forwarding but it is much more complicated to setup and the allocated CPUs will always be used at 100%.
  - *Embedded LibPcap* – Select to use the built-in LibPcap 1.8.1 library
  - *System LibPcap* – Select to use the LibPcap library installed by the Linux distribution
  - *Myricom Sniffer10G* – Select when using a Myricom network adapter with a Sniffer 10G license. Click

the button on the right for driver-specific settings

- *Netmap* – Select to use the Netmap framework to speed up packet processing
- *PF_RING* – Select to use the PF_RING framework to speed up packet processing. Click the button on the right for PF_RING-specific settings
- *DPDK* – Select to use the DPDK framework, then click the button on the right of the Capture Engine field to configure DPDK-specific parameters as described in Appendix 3 on page 73

- **Sniffing Interface** – The network interface(s) listened by the Packet Sensor. If the server running the Packet Sensor is deployed in-line, then this field must contain the network interface that receives the traffic entering your network. The PF_RING framework allows listening to multiple physical interfaces simultaneously when the interfaces are entered separated by semicolon ";"
- **CPU Threads** – Packet Sensor can run multi-threaded on a given set of CPU cores. Each thread increases the RAM usage. On most systems, activating more than 6 CPU threads hurts performance
- **Link Speed IN / OUT** – Enter the speed (bandwidth, capacity) of the monitored link. The values are used for percentage-based reports
- **Sensor License** – The license used by the Packet Sensor. Wanguard provides all features; Wansight does not provide traffic anomaly detection and reaction
- **Stats Engine** – Collects traffic tops and AS graphs:
  - *Basic* – Enables tops for Internal IPs, IP protocols, versions and TCP/UDP ports. It is the recommended value because it adds a very small performance penalty
  - *Extended* – Enables all tops from *Basic* as well as tops for external IPs (IPs not included in the IP Zone). It adds performance penalty of over 20%, especially during spoofed attacks. Permits the detection of threshold violations for external IPs
  - *Full* – Enables all tops from *Extended* as well as tops and graphs for autonomous systems. It adds a performance penalty of over 20%, especially during spoofed attacks. Permits the detection of threshold violations for external IPs
- **Stats Engine Options** – When Stats Engine is set to Full you can click the button next to it. To enable Transit AS tops and graphs, enter the path to an existing **BGP Dump File** exported by BGPd in MTR format, and the IPv4 and optionally IPv6 address of the BGP router
- **IP Zone** – Packet Sensor needs an IP Zone from which to learn about your network's boundaries and to extract per-subnet settings. IP Zones are described in the "IP Zone" chapter on page 22
- **BPF Expression** – You can filter the type of traffic the Packet Sensor receives using a tcpdump-style syntax
- **IP Validation** – This option is the frequently-used way to distinguish the direction of the packets:
  - *Off* – Packet Sensor analyzes all traffic and uses MAC Validation to identify the direction of traffic
  - *On* – Packet Sensor analyzes the traffic that has the source and/or the destination IP in the selected IP Zone
  - *Strict* – Packet Sensor analyzes the traffic that has either the source or the destination IP in the selected IP Zone
  - *Exclusive* – Packet Sensor analyzes the traffic that has the destination IP in the selected IP Zone, but not the source IP
- **MAC Validation/Options** – This option can be used to distinguish the direction of the packets or to ignore unwanted OSI Layer 2 traffic:

- *None* – Packet Sensor analyzes all traffic and uses IP Validation to identify the direction of traffic
- *Upstream MAC* – MAC validation is active and the MAC Address belongs to the upstream router
- *Downstream MAC* – MAC validation is active and the MAC Address belongs to the downstream router

  The MAC Address must be written using the Linux convention – six groups of two hexadecimal values separated by colons (`:`)

- **Granularity** – Interval between successive updates for traffic parameters
- **Sampling (1/N)** – Must contain the packet sampling rate. On most systems, the correct value is 1
- **Comments** – Comments about the Packet Sensor can be saved here. They are not visible elsewhere

To start the Packet Sensor, click the small button displayed next to its name in Configuration » Components. Ensure that the Packet Sensor starts correctly by watching the event log (details on page 41).

If the Packet Sensor starts without errors, but you can't see any data collected by it in Reports » Components » Overview, follow the troubleshooting steps listed below.

Packet Sensor Troubleshooting

- ✔ Look for warnings or errors produced by the Packet Sensor in the event log (details on page 41)
- ✔ Ensure that you have correctly configured the Packet Sensor. Each configuration field is described in depth in this chapter
- ✔ The event log error "*License key not compatible with the existing server*" can be fixed by sending the string from Configuration » Servers » [Packet Sensor server] » Hardware Key to sales@andrisoft.com
- ✔ Make sure that the sniffing interface is up:

  ```
  ip link show <interface>
  ```

- ✔ Ensure that you have correctly configured the switch/TAP to send packets to the server on the configured interface
- ✔ Verify whether the server is receiving packets through the configured interface:

  ```
  tcpdump -i <interface_usually_eth1_or_p1p2> -n -c 100
  ```

- ✔ When **IP Validation** is not disabled, make sure that the selected IP Zone contains all your subnets
- ✔ If the CPU usage of the Packet Sensor is too high, set the **Stats Engine** parameter to "Basic", install PF_RING or Netmap to enable multi-threading, or use a network adapter that allows distributing Packet Sensors over multiple CPU cores
- ✔ To troubleshoot Sensor graph or IP graph issues, follow the Graphs Troubleshooting guide on page 18
- ✔ For PF_RING-related issues, contact ntop.org. To increase the maximum number of PF_RING programs from 64 to 256, increase the MAX_NUM_RING_SOCKETS defined in kernel/linux/pf_ring.h and recompile the pf_ring kernel module
- ✔ The system process responsible for capturing packets is called WANtrafficlogger. There will be as many processes active as the number of packet traces active in Reports » Tools » Packet Tracers
- ✔ Make sure you are running the latest version of the software by checking Help » Software Updates

Packet Sensor Optimization Steps for Intel 82599

To distribute the packet-processing tasks of the Packet Sensor over multiple CPU cores when using an adapter with the Intel 82599 chipset (Intel X520, Intel X540, HP X560, etc.):

- ✔ Follow the documentation and optimization guides provided by the network adapter vendor
- ✔ Install PF_RING and switch to the PF_RING-aware ixgbe driver
- ✔ See the number of RSS queues allocated by the ixgbe driver by executing dmesg, or by listing /var/log/messages or /var/log/syslog. By default, the number of RSS queues is equal to the number of CPU cores when Hyper-threading is off, or double the number of CPU cores when hyper-threading is on. You can set the number of RSS queues manually, by loading ixgbe.ko with the RSS=<number> option
- ✔ Enable multithreading in the Packet Sensor configuration or define multiple Packet Sensors, each listening to ethX@queue_id or ethX@queue_range and add them to a Sensor Cluster to have a unified reporting and anomaly detection domain. All Packet Sensors defined to listen to a single interface use a single Sensor license

On a quad-core CPU with multithreading, the ixgbe driver allocates 8 RSS queues. In this case, if you define a Packet Sensor for ethX@0-3 and another one for ethX@4-7, the packet-processing task will be distributed over 2 CPU cores. PF_RING exposes up to 32 RSS queues.

Packet Sensor Optimization Steps for Myricom

To distribute the packet-processing tasks of the Packet Sensor over multiple CPU cores with a Myricom adapter:

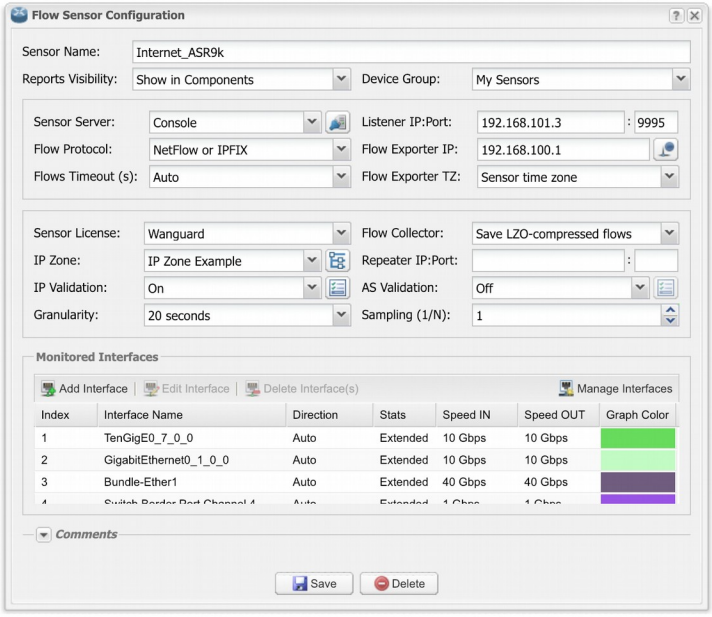
- ✔ Follow the documentation provided by Myricom to install Sniffer10G v2 or v3 (recommended)
- ✔ Start the driver with `/opt/snf/sbin/myri_start_stop start`
- ✔ Check that the driver is loaded successfully with `lsmod | grep myri_snf`. Check for errors in syslog
- ✔ Define multiple Packet Sensors, one for each CPU core if needed
- ✔ For each Packet Sensor, set the Capture Engine parameter to “Myricom Sniffer10G”, and click the [Capture Engine Options] button on the right. Set the **Packet Sensor Rings** parameter to the number of Packet Sensors listening to the interface. Sniffer10G v3 users must set two unique **App IDs** for Packet Sensors and Packet Tracers listening to the same interface to ensure that the traffic is directed to both applications
- ✔ Stop all Packet Sensors before changing the **Capture Engine** parameter
- ✔ Add the Packet Sensors to a Sensor Cluster to have a unified reporting and anomaly detection domain

Configuration » Components » Flow Sensor

Many routers and switches can collect IP traffic statistics and periodically export them as flow records to a **Flow Sensor**. Since the flow protocol already performs pre-aggregation of traffic data, the flow data sent to Flow Sensor is much smaller than the monitored traffic, and this makes the Flow Sensor a good option for monitoring remote or high-traffic networks. The advantages and disadvantages of flow-based monitoring are listed on page 7.

For detailed instructions on how to enable NetFlow, sFlow or IPFIX on your network device, consult its documentation. Appendix 2 on page 68 shows some examples on how to configure NetFlow on a few Cisco IOS, CatOS, and Juniper devices.

To add a Flow Sensor, click the [+] button from the title bar of the Configuration » Components panel. To modify an existing Flow Sensor, go to Configuration » Components and click its name.

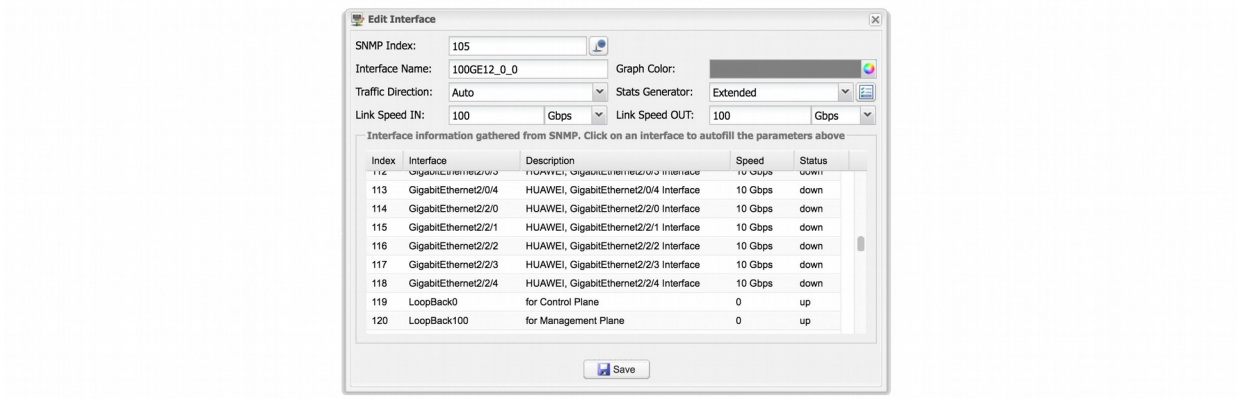


- **Sensor Name** – A short name to help you identify the Flow Sensor
- **Device Group** – Optional description used used within Console to group up components (e.g. by location or role). It can be used to restrict the access of Guest accounts
- **Reports Visibility** – Enable if the Flow Sensor should be listed inside Reports » Components
- **Sensor Server** – The server that runs the Flow Sensor. The configuration of servers is described on page 24
- **Listener IP:Port** – The IP address (IPv4 or IPv6) of the network interface that receives flow packets, and the destination port
- **Flow Protocol** – Flow protocol used by the flow exporter: NetFlow, IPFIX or sFlow
- **Flow Exporter IP** – IP address of the flow exporter (router, switch, probe). Usually, it is the loopback address of the router. For sFlow exporters, enter the IP that sends flow packets, not the Agent IP

- **SNMP Settings** – Click the button on the right of the Flow Exporter IP field. You must enable SNMP on the flow exporter to allow Console to automatically extract interface information. When SNMP settings are not configured, you must manually enter the SNMP index, speed, etc. for each interface
- **Flows Timeout (s)** – Some flow exporters (e.g. Juniper MX) maintain the start time of flow. If this is the case then you need to set here the same flow active/inactive timeout value as the one defined in the flow exporter's configuration. The value must be entered in seconds (s)
- **Flow Exporter TZ** – Set the time offset between the time zone (TZ) of the Flow Sensor server and the time zone of the flow exporter. Running NTP on both devices to keep their clocks synchronized is a critical requirement
- **Sensor License** – The license allocated to the Flow Sensor. Wanguard provides all features; Wansight does not provide traffic anomaly detection and reaction
- **Flow Collector** – When enabled, all flow data is stored in a space-efficient binary format. Flow records can be queried in Reports » Tools » Flow Collectors
- **IP Zone** – Flow Sensor needs an IP Zone from which to learn the monitored network's boundaries and to extract per-subnet settings. For more information about IP Zones consult the “IP Zone” chapter on page 22
- **Repeater IP:Port** – An embedded packet repeater can send all incoming flows to another flow collector or host. To use this optional feature enter the IP of the other flow collector and a port of your choice
- **IP Validation** – This option can be used to distinguish the direction of traffic or to ignore certain flows:
  - *Off* – Flow Sensor examines all flows. The traffic direction is established on interface level
  - *On* – Flow Sensor examines the flows that have the source IP and/or the destination IP inside the selected IP Zone
  - *Strict* – Flow Sensor examines the flows that have either the source IP or the destination IP inside the IP Zone
  - *Exclusive* – Flow Sensor examines the flows that have the destination IP inside the IP Zone
- **IP Validation Options** – Set the **Log Invalidated Flows** field to *Periodically* if you want to see in the event log the percentage of invalidated flows and 10 flows failing validation, once every 10 ticks
- **AS Validation** – Flows from BGP-enabled routers can contain the source and destination Autonomous System number (ASN). In most configurations if the AS number is set to 0 the IP address belongs to your network. This rarely-used option is used for establishing traffic direction. AS validation has three choices:
  - *Off* – Disables AS validation
  - *On* – Flow Sensor examines only the flows that have the source ASN and/or the destination ASN inside the local AS list (defined below)
  - *Strict* – Flow Sensor examines only the flows that have either the source ASN or the destination ASN inside the local AS list (defined below)
- **AS Validation Options** – When AS Validation is enabled, you can enter all your AS numbers (separated by space) into the **Local AS List** field. Set the **Log Invalidated Flows** field to *Periodically* if you want to see in the event log the percentage of invalidated flows and 10 flows failing validation, once every 10 ticks
- **Granularity** – Low values increase the accuracy of Sensor graphs, at the expense of increasing the RAM usage. Do not select values under 20 seconds
- **Sampling (1/N)** – Enter the sampling rate configured on the flow exporter, or 1 when no sampling rate is configured. For NetFlow v9 and sFlow the value entered here is ignored because the flow protocol

automatically adjusts the sampling rate. To force a particular sampling value, enter it as a negative value

- **Monitored Interfaces** – List of interfaces that should be monitored. To avoid producing duplicate flow entries, add only upstream interfaces



  - *SNMP Index* – The interfaces are identifiable only by their SNMP indexes. Enter the index manually, or configure the SNMP settings
  - *Interface Name* – A short description used to identify the monitored interface. Descriptions longer than 10 characters clutter some reports
  - *Graph Color* – The color used in graphs for the interface. The default color is a random one, which can be changed by entering a different HTML color code or by clicking the drop-down menu
  - *Traffic Direction* – Direction of traffic entering the interface, relative to your network:
    - "Auto" – Set to establish the direction of traffic by IP and/or AS Validation alone
    - "Upstream" – Set for upstream interfaces, e.g. peering interfaces, interfaces connected to the Internet
    - "Downstream" – Set for downstream interfaces, e.g. customer interfaces, interfaces connected to your network
    - "Null" – Traffic to Null interfaces is discarded by the router and should be ignored
  - *Stats Engine* – Collects various traffic tops and AS (Autonomous System) data:
    - "Basic" – Enables tops for Internal IPs, IP protocols, versions and TCP/UDP ports. It adds a very small performance penalty
    - "Extended" (recommended) – Enables all tops from "Basic" as well as tops and graphs for autonomous systems and countries, but increases the CPU usage by a few percentage points. When the router does not export AS information (e.g. non-BGP router) Flow Sensor uses an internal GeoIP database to obtain AS data. Live stats for autonomous systems and countries are not very accurate
    - "Full" – Enables all tops from "Extended" as well as tops for external IPs (IPs not included in the IP Zone), but increases the RAM usage several times over, especially during spoofed attacks. Live stats for autonomous systems and countries are very accurate. Set the value to "Extended", unless you know what you are doing. Permits the detection of threshold violations for external IPs
  - *Stats Engine Options* – When Stats Engine is "Extended" or "Full" you can click the button next to it. To enable Transit AS tops and graphs, enter the path to an existing BGP Dump File exported by BGPd in

MTR format, and the IPv4 and optionally IPv6 address of the BGP router

- *Link Speed In & Link Speed Out* – Enter the speed (bandwidth, capacity) of the interface. The values are used for percentage-based reports

- **Comments** – Comments about the Flow Sensor can be saved here. These observations are not visible elsewhere

To start the Flow Sensor, click the small button displayed next to its name in Configuration » Components. Ensure that the Flow Sensor starts correctly by watching the event log (details on page 41).

If the Flow Sensor starts without errors, but you can't see any data collected by it in Reports » Components » Overview after more than 5 minutes, follow the troubleshooting guide below.

Flow Sensor Troubleshooting

- ✔ Look for warnings or errors produced by the Flow Sensor in the event log (details on page 41)
- ✔ Check if you have correctly configured the Flow Sensor. Each configuration field is described in depth in the previous section
- ✔ Event log error "*License key not compatible with the existing server*" can be fixed by sending the string from Configuration » Servers » [Flow Sensor server] » Hardware Key to sales@andrisoft.com
- ✔ Ensure that the server is receiving flow packets on the configured **Listener IP:Port**:

  ```
  tcpdump -i <interface_eth0_p1p1_etc> -n -c 100 host <flow_exporter_ip> and udp and port <destination_port>
  ```

- ✔ Make sure that the local firewall permits the Flow Sensor to receive flow packets:

  ```
  iptables -L -n -v && iptables -t raw -L -n -v
  ```

- ✔ Ensure that the clocks of both devices are synchronized with NTP. When the devices do not reside in the same time zone, adjust the **Time Settings** parameter from the Flow Sensor configuration accordingly
- ✔ Flow Sensor may crash during spoofed attacks for not having enough RAM when a monitored interface has the *Stats Engine* parameter set to "Full". It is highly recommended to set the **Stats Engine** parameter to "Extended" not to "Full" on systems with low amounts of RAM
- ✔ When you add interfaces with the **Traffic Direction** parameter set to "Auto", make sure that the IP Zone you have selected contains all your IP blocks because **IP Validation** and/or **AS Validation** will be used to establish traffic direction. To capture a sample of flows failing validation in the event log, set the **Log Invalidated Flows** parameter to "Periodically"
- ✔ In order to provide fast and up-to-date traffic statistics, the Flow Sensor accepts only flows describing traffic from the last 5 minutes. All flows aged and exported with a delay exceeding 300 seconds (5 minutes) are ignored, and the event log contains the warning "*Received flow <starting/ending> <X> seconds ago*"

  When the warnings refer to the starting time, make sure that the clocks are synchronized, the flow exporter is properly configured, and the time zone and the **Flow Timeout** parameter are correctly set.

  When the warnings refer to the ending time, make sure that the clocks are synchronized, the time zone is correctly set, the flow exporter is properly configured, and the PFC PIC is not overloaded (Juniper issue).

  You can double-check whether the time of the Flow Sensor and the start/end time of flows differ by more

than 300 seconds. In Reports » Tools » Flow Collectors » Flow Records, select the Flow Sensor, set Output to Debug and generate a listing for the last 5 minutes:

- Column *Date_flow_received* indicates the time when the Flow Sensor received the flow packet
- Column *Date_first_seen* indicates the time when the flow started
- Column *Date_last_seen* indicates the time when the flow ended

Flow Sensor does not misinterpret the start/end time of flows. A few flow exporters are known to have bugs, limitations or inconsistencies regarding flow aging and stamping flow packets with the correct time. In this case, contact your vendor to make sure that the flow exporter is correctly configured, and it is able to expire flows in under 5 minutes. Try a router reboot if possible.

In JunOS there is a flow export rate limit with a default of 1k pps, which leads to flow aging errors. To raise the limit to 40k pps execute:

```
set forwarding-options sampling instance NETFLOW family inet output inline-jflow
flow-export-rate 40
```

Some Cisco IOS XE devices do not export flows using NetFlow version 5, in under 5 minutes, even when configured to do so. In this case, switch to using Flexible NetFlow

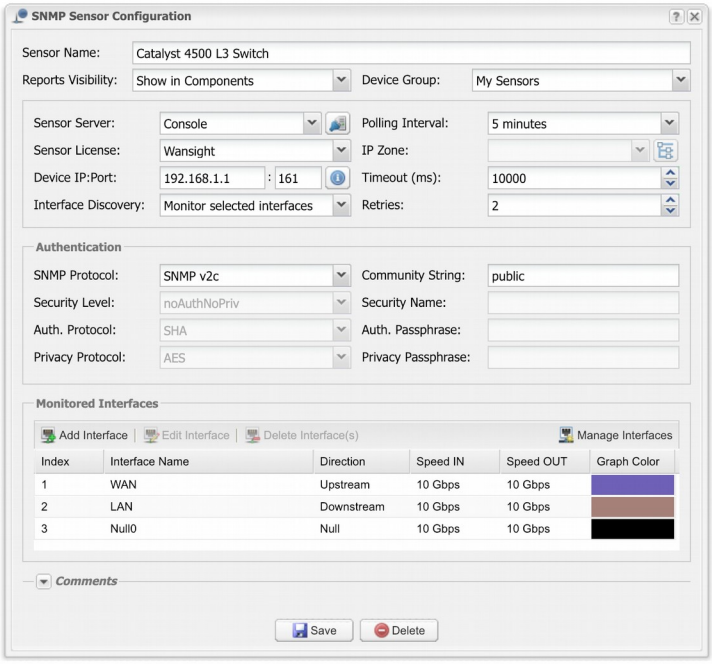
- ✔ Ensure that you have correctly configured the flow exporter to send flows to the server for each of the monitored interfaces. To list all interfaces that send flows, go to Reports » Tools » Flow Collectors » Flow Tops, select any Flow Sensor interface, set Output to Debug, set Top Type to Any Interface and generate the top for the last 10 minutes. The column In/Out_If lists the SNMP index of every interface that exports flows, even if it was not configured as a monitored interface in the Flow Sensor configuration
- ✔ If you see statistics for only one traffic direction (inbound or outbound), go to Reports » Tools » Flow Collectors » Flow Records, and generate a listing for the last 10 minutes. If all your IPs are listed in a single column, check the flow exporter's configuration and feature list. Not all devices can export flows in both directions (e.g. some Brocade equipment generates only inbound sFlow) or with the same interface SNMP index
- ✔ The traffic readings of the Flow Sensor may differ from the SNMP Sensor or from other SNMP-based monitoring tools. Flow Sensor counts In/Out traffic as traffic entering/exiting the IP Zone (when **IP Validation** is enabled), unlike SNMP tools that count In/Out traffic as traffic entering/exiting the interface. You can double-check the traffic readings of a Flow Sensor by configuring an SNMP Sensor that monitors the same flow exporter (page 35)
- ✔ If the Flow Sensor does not show the correct statistics after upgrading the router's firmware, the SNMP index of the interfaces may have changed. In this case, enter the new SNMP index for each monitored interface
- ✔ To troubleshoot Sensor graph or IP graph issues, follow the Graphs Troubleshooting guide on page 18
- ✔ Make sure you are running the latest version of the software by checking Help » Software Updates

Configuration » Components » SNMP Sensor

SNMP Sensor monitors the bandwidth usage of routers and switches on a port-by-port basis. SNMP Sensor queries devices (e.g. routers, switches, servers) for the traffic counters of each port with small data packets. These are triggering reply packets from the device. The advantages and disadvantages of monitoring traffic by SNMP are listed on page 7.

For detailed instructions on how to enable SNMP on your network device, consult its documentation.

To add an SNMP Sensor click the [+] button from the title bar of the Configuration » Components panel. To modify an existing SNMP Sensor, go to Configuration » Components and click its name.



- **Sensor Name** – A short name to help you identify the SNMP Sensor
- **Device Group** – Optional description used within Console to group up components (e.g. by location or role). It can be used to restrict the access of Guest accounts
- **Reports Visibility** – Enable if the SNMP Sensor should be listed inside Reports » Components
- **Sensor Server** – Which server runs the SNMP Sensor. It is recommended to run all SNMP Sensors on the Console server. The configuration of servers is described on page 24
- **Polling Interval** – Polling is the process of sending the SNMP request periodically to the device to retrieve information. A low polling interval (of say 1 minute) gives you granular reports but may place an increased load on your server if you poll a large number of interfaces
- **Sensor License** – License used by the SNMP Sensor. Wanguard provides all features (although severely limited by the SNMP technology); Wansight does not provide traffic anomaly detection and reaction
- **IP Zone** – When a Wanguard license is being used, the SNMP Sensor can check thresholds listed in the

selected IP Zone with the following precondition (because SNMP does not provide any information about IPs or protocols):

- Subnet must be “0.0.0.0/0”
- Domain must be “subnet”
- Value must be absolute, not percentage
- Decoder must be “IP”

- **Device IP:Port** – Enter the IP address and SNMP port (161 by default) of the networking device
- **Timeout (ms)** – The timeout value should be at least a little more than double the time it takes for a packet to travel the longest route between devices on your network. The default value is 1000 milliseconds (1 second)
- **Interface Discovery** – Activates or deactivates interface discovery:
  - *Monitor all interfaces* – Select to add all interfaces automatically to the SNMP Sensor. The interface names are based on the **Interface Name** setting available when pressing the [**SNMP Tester & SNMP Object Identifier**] button located next to the **Device IP:Port** field
  - *Monitor defined interfaces* – Select to monitor only interfaces listed in the SNMP Sensor configuration
- **Retries** – This value represents the number of times the SNMP Sensor retries a failed SNMP request defined as any SNMP request that does not receive a response within the Timeout (ms) defined above. The default value is 2
- **SNMP Protocol** – Select the SNMP protocol used for authentication:
  - *SNMP v1* – Easy to set up – only requires a plaintext community. Supports only 32-bit counters and it has very little security
  - *SNMP v2c* – Version 2c is identical to version 1, except it adds support for 64-bit counters. This is imperative when monitoring gigabit interfaces. Even a 1Gbps interface can wrap a 32-bit counter in 34 seconds, which means that a 32-bit counter being polled at one-minute intervals is useless. Select this option instead of v1 in most cases
  - *SNMP v3* – Adds security to the 64-bit counters. SNMP version 3 adds both encryption and authentication, which can be used together or separately. Setup is much more complex than just defining a community string
- **Community String** – SNMP v1 and v2c credentials serve as a type of password that is authenticated by confirming a match between the string provided here and the SNMP Community String stored as a MIB object on an SNMP-enabled, managed device
- **Security Level & Name** – SNMP v3-only. SNMP Sensor supports the following set of security levels as defined in the USM MIB (RFC 2574):
  - *noAuthnoPriv* – Communication without authentication and privacy
  - *authNoPriv* – Communication with authentication and without privacy
  - *authPriv* – Communication with authentication and privacy
- **Authentication Protocol & Passphrase** – SNMP v3-only. The protocols used for Authentication are *MD5* and *SHA* (Secure Hash Algorithm)
- **Privacy Protocol & Passphrase** – SNMP v3-only. An indication of whether messages sent on behalf of this user can be protected from disclosure, and if so, the type of privacy protocol which is used. This option takes the value *DES* (CBC-DES Symmetric Encryption) or *AES* (Advanced Encryption Standard)

- **Monitored Network Interfaces** – Interfaces that should be monitored. To avoid mirrored graphs, add only upstream interfaces. Settings per interface:
  - *SNMP Index* – The interfaces are identifiable by their unique indexes
  - *Interface Name* – A short description used to identify the monitored interface. Descriptions longer than 10 characters clutter some reports. By default, the auto-filled interface name is retrieved from the ifAlias OID. To change the OID used for the interface name click the [**SNMP Tester & SNMP Object Identifier**] button located next to the **Device IP:Port** field
  - *Graph Color* – Color used in graphs for the interface. The default color is a random one, which can be changed by entering a different HTML color code or by clicking the drop-down menu
  - *Traffic Direction* – Direction of the traffic entering the interface, from the user's perspective:
    - "Unset" – Traffic entering the interface is considered "downstream"; traffic exiting the interface is considered "upstream"
    - "Upstream" – Set for upstream interfaces, e.g. peering interfaces, interfaces connected to the Internet
    - "Downstream" – Set for downstream interfaces, e.g. customer interfaces, interfaces connected to your network
    - "Null" – Traffic to Null interfaces is ignored
  - *Link Speed In & Link Speed Out* – Enter the speed (bandwidth, capacity) of the interface. The values are used for percentage-based reports
- **Comments** – Comments about the SNMP Sensor can be saved here. These observations are not visible elsewhere

To start the SNMP Sensor, click the small button displayed next to its name in Configuration » Components. Ensure that the SNMP Sensor starts correctly by watching the event log (details on page 41).

If the SNMP Sensor starts without errors, but you cannot see any data collected by it in Reports » Components » Overview after more than 5 minutes, follow the troubleshooting guide below.

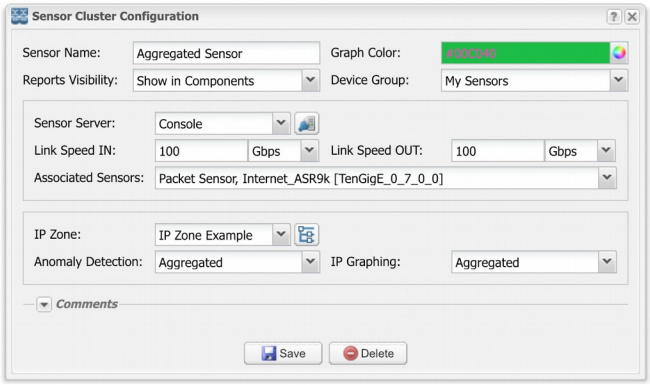
SNMP Sensor Troubleshooting

- ✔ Look for warnings or errors produced by the SNMP Sensor in the event log (details on page 41)
- ✔ Ensure that you have correctly configured the SNMP Sensor. Each configuration field is described in depth in this chapter
- ✔ Event log error "*License key not compatible with the existing server*" can be fixed by sending the string from Configuration » Servers » [SNMP Sensor server] » Hardware Key to sales@andrisoft.com
- ✔ Verify if the Console can reach the device by clicking the [**OIDs and Tests**] button from the SNMP Sensor Configuration window, then press [**Query Device**]
- ✔ Permit the server to contact the SNMP device, by configuring its ACL
- ✔ If Sensor graphs are very spiky, increase the Polling Interval value.
- ✔ Make sure you are running the latest version of the software by checking Help » Software Updates

Configuration » Components » Sensor Cluster

Sensor Cluster aggregates traffic data provided by Packet Sensors and Flow Sensors into a single IP graphing domain.

To add a Sensor Cluster, click the [+] button found on the title bar of the Configuration » Components panel. To configure an existing Sensor Cluster, go to Configuration » Components, and click its name.



- **Sensor Name** – A short name to help you identify the Sensor Cluster
- **Graph Color** – Color used in graphs for the Sensor Cluster. The default color is a random one, which can be changed by entering a different HTML color code or by clicking the drop-down menu
- **Reports Visibility** – Enable if the Sensor Cluster should be listed inside Reports » Components
- **Device Group** – Optional description used within Console to group up components (e.g. by location or role). It can be used to restrict the access of Guest accounts
- **Sensor Server** – Which server runs the Sensor Cluster. It is recommended to run Sensor Clusters on the Console server. The configuration of servers is described on page 24
- **Link Speed IN / OUT** – Summed-up speeds (bandwidth, capacity) of the aggregated interfaces. The values are used for percentage-based reports
- **Associated Sensors** – Select which Packet Sensors and Flow Sensor interfaces must be aggregated by the Sensor Cluster
- **IP Zone** – Sensor Cluster extracts from the selected IP Zone per-subnet settings about thresholds and/or IP graphing. For more information about IP Zones consult the “IP Zone” chapter on page 22
- **IP Graphing** – Select “Aggregated” to enable IP graphing by the Sensor Cluster for the summed up traffic data, and disable IP graphing by the associated Sensors. Select “Not Aggregated” to enable IP graphing by each associated Sensor and to disable IP graphing by the Sensor Cluster
- **Comments** – Comments about the Sensor Cluster can be saved here. These observations are not visible elsewhere

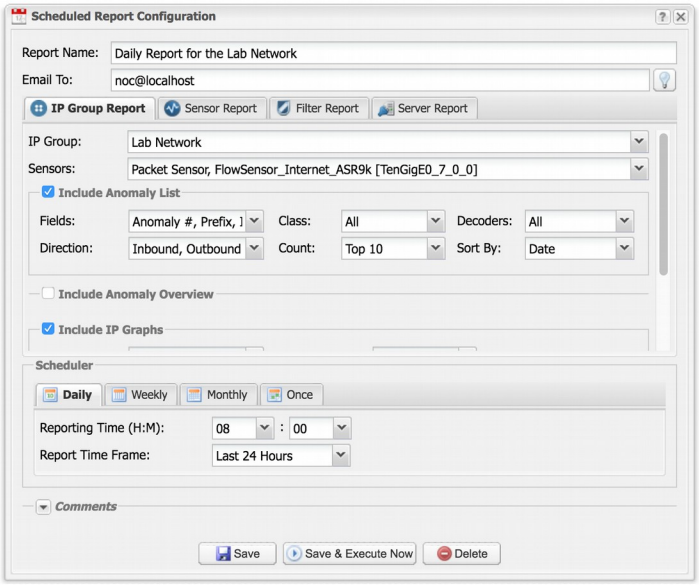
To start the Sensor Cluster, click the small button displayed next to its name in Configuration » Components.

Ensure that the Sensor Cluster starts correctly by watching the event log (see details on page 41) and by watching Reports » Components » Overview.

Configuration » Schedulers » Scheduled Reports

One of the greatest strengths of the Console is the ease in which it can generate complex Reports. Most reports created by clicking items from the Reports Region can be printed, exported as PDFs or sent by email.

If you want to receive periodic reports by email without having to log in to Console, go to Configuration » Schedulers and click the [+] button from the title bar of the panel.



You can include more than one email address in the **Email To** field by separating addresses with a comma.

The emails are sent periodically according to the settings in the **Scheduler** tab.

To see how the email would look like without waiting for the preconfigured time, enter your email address, and then click the [**Save & Execute Now**] button. You should receive the email containing the report within a few seconds. If you do not, verify the settings from Configuration » General Settings » Outgoing Email.

All emails are formatted as HTML messages and include MIME attachments.

Configuration » Schedulers » Event Reporting

Events are short text messages that describe errors, warnings or the change of an operational status. They are generated by Wansight components and logged by Console.

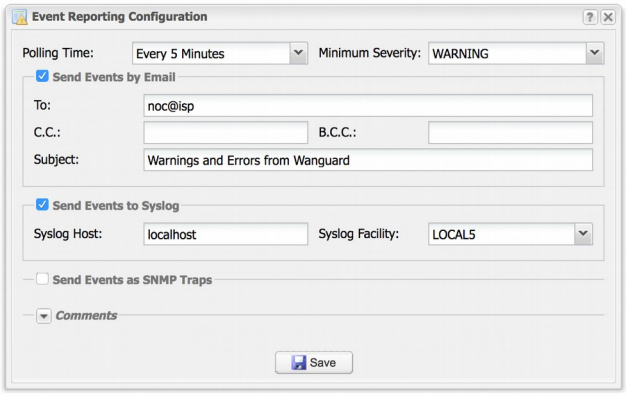
You can list events in Reports » Components » [Component Name] » [Component Type] Event sub-tab. To search, sort or filter event messages, click the small down arrow that appears when hovering over the Event column header. To see additional details about an event click the [+] button from the first column.

To see a recent list of **Latest Events**, click the small bottom edge of the window to raise the South Region or press Ctrl+E. On one side the Latest Events tab displays the latest 60 events, while on the other side it shows a list of components that can generate events and the number of events generated in the last 24 hours by each component. The number's color indicates the maximum severity of the events: red means that there are ERRORS, blue is for INFO events, etc.

The event's **severity** indicates its importance:

- **MELTDOWN** – Meltdown events are generated in severe situations, such as hardware failures
- **CRITICAL** – Critical events are generated when significant software errors occur, such as a memory exhaustion situation
- **ERROR** – Error events are usually caused by misconfigurations, communication errors between components, or bugs. Sensors auto-recover from errors by restarting themselves
- **WARNING** – Warning events are generated when authentication errors occur, on I/O bottlenecks or when there are time synchronization issues
- **INFO** – Informational events are generated when configurations are changed or when users log in to Console
- **DEBUG** – Debug events are generated to help troubleshooting coding errors

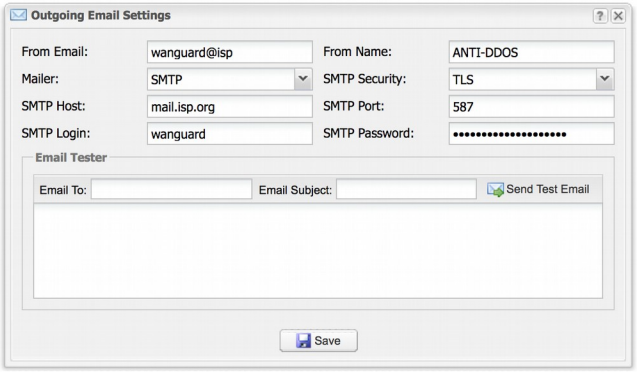
As an administrator, you should keep events with high severities under surveillance! Configure Console to send important events periodically by email, Syslog or SNMP in Configuration » Schedulers » Event Reporting.



To send events by SNMP, fill the **SNMP Host**, **Community**, and **SNMP OID** fields.

Configuration » General Settings » Outgoing Email

Console sends notification emails using the settings from Configuration » General Settings » Outgoing Email:



- **From Email** – The email address you would like to appear as the sender
- **From Name** – The name as you would like it to appear on messages
- **Mailer** – Console supports several mailing systems:
  - *PHP Mail* – Use the PHP mail() function. To use it, you may have to configure a Mail Transfer Agent (Postfix, Qmail, Sendmail) on the Console server
  - *SMTP* – Use the integrated SMTP support to send emails directly, without using a local Mail Transfer Agent
  - *Sendmail* – Send emails using the sendmail command. To use it, you may have to configure a Mail Transfer Agent (Postfix, Qmail, Sendmail) on the Console server
- **SMTP Security** – Security options:
  - *None* – No encryption
  - *SSL* – Enable SSL encryption
  - *TLS* – Enable TLS encryption
- **SMTP Host** – Specify the SMTP server(s). You can include backup SMTP server(s) separated by the ";" character
- **SMTP Port** – TCP port to connect to, usually 25 (insecure) or 587 (secure, uses SSL/TLS)
- **SMTP Login/Password** – Credentials used for SMTP authentication. When the fields are empty, no authentication is performed
- **Email Tester** – Send a test email to verify the settings

If you can send emails through the Email Tester, but you are not receiving emails from a Response action, check if there are errors when executing from CLI "php /opt/andrisoft/webroot/rep_reports.php".

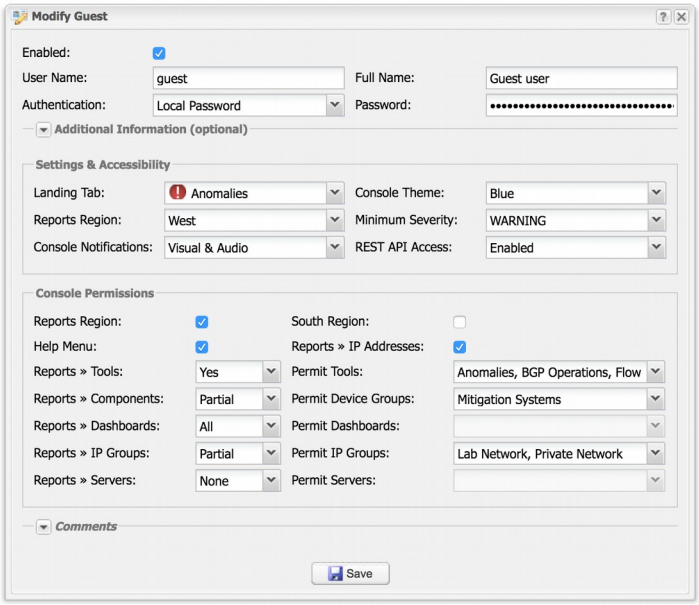
Configuration » General Settings » User Management

To add, modify or delete Console user accounts click Configuration » General Settings » User Management.

Each Console user must be assigned to one role / access level:

- **Administrator** – Has full privileges. Can manage other user accounts. Is the only role allowed to access Configuration » General Settings » License Manager
- **Operator** – Can change any configuration but is not authorized to modify user accounts
- **Guest** – Has read-only access to Console, without access to any configuration. Can have a granular, permission-based access to specific reports, dashboards, Sensors, IP groups, tools, etc.

To add a Console account, press [**Add User**] and the select the desired role. You can modify an account by double-clicking it, or by selecting it and by pressing the [**Modify User**] button.



The **Enabled** checkbox enables or disables the selected account.

There are two **Authentication** options:

- *Local Password* – The user will be authenticated with the password entered in the **Password** field. All passwords are stored encrypted
- *Remote Authentication* – The user will be authenticated by remote LDAP or RADIUS servers configured in Configuration » General Settings » User Management (details on page 45)

The **Full Name**, **Company**, **Position**, **Email, Phone** and **Comments** fields are optional. These details are not used anywhere.

Landing Tab shows the tab that opens immediately after logging in. The list is dynamic and expands as you add Sensors, dashboards, IP groups, etc. Set the Landing Tab to a relevant dashboard or report.

Minimum Severity shows the minimum severity level of events displayed in Console.

Reports Region lets you switch the position of the Reports Region (described on page 14) to east or west.

Configuration Region lets you switch the position of the Configuration Region (described on page 14) to east or west.

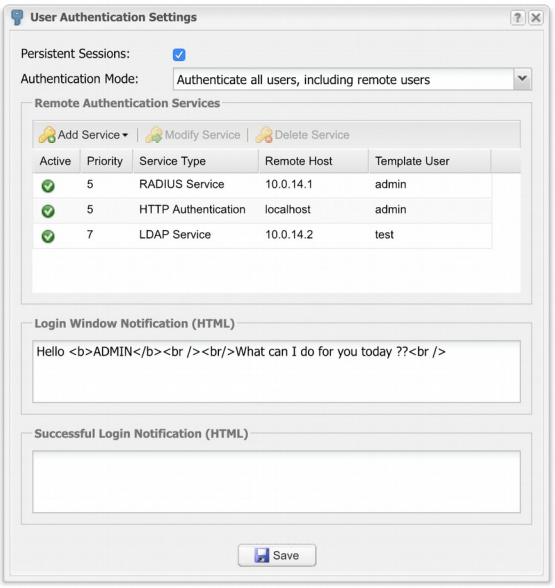
Console Theme allows you to change how Console looks after re-login. The most popular themes are the corporate “Gray” theme and the industrial-looking “Azenis”. The “Black” theme is recommended for OLED screens and NOC displays.

Console Notifications controls the visual and audio notifications sent by Responses.

REST API Access controls whether the user has access to the REST API using his credentials. The REST API is documented on *http://<console_ip>/wanguard-api-ui* or *https://<console_ip>/wanguard-api-ui.*

Configuration » General Settings » User Authentication

To configure remote authentication mechanisms and login window settings click Configuration » General Settings » User Authentication.



Persistent Sessions enable cookie-based authentication for Console users that select the *Remember* option in the login screen. Subsequent sessions skip the login screen for the next 30 days or until the user logs off.

Authentication Mode enables or disables the authentication of Console users that are not defined in Configuration » General Settings » User Management but defined in LDAP or Radius.

Console permits the use of external Radius and LDAP servers for end user authentication.

LDAP server settings:

- **Priority** – You can set the order in which Console connects to multiple authentication services. The authentication process stops after the first successful authentication
- **Template User** – Remotely authenticated users without a Console account have the privileges of the Template User
- **LDAP Host** – IP or hostname of the LDAP server. To connect to an LDAP server by SSL, set this parameter as *ldaps://<IP>/*
- **Login Attribute** – Enter the LDAP attribute that contains the username. For Active Directory it usually is *mailNickname* or *sAMAccountName*, for OpenLDAP or IBM Directory Server it could be *uid*
- **LDAP Base DN** – Specify the location in the LDAP hierarchy where Console should begin searching for usernames for authorization requests. The base DN may be something equivalent to the organization,

group, or domain name (AD) of the external directory: *dc=domain,dc=com*

- **Bind User DN/Password** – Distinguished name and password for a LDAP user permitted to search within the defined Base DN
- **Search Filter** – Can contain rules that restrict which users are authenticated using the current configuration. For example, the string "|(department=*NOC*)(department=ISP)" only allows users from departments containing the string “NOC” or (|) from the “ISP” department to authenticate in Console

RADIUS server settings:

- **Priority** – You can set the order in which Console connects to multiple authentication services. The authentication process stops after the first successful authentication
- **Template User** – Remotely authenticated users without a Console account have the privileges of the Template User
- **RADIUS Host** – IP or hostname of the Radius server
- **RADIUS Port** – Port through which the Radius server is listening for authentication requests
- **RADIUS Protocol** – Protocol used for authentication purposes:
    - **PAP** (Password Authentication Protocol) – provides a simple method for the peer to establish its identity using a 2-way handshake
    - **CHAP** (Challenge-Handshake Authentication Protocol) – authenticates a user or network host to an authentication entity
    - **MSCHAP** – is the Microsoft version of the Challenge-handshake authentication protocol, CHAP
    - **MSCHAP2** – is another version of Microsoft version of the Challenge-handshake authentication protocol, CHAP
- **RADIUS Secret** – Enter the credentials for connecting to the Radius server.

The contents of the **Login Window Notification** field is shown inside the Console login window.

The contents of the **Successful Window Notification** field is shown inside the Console window after logging in.

Reports » Tools » Flow Collectors

Reports » Tools contains a link to the **Flow Collectors** item only if there is at least one Flow Sensor in use. Here you can list, aggregate, filter and sort flow records, and generate traffic tops and statistics.

There are 2 sub-tabs, located at the left lower side of the window:

Flow Records

You can list and filter flow data. The options are:

- **Sensor Interfaces** – Select the interfaces you are interested in. Administrators can restrict the interfaces accessible by guest accounts
- **Time Frame** – Select a predefined time frame, or select "Custom..." to enter a specific time interval, in order to list flows that started or ended inside the interval. Time zone differences between the Console server and remote Flow Sensor servers are not automatically adjusted
- **Flow Filtering Expression** – Here you can enter a filtering expression for flows. Click the light bulb icon on the right to open a window that shows you the correct syntax. Frequently-used flow filters can be saved there and reused at a later time
- **Output** – You can select several output formats, or you can type your own format. Click the light bulb icon on the left to open a window that shows you the correct syntax
- **Export** – If the output is not very large, it can be viewed, converted to PDF, emailed or printed.

  If you need to list huge amounts of flow data, doing it solely from within the web browser may not be a good idea. In this case, select the "Dump" option to view the CLI command used for flow listing. You can execute that CLI command from the shell and forward the output to a file
- **Aggregation** – By default, flows are not aggregated. By clicking on the appropriate checkboxes, you can select how to aggregate flows. You can aggregate entire subnets by selecting src(dst)IPv4(IPv6)/<subnet bits>
- **Limit Flows** – List only the first N flows of the selected time slot
- **Sorting –** When listing flows sent by different interfaces, you can sort them according to the start time of the flows. Otherwise, flows are listed in the sequence of the selected interfaces

Flow Tops

You can generate tops from flow data. The options are:

- **Sensor Interfaces** – Select the interfaces you are interested in. Administrators can restrict the interfaces accessible by guest accounts
- **Time Frame** – Select a predefined time frame, or select "Custom..." to enter a specific time interval, in

order to count only flows that started or ended inside the interval. Time zone differences between the Console server and remote Flow Sensor servers are not automatically adjusted

- **Flow Filtering Expression** – Here you can enter a filtering expression for flows. Click the light bulb icon on the right to open a window that shows you the correct syntax. Frequently-used flow filters can be saved there and reused at a later time
- **Output** – You can select several output formats, or you can type your own format. Click the light bulb icon on the left to open a window that shows you the correct syntax
- **Export** – If the output is not very large, it can be emailed, converted to PDF, or printed.

  If you need to list huge amounts of flow data, doing so solely from within the web browser may not be a good idea. In this case, select the “Dump” option to view the CLI command used to list the top. You can execute that CLI command from the shell and forward the output to a text file
- **Top Type** – Select the top type from the drop-down menu
- **Aggregation** – By default, flows are not aggregated. By clicking on the appropriate checkboxes, you can select how to aggregate flows. You can aggregate entire subnets by selecting src(dst)IPv4(IPv6)/<subnet bits>
- **Limit** – Limit the output to only those records whose packets or bytes match the specified condition
- **Top** – Limit the top listing to the first N records

Reports » Tools » Packet Tracers

Reports » Tools contains a link to the **Packet Tracers** item only if there is at least one Packet Sensor in use. The number of active packet traces (dumps) is displayed within the panel.

Here you can easily capture packets from various parts of your network using distributed Packet Sensors. You can view the contents of packets directly from Console using an integrated packet analyzer user interface that resembles the popular WireShark software.

There are 2 sub-tabs located at the lower left side of the window:

Active Packet Traces

Administrators, operators, and guests with packet capturing privileges can generate packet dumps by clicking the [**Capture Packets**] button. The options are:

- **Description** – An optional short description to help you identify the packet trace
- **Packet Sensor** – Select which Packet Sensors can capture the traffic you are interested in. Administrators can restrict which Packet Sensors are accessible by guest accounts
- **BPF Expression** – Click the light bulb icon on the right to open a window that explains the Berkley Packet Filter (BPF) syntax. Frequently used BPF expressions can be saved there and reused at a later time. Entering a BPF expression is mandatory. To capture all IP traffic enter “ip”
- **Max. Running Time** – Maximum running time of the capturing thread (process)
- **Stop Capture Time** – When Max. Running Time is set to “Unlimited”, you can set the exact date when the capturing thread will stop
- **Max. File Size (MB)** – This option is used for splitting packet dumps into multiple files of <number> Mbytes. Before writing a raw packet to a file, the Packet Sensor checks whether the file is currently larger than <number> and, if so, closes the current file and opens a new one
- **Max. Packets** – The capture stops after receiving <number> packets
- **Max. Files Number** – Setting this will limit the number of files created for the specified <number>, and begin overwriting files from the beginning, thus creating a “rotating” buffer. In addition, it will name the files with enough leading 0s to support the maximum number of files, allowing them to sort correctly
- **Time Rotation (s)** – If specified, this rotates the file every <number> seconds
- **Sampling Type & Value** – Select “None” when no packet sampling is required. Select “1 / Value” to save just one packet every <value> packets. Select “Value / 5s” to save maximum <value> packets every 5 seconds
- **Packet Payload** – Select “Full” to capture the entire payload, “Only Layer 3” to zero-out the payload except for the IP header, or “Only Layer 4” to zero-out the packet payload while retaining TCP, UDP and ICMP headers
- **Snapshot Length** – Snarf <number> bytes of data from each packet rather than the default of 65535 bytes. Note that taking larger snapshots both increases the amount of time it takes to process packets

and, effectively, decreases the amount of packet buffering. This may cause packets to be lost. You should limit this <number> to the smallest number that will capture the protocol information you are interested in

- **Filename Prefix** – Name of the capture file. If any file-rotation options are used, a number will be appended to the filename
- **Comments** – This field may contain comments about the packet trace

All active Packet Traces are listed in a table having the following format:

- **Description [BPF]** – Description and BPF expression of the trace
- **Sampling** – Type of sampling being used
- **From** – Date when the Packet Tracer started capturing packets
- **Until** – Time or the conditions that will cause the Packet Tracer to stop capturing the traffic
- **Status** – Indicates the status of the Packet Tracer. It is green if it is running, and red if it is not
- **Packet Tracer** – Packet Sensor or Packet Filter used for capturing packets
- **Files / Size** – Number of dump files generated and the size of the latest dump file
- **Packets** – Number of packets captured
- **Actions** – Click the first icon to view the latest dump file in an integrated packet analyzer interface. Click the second icon to download the latest dump file to your computer. If downloading does not work, but viewing does, increase the values of the *max_execution_time* and *memory_limit* from php.ini. Click the third icon to stop capturing packets

Packet Trace Archive

By default, packet traces are sorted by time in descending order. By clicking the down arrow of any column header, you can apply row filters, change sorting direction and toggle the visibility of columns.

The [+] sign from the first column expands each row for additional information about the packet trace and provides access to packet dump files. The columns are explained in the previous section.

Reports » Components » Overview

This tab displays a few self-refreshing tables that show real-time system parameters collected from all active Wansight components and servers:

Console

The table displays the following data:

Status	A green check mark indicates that Console is functioning properly. When a red "X" appears, enable the WANsupervisor service on the Console server
Online Users	Active Console sessions
Avg. DB Bits/s (In/Out)	Average number of bits/s sent and received since the start of the Console database
Avg. DB Queries/s	Average number of queries per second since the start of the Console database
DB Clients	DB clients that are currently using the Console database
DB Connections	Active connections to the Console database
DB Size	Disk space used by the Console database
Free DB Disk	Disk space available on the partition configured to store the Console database
Free Graphs Disk	Disk space available on the partition configured to store IP graphs
Time Zone	Time zone of the Console server
Console Time	Time on the Console server
Uptime	Uptime of the Console database

Servers

The table displays the following data for each server that runs software components of Wansight:

Status	A green check mark indicates that the server is connected to Console. When a red "X" is displayed, start the WANsupervisor service and make sure that the clocks are synchronized between the server and the Console server
Server Name	Displays the name of the server and a colored square with the color defined in its configuration. Click to open a new tab with data specific to the server. Administrators and operators can right-click to open the Server Configuration window

Load	Load average reported by the Linux kernel for the last 5 minutes
Free RAM	Available RAM. Swap memory is not counted
CPU% User	Percentage of CPU resources used by the user space processes. Can be >100% on multiple cores/CPUs (e.g. the maximum value for a quad-core system is 400%)
CPU% System	Percentage of CPU resources used by the kernel. Can be >100% on multiple cores/CPUs (e.g. the maximum value for a quad-core system is 400%)
CPU% IOwait	Percentage of CPU resources waiting for I/O operations. A high number indicates an I/O bottleneck
CPU% Idle	Percentage of idle CPU resources. Can be >100% on multiple cores/CPUs (e.g. the maximum value for a quad-core system is 400%)
Free Flows Disk	Disk space available on the partition that is configured to store flows
Free Dumps Disk	Disk space available on the partition that is configured to store packet dumps
Contexts/IRQs/SoftIRQs	Context switches, hardware interrupts and software interrupts per second
Uptime	Uptime of the operating system

Sensor Clusters

The table is displayed when there is at least one active Sensor Cluster.

Status	A green check mark indicates that the Sensor Cluster is connected to Console. If you see a red "X" instead, make sure that the WANsupervisor service is running and look for errors in the event log (see page 41)
Sensor Name	Displays the name of the Sensor Cluster and a colored square with the color defined in its configuration. Click to open a new tab with data specific to the Sensor Cluster. Administrators and operators can right-click to open the Sensor Cluster configuration window
Pkts/s (In / Out)	Inbound and outbound packets/second throughput
Inbound Bits/s	Inbound bits/second throughput and the usage percent
Outbound Bits/s	Outbound bits/second throughput and the usage percent
Received Pkts/s	Packet/s reported by the associated Sensors
IPs (Int./Ext.)	IP addresses that sent or received traffic. The Int(ernal)/Ext(ernal) IPs are the IPs inside/outside the IP Zone. The Stats Engine parameter from the associated Sensors' configurations enables or disables the monitoring of external IPs
Dropped	Packets dropped by the Server Cluster
CPU%	Percentage of CPUs used by the Sensor Cluster process
RAM	Amount of memory utilized by the Sensor Cluster process
Start Time	Time when the Sensor Cluster instance started

Server	Which server runs the Sensor Cluster. Click to open a new tab with data specific to the server. Administrators and operators can right-click to open the Server Configuration window

Packet Sensors

The table is displayed when there is at least one active Packet Sensor.

Status	A green check mark indicates that the Packet Sensor is connected to Console. If you see a red "X" instead, make sure that the WANsupervisor service is running and look for errors in the event log (see page 41)
Sensor Name	Displays the name of the Packet Sensor and a colored square with the color defined in its configuration. Click to open a new tab with data specific to the Packet Sensor. Administrators and operators can right-click to open the Packet Sensor Configuration window
Pkts/s (In / Out)	Inbound and outbound packets/second throughput after IP or MAC validation
Inbound Bits/s	Inbound bits/second throughput after IP or MAC validation and the usage percent
Outbound Bits/s	Outbound bits/second throughput after IP or MAC validation and the usage percent
Received Pkts/s	Rate of sniffed packets before IP or MAC validation
IPs (Int / Ext)	IP addresses that sent or received traffic. The Int(ernal)/Ext(ernal) IPs are the IPs inside/outside the IP Zone. The Stats Engine parameter from the Sensor configuration enables or disables the monitoring of external IPs
Dropped	Packets dropped by the packet capturing engine. A high number usually indicates a sniffing performance problem
CPU%	Percentage of CPUs used by the Packet Sensor process
RAM	Amount of memory used by the Packet Sensor process
Start Time	Time when the Packet Sensor started
Server	Which server runs the Packet Sensor. Click to open a new tab with data specific to the server. Administrators and operators can right-click to open the Server Configuration window

Flow Sensors

The table is displayed when there is at least one active Flow Sensor.

Status	A green check mark indicates that the Flow Sensor is connected to Console. If you see a red

	"X" instead, make sure that the WANsupervisor service is running and look for errors in the event log (see page 41)
Sensor Name	Displays the name of the Flow Sensor. Click to open a new tab with data specific to the Flow Sensor. Administrators and operators can right-click to open the Flow Sensor Configuration window
Interface	Interface name and a colored square with the configured graph color. If the interface names are missing for more than 5 minutes after the Flow Sensor has started, check the troubleshooting guide on page 33
Pkts/s (In / Out)	Inbound and outbound packets/second throughput after IP or AS validation
Inbound Bits/s	Inbound bits/second throughput after IP or AS validation and usage percent
Outbound Bits/s	Outbound bits/second throughput after IP or AS validation and usage percent
IPs (Int / Ext)	IP addresses that send or receive traffic. The Int(ernal)/Ext(ernal) IPs are the IPs inside/outside the IP Zone. The Stats Engine parameter from the Sensor configuration enables or disables the monitoring of external IPs
Flows/s	Flows per second received by the Flow Sensor
Flows Delay	Because traffic data must be aggregated first, flow devices export flows with a configured delay. Some devices export flows much later than the configured delay and this field contains the maximum flows delay detected by the Flow Sensor. Flow Sensor cannot run with flow delays of over 5 minutes
Dropped	Unaccounted flows. A high number indicates a performance problem of the Flow Sensor or a network connectivity issue with the flow exporter
CPU%	Percentage of CPU resources used by the Flow Sensor process
RAM	Amount of RAM used by the Flow Sensor process
Start Time	Time when the Flow Sensor started
Server	Which server runs the Flow Sensor. Click it to open a new tab with data specific to the server. Administrators and operators can right-click to open the Server Configuration window

SNMP Sensors

The table is displayed when there is at least one active SNMP Sensor.

Status	A green check mark indicates that the SNMP Sensor is connected to Console. If you see a red "X" instead, make sure that the WANsupervisor service is running and look for errors in the event log (see page 41)
Sensor Name	Displays the name of the SNMP Sensor and a colored square with the color defined in its configuration. Click to open a new tab with data specific to the SNMP Sensor. Administrators and operators can right-click to open the SNMP Sensor Configuration window

Interface	Interface name and a colored square with the configured graph color
Pkts/s (In / Out)	Inbound and outbound packets/second throughput
Inbound Bits/s	Inbound bits/second throughput and usage percent
Outbound Bits/s	Outbound bits/second throughput and usage percent
Errors/s (In / Out)	For packet-oriented interfaces, it represents the number of inbound and outbound packets that contained errors, preventing them from being deliverable to a higher-layer protocol. For character-oriented or fixed-length interfaces, it represents the number of inbound transmission units that contained errors preventing them from being deliverable to a higher-layer protocol
Discards/s (In / Out)	Inbound and outbound packets which were chosen to be discarded even though no errors had been detected to prevent them from being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space
Oper. Status	Current operational state of the interface. The *Testing* state indicates that no operational packets can be passed. If Administrative Status is *Down* then Operational Status should be *Down*. If Administrative Status is changed to *Up* then Operational Status should change to *Up* if the interface is ready to transmit and receive network traffic; it should change to *Dormant* if the interface is waiting for external actions (such as a serial line waiting for an incoming connection); it should remain in the *Down* state if and only if there is a fault that prevents it from going to the *Up* state; it should remain in the *NotPresent* state if the interface has missing (typically, hardware) components
Admin. Status	Desired state of the interface. The *Testing* state indicates that no operational packets can be passed. When a managed system initializes, all interfaces start with the Administrative Status in the *Down* state. As a result of either explicit management action or per configuration information retained by the managed system, the Administrative Status is then changed to either the *Up* or *Testing* states (or remains in the *Down* state)
CPU%	Percentage of CPU resources used by the SNMP Sensor process
RAM	Amount of RAM used by the SNMP Sensor process
Start Time	Time when the SNMP Sensor started
Server	Which server runs the SNMP Sensor. Click it to open a new tab with data specific to the server. Administrators and operators can right-click to open the Server Configuration window

Reports » Components » Sensors

Click on a Sensor anywhere in Console to open a tab which contains Sensor-specific information. This tab includes a few sub-tabs, located at the lower side of the window. All sub-tabs share the following common toolbar fields:

- **Sensor Interfaces** – Select the Sensor interfaces you are interested in, or select "All" to select all Sensor Interfaces. Administrators can restrict which Sensors are accessible by guest accounts
- **Time Frame** – Select a predefined time frame, or select "Custom..." to enter a specific time interval

Sensor Dashboard

The Sensor Dashboard tab allows you to group the most relevant data collected by Sensors. The Sensor dashboard configuration does not apply to a particular Sensor, so the changes you make are visible for other Sensor dashboards as well. The operation of dashboards is described in the "Reports » Dashboards" chapter on page 61.

The configuration of Sensor widgets is outlined in the following paragraphs.

Sensor Graphs

This sub-tab allows you to view a variety of Sensor-related histograms for the selected Sensor Interface(s):

- **Data Units** – Select one or more data units:
  - *Most Used* – Frequently-used data units
  - *Packets* – Inbound packets/second (+ on Y-axis) and outbound packets/second (- on Y-axis)
  - *Bits* – Inbound bits/second (+ on Y-axis) and outbound bits/second (- on Y-axis)
  - *Applications* – Sensor can collect application-specific distribution data for HTTP, HTTPS, SMTP, POP3, IMAP, SNMP, FTP, SSH, TELNET, SQL, NETBIOS, MS-DS, MS-RDP, DNS, ICMP, and OTHERS. The graphs are updated when the Sensor configuration has the Stats Engine parameter set to "Basic"
  - *Bytes* – Bytes/second throughput
  - *Internal* or *External IPs* – IP addresses that send or receive traffic. internal and external IPs are hosts inside and respectively outside the IP Zone. The Stats Engine parameter from the Sensor configuration enables or disables monitoring of external IPs. A spike in the Internal IPs graph usually means that an IP class scan was performed against your IP blocks. A spike in the external IPs graph usually means that you have received a spoofed attack
  - *Received Frames* – For Packet Sensors, it represents the number of packets/s received before IP or MAC validation. For Flow Sensors, it represents the number of flows/s received before IP or AS validation
  - *Dropped Frames* – For Packet Sensors, it represents the number of packets dropped by the packet capturing engine. A high number indicates a sniffing performance problem. For Flow Sensors, it

represents the number of unaccounted flows. A high number indicates a wrong configuration of the Flow Sensor or a network connectivity issue with the flow exporter

- *Unknown Frames* – For Packet Sensors, it represents the rate of packets not passing IP validation. For Flow Sensors, it represents the rate of invalidated flows
- *Unknown Sources* – *S*ource IP addresses that did not pass IP validation
- *Unknown Destinations* – Destination IP addresses that did not pass IP validation
- *Avg. Packet Size* – Average packet size in bits/packet
- *CPU%* – Percentage of CPU resources used by the Sensor process
- *RAM* – Amount of RAM utilized by the Sensor process
- *Load* – Load reported by the Linux kernel
- *IP Graphs* – Updated IP graphs files
- *IP Accounting* – IP accounting records updated
- *HW Graphs* – Traffic profiling files updated
- *IP Graphs Time* – Seconds needed to update the IP graphs files
- *HW Graphs Time* – Seconds needed to update the traffic profiling files
- *Processing Time* – Seconds needed to perform traffic analysis functions
- *IP Structures* – Internal IP structures
- *IP Structure RAM* – RAM bytes used by each IP structure

- **Graphs Size** – Select a predefined dimension or enter a custom one in a "<X> x <Y>" format, where <X> and <Y> are the X-axis and Y-axis pixels
- **Graphs Title** – Graphs can have an automatically-generated title for the "Auto" option, no title for the "None" option, or you can enter your own text to be rendered as a title
- **Graph Legend** – Select the level of detail for the graph legend
- **Consolidation** – If you are interested in spikes, choose the *MAXIMUM* aggregation type. If you are interested in average values, choose the *AVERAGE* aggregation type. If you are interested in low values, choose the *MINIMUM* aggregation type
- **Group Sensor Interfaces** – Select to generate a single graph for the selected Sensor Interfaces
- **Stack Sensor Interfaces** – Select to view the summed up, stacked values for multiple Sensor Interfaces

Sensor Tops

This sub-tab allows you to generate various traffic tops for the selected Sensor Interfaces. The Stats Engine parameter from the Sensor configuration enables or disables data collection for various Sensor tops.

- **Top Type** – Select a top type:
  - *Talkers* – Hosts from your network that send or receive the most traffic for the selected decoder. Available only when the Stats Engine parameter from the Sensor configuration is set to "Basic"
  - *IP Groups* – IP groups that send or receive the most traffic for the selected decoder. Available only when the Stats Engine parameter from the Sensor configuration is set to "Basic"

- *External IPs* – External IPs that send or receive the most traffic for the selected decoder. Available when the Stats Engine parameter from the Sensor configuration is set to "Extended" or "Full"
- *Autonomous Systems* – Autonomous systems that send or receive the most traffic. Available only when the Stats Engine parameter from the Sensor configuration is set to "Extended" or "Full"
- *Transit Autonomous Systems* – Transit autonomous systems that send or receive the most traffic. Available only when the Sensor is configured to extract Transit AS data from a BGP dump file
- *Countries* – Countries that send or receive the most traffic. Available when the Stats Engine parameter from the Sensor configuration is set to "Extended" or "Full"
- *TCP Ports* – Most-used TCP ports. Available when the Stats Engine parameter from the Sensor configuration is set to "Basic"
- *UDP Ports* – Most-used UDP ports. Available when the Stats Engine parameter from the Sensor configuration is set to "Basic"
- *IP Protocols* – Most-used IP protocols. Available when the Stats Engine parameter from the Sensor configuration is set to "Basic"
- *IP Versions* – Most-used IP versions: IPv4 or IPv6. Available when the Stats Engine parameter from the Sensor configuration is set to "Basic"

- **Decoder** – Select the decoder that analyzes the type of traffic that interests you
- **Direction** – Direction of traffic, *Inbound* or *Outbound*
- **Group Sensor Interfaces** – When unchecked, a different top is generated for each selected Sensor Interface. When checked, top data is combined
- **DNS** – When checked, it enables reverse DNS resolution for IP addresses. It may slow down generating tops for *Talkers* and *External IPs*

You can increase the number of top records and change the available decoders in Configuration » General Settings » Graphs & Storage, see page 16.

Generating tops for many Sensor Interfaces and for long time frames may take minutes. If the report page timeouts, increase the *max_execution_time* parameter from *php.ini*.

Flow Records

You can list and filter the flow data collected for the selected Sensor Interfaces. The options are described in the "Flow Collectors" chapter on page 47. This sub-tab is visible only for tabs opened for Flow Sensors.

Flow Tops

You can generate tops from the flow data collected for the selected Sensor Interfaces. The options are described in the "Flow Collectors" chapter on page 47. This sub-tab is visible only for tabs opened for Flow Sensors.

AS Graphs

Flow Sensors and Packet Sensors can generate traffic and bandwidth histograms for autonomous systems. This feature is enabled for Packet Sensors that have the Stats Engine parameter set to “Full”, and for Flow Sensors that have the Stats Engine parameter set to “Full” or “Extended”.

The inbound traffic represents the traffic received by your AS, while outbound traffic represents the traffic sent by your AS.

- **AS Data Source** – Select one of the following options:
  - *Src/Dst ASNs* – Select to see the traffic to/from the AS number(s)
  - *Peering ASNs* – Select to see traffic to/from your AS peers (PrevAdjacentAS and NextAdjacentAS in NetFlow v9)
  - *Transit ASNs* – Select to see the traffic transited via the AS number(s)
- **AS Number(s)** – Click the lightbulb icon on the right to open a window containing the correct syntax. Frequently-searched AS numbers can be saved there, and used at a later time. To see the list of AS numbers owned by a particular organization, go to Help » IP & AS Information » AS Numbers List
- **Graphs Size** – Select a predefined dimension or enter a custom one in a “<X> x <Y>” format, where <X> and <Y> are the X-axis and Y-axis pixels
- **Graphs Title** – Graphs can have an automatically-generated title for the “Auto” option or no title for the “None” option, or you can enter your own text to be rendered as a title
- **Group Sensor Interfaces** – Select to view a single graph for the selected Sensor Interfaces
- **Group ASNs** – Select to view a single graph for multiple AS numbers
- **Stack ASNs** – Select to stack up to 20 ASNs into a single graph

Country Graphs

Flow Sensors and Packet Sensors can generate traffic and bandwidth histograms for countries. This feature is enabled for Sensors that have the Stats Engine parameter set to “Full” or “Extended”.

- **Countries** – Select the country or countries from the drop-down list, or click the light bulb icon on the right to open a window with saved selections for continents and world regions
- **Graphs Size** – Select a predefined dimension or enter a custom one in a “<X> x <Y>” format, where <X> and <Y> are the X-axis and Y-axis pixels
- **Graphs Title** – Graphs can have an automatically-generated title for the “Auto” option or no title for the “None” option, or you can enter your own text to be rendered as a title
- **Group Sensor Interfaces** – Select to generate a single graph for the selected Sensor Interfaces
- **Group Countries** – Select to view a single graph when multiple countries are selected
- **Stack Countries** – Select to stack up to 20 countries into a single graph

Sensor Events

This sub-tab lists events generated by the selected Sensor(s) for the selected time frame. The events are described in the “Event Reporting” chapter on page 41.

Reports » Dashboards

Wouldn't it be nice to see all the relevant data in a single tab? **Dashboards** allow you to group data from any report according to your needs.

Any dashboard can be configured to refresh itself at intervals ranging from 5 seconds to 15 minutes.

A few sample dashboards are included by default. If you are a Console administrator or operator you can **create** and configure your own dashboards by clicking Reports » Dashboards » [+] » Dashboard. Guest accounts are not allowed to add or make modifications to dashboards.

In the dashboard **configuration**, you can edit the name of the dashboard, set permissions, layout, or choose to override the time frame of widgets with the time frame of the dashboard.

Each dashboard contains **widgets**. To sort them, click the title bar and move them around. To collapse a widget, click the first icon on the widget title bar. To configure a widget, click the second icon from its title bar. To delete a widget, click the third icon from its title bar.

Along with few specific fields, every widget has a configurable title and height. Leave the widget's height parameter set to “Auto” for the widget to take all the vertical space it needs. To restrict the height of a widget, enter a number of pixels instead.

Widget options are self-explanatory or described in other chapters.

Reports » IP Addresses & Groups

This chapter describes how to generate detailed traffic reports for any IP address, block or group included in Configuration » Network & Policy » [IP Zone].

You can generate IP graphs only for IP addresses, blocks or groups specifically defined in your IP Zone(s), or that belong to a subnet having the IP Graphing parameter set to “Yes”.

You can generate IP graphs only for IP addresses, blocks or groups specifically defined in your IP Zone(s), or that belong to a subnet having the IP Graphing parameter set to “Yes”.

You can generate IP accounting reports only for IP addresses, blocks or groups specifically defined in your IP Zone(s), or that belong to a subnet that has the IP Accounting parameter set to “Yes”.

Reports » IP Addresses allows you to quickly generate traffic reports for IP addresses and blocks, either entered manually on the upper side of the panel, or selected from the expandable tree below.

Reports » IP Groups lists all IP groups defined in IP Zones. Select an IP group to generate a traffic report for all IP blocks belonging to it. To search for a specific IP group, enter a sub-string contained in its name on the upper side of the panel.

The traffic report tab includes a few sub-tabs located on the lower side of the window. All sub-tabs share the following common toolbar fields:

- **Sensor Interfaces** – Select the Sensor Interfaces you are interested in. Administrators can restrict the Sensors accessible by guest accounts
- **Time Frame** – Select a predefined time frame, or select “Custom...” to enter a specific time interval

IP Dashboard

IP dashboard allows you to group the most relevant data collected for the selected Sensor Interfaces and for the selected IP address, block or group. The configuration of IP dashboard does not apply to a particular IP address, block or group, and the changes you make will be visible for other IP dashboards as well. The operation of dashboards is described in the “Reports » Dashboards” chapter on page 61.

The configuration of the Decoder Graph widget and IP Accounting widget is described in the following paragraphs.

IP Graphs

Allows you to view traffic histograms generated for the selected IP block, host or group:

- **Decoders & Data Unit** – Select the decoders and data unit you are interested in. Available data units: *Packets*, *Bits*, and *Bytes*
- **Graphs Size** – Select a predefined dimension or enter a custom one in a “<X> x <Y>” format, where <X> and <Y> are the X-axis and Y-axis pixels

- **Graph Title** – Graphs can have an automatically-generated title for the "Auto" option or no title for the "None" option, or you can enter your own text to be rendered as a title
- **Graph Legend** – Select the detail of the graph legend
- **Consolidation** – If you are interested in spikes, choose the *MAXIMUM* aggregation type. If you are interested in average values, choose the *AVERAGE* aggregation type. If you are interested in low values, choose the *MINIMUM* aggregation type
- **Direction** – Generates a graph for both directions, or only for inbound traffic or outbound traffic.
- **Grouping**
  - **Sensor Interfaces** – Generates a single graph for the selected Sensor Interfaces
  - **Subnet IPs** – Uncheck this option if you want a different traffic graph displayed for every IP address contained in the selected IP block or IP group. Do not uncheck this option on large subnets
- **Stacking**
  - **Decoders** – Select to view the summed up, stacked values for the selected decoders
  - **Sensor Interfaces** – Select to view the summed up, stacked values for multiple Sensor Interfaces
- **Permissions**
  - **Decoder Conflict** – If decoders can be included one within the other (e.g. IP contains TCP which contains HTTP and HTTPS), the graph will display stacked decoders to show the most specific ones. This generates both accurate and intuitive traffic graphs. In the example above, IP will be displayed as IP OTHER and TCP as TCP OTHER. However, when you select TCP, HTTP and TCP+SYN as decoders, the TCP+SYN decoder can be included in both TCP and HTTP, thus generating a decoder conflict. Check this option to stop detection of conflicting decoders, in order to generate more intuitive but potentially inaccurate traffic graphs
  - **Use Per-IP Data** – Creates a subnet graph by aggregating the IP graph data generated for every IP address contained in the selected IP block or group. This option will increase the load of the server if used frequently on large subnets. Use this option carefully, only when the IP block or group is not explicitly defined in the IP Zone but it is included in a larger subnet defined with the IP Graphing parameter set to "Yes"

The number of decoders, data units, and aggregation types can be modified in Configuration » General Settings » Graphs & Storage (see page 16).

IP Accounting

Allows you to generate traffic accounting reports for the selected IP block, host or group:

- **Decoders & Data Unit** – Select the decoders and data unit that you are interested in. Available data units: *Packets*, *Bits*, and *Bytes*
- **Report Type** – Select the interval used to aggregate the accounting data: *Daily*, *Weekly*, *Monthly*, *Yearly*. The maximum accuracy of traffic accounting reports is 1 day, therefore when you select a shorter time frame you will still see the accounting data collected for the whole day
- **Group Sensor Interfaces** – Generates a single traffic accounting report for multiple Sensor Interfaces

- **Show IPs** – Check this option for the traffic accounting report to display each IP address contained in the selected IP block or group. Selecting this option also enables the option below
- **Use Per-IP Data** – Creates a traffic accounting report by aggregating the IP accounting data generated for every IP address contained in the selected IP block or group. This option will increase the load of the server if used frequently on large subnets. Use this option carefully, only when the selected IP block or group is not explicitly defined in the IP Zone but it is included in a larger subnet defined with the IP Accounting parameter set to "Yes"

The number of decoders can be modified in Configuration » General Settings » Graphs & Storage (see page 16).

Flow Records

This sub-tab is visible only when there is at least one Flow Sensor in use.

You can list and filter the flow data collected by the selected Flow Sensors, for the selected IP block, host or group. The options are described in the "Flow Collectors" chapter on page 47.

Flow Tops

This sub-tab is visible only when there is at least one Flow Sensor in use.

You can generate tops from the flow data collected by Flow Sensors, for the selected IP block, host or group. The options are described in the "Flow Collectors" chapter on page 47.

Reports » Servers

Click on a server name anywhere in Console to open a tab containing server-specific information. This tab includes a few sub-tabs, located at the lower side of the window. All sub-tabs share the following common toolbar fields:

- **Servers** – Select the servers you are interested in, or select "All" to select all servers. Administrators can restrict the servers available to guest accounts
- **Time Frame** – Select a predefined time frame, or select "Custom..." to enter a specific time interval

Console / Server Dashboard

Allows you to group the most relevant server-related data. The configuration for the server dashboard does not apply to a particular server, and the changes you make will be visible for other server dashboards as well. The operation of dashboards is described in the "Reports » Dashboards" chapter on page 61.

The configuration of Server and Console widgets is described in the following paragraphs.

Console / Server Graphs

Server Graphs allows you to generate various histograms for the selected server(s):

- **Data Units** – Select one or more data units:
  - *Most Used* – Frequently-used data units
  - *System Load* – Load reported by the Linux kernel
  - *Free RAM* – Available RAM. Swap memory is not counted
  - *Database/Graphs/SSD/Flow Collector/Packet Dumps Disk - Free space* – How much disk space is available for each file-system path
  - *Uptime* – Uptime of the operating system
  - *CPU% system/userspace/niced/idle* – Percentages of CPU resources used by the system, userspace processes, processes running with increased (nice) priority, and idle loop
  - *Number of processes* – Total number of processes that are running
  - *Hardware/Software CPU Interrupts* – CPU interrupts made by hardware and software events
  - *Context Switches* – Indicates how much time the system spends on multi-tasking
  - *Running Components* – Sensor instances
  - *Clock Delta* – Difference of time between the selected server and the Console server, in seconds. If the value is not zero run ntpd to keep the clock synchronized on all servers
  - *Database/Graphs/SSD/Packet Dumps/Flow Collector Disk - Total* – How much disk space is allocated for the partitions that store the paths

- *Database/Graphs/SSD/Packet Dumps/Flow Collector Disk - Free Inodes* – Free inodes held by the partitions that store the paths
- *Database/Graphs/SSD/Packet Dumps/Flow Collector Disk - Ops/s* – Reads and writes made on the partitions that store the paths
- *Database/Graphs/SSD/Packet Dumps/Flow Collector Disk - Bytes/s* – Bytes/s on the partitions that store the paths
- *Server Interface(s) - Packets/Bits/Errors/Dropped* – Interface statistics collected for the network interfaces defined in the Configuration » Servers

- **Graphs Size** – Select a predefined dimension or enter a custom one in a "<X> x <Y>" format, where <X> and <Y> are the X-axis and Y-axis pixels
- **Graphs Title** – Graphs can have an automatically-generated title for the "Auto" option or title for the "None" option, or you can enter your own text to be rendered as a title
- **Graph Legend** – Select the level of detail for the graph legend
- **Consolidation** – If you are interested in spikes, choose the *MAXIMUM* aggregation type. If you are interested in average values, choose the *AVERAGE* aggregation type. If you are interested in low values, choose the *MINIMUM* aggregation type
- **Group Servers** – Generate a single graph for the selected servers
- **Group Interfaces** – Generate a single graph for the interfaces of the selected servers
- **Stack Servers** – Shows the summed up, stacked values for the selected servers

Server Events

Lists events generated by the selected server(s). The events are described in the "Event Reporting" chapter on page 41.

Console Events

This sub-tab is visible only when opening the Console tab. It lists events generated by Console. Events are described in the "Event Reporting" chapter on page 41.

Server Commands

Console administrators can execute CLI commands on the selected server(s) and see the output in this sub-tab. The commands are executed by the WANsupervisor service with the "andrisoft" user's privileges. To prevent the execution of CLI commands via Console, start the WANsupervisor service with the "-n" option.

Appendix 1 – IPv4 Subnet CIDR Notation

Wansight uses extensively IP addresses and IP classes with the CIDR notation. To view details about any IPv4 subnet click Help → Subnet Calculator.

CIDR MASK	CLASS	HOSTS NO.	MASK
/32	1/256 C	1	255.255.255.255
/31	1/128 C	2	255.255.255.254
/30	1/64 C	4	255.255.255.252
/29	1/32 C	8	255.255.255.248
/28	1/16 C	16	255.255.255.240
/27	1/8 C	32	255.255.255.224
/26	1/4 C	64	255.255.255.192
/25	1/2 C	128	255.255.255.128
/24	1 C	256	255.255.255.000
/23	2 C	512	255.255.254.000
/22	4 C	1024	255.255.252.000
/21	8 C	2048	255.255.248.000
/20	16 C	4096	255.255.240.000
/19	32 C	8192	255.255.224.000
/18	64 C	16384	255.255.192.000
/17	128 C	32768	255.255.128.000
/16	256 C, 1 B	65536	255.255.000.000
/15	512 C, 2 B	131072	255.254.000.000
/14	1024 C, 4 B	262144	255.252.000.000
/13	2048 C, 8 B	524288	255.248.000.000
/12	4096 C, 16 B	1048576	255.240.000.000
/11	8192 C, 32 B	2097152	255.224.000.000
/10	16384 C, 64 B	4194304	255.192.000.000
/9	32768 C, 128B	8388608	255.128.000.000
/8	65536 C, 256B, 1 A	16777216	255.000.000.000
/7	131072 C, 512B, 2 A	33554432	254.000.000.000
/6	262144 C, 1024 B, 4 A	67108864	252.000.000.000
/5	524288 C, 2048 B, 8 A	134217728	248.000.000.000
/4	1048576 C, 4096 B, 16 A	268435456	240.000.000.000
/3	2097152 C, 8192 B, 32 A	536870912	224.000.000.000
/2	4194304 C, 16384 B, 64 A	1073741824	192.000.000.000
/1	8388608 C, 32768 B, 128 A	2147483648	128.000.000.000
/0	16777216 C, 65536 B, 256 A	4294967296	000.000.000.000

Appendix 2 – Configuring NetFlow Data Export

This appendix is a brief guide to setting up the NetFlow data export (NDE) on Cisco and Juniper routers or intelligent Cisco Layer 2/Layer 3/Layer 4 switches. If you have problems with the configuration, contact your network administrator or consultant. For devices that run hybrid mode on a Supervisor Engine (Catalyst 65xx series), it is recommended to configure IOS NDE on the MSFC card and CatOS NDE on the Supervisor Engine. For more information about setting up NetFlow on Cisco, please visit http://www.cisco.com/go/netflow.

Configuring NDE on older IOS Devices

In the configuration mode on the router or MSFC, issue the following to start NetFlow Export.

First, enable Cisco Express Forwarding:

```
router(config)# ip cef
router(config)# ip cef distributed
```

Turn on flow accounting for each input interface with the interface command:

```
interface
ip route-cache flow
```

For example:

```
interface FastEthernet0
ip route-cache flow
interface Serial2/1
ip route-cache flow
```

It is necessary to enable NetFlow on all interfaces through which traffic (you are interested in) will flow. Now, verify that the router (or switch) is generating flow stats – try command 'show ip cache flow'. Note that for routers with distributed switching (GSR's, 75XX's) the RP cli will only show flows that made it up to the RP. To see flows on the individual line cards use the 'attach' or 'if-con' command and issue the 'sh ip ca fl' on each LC.

Enable the exports of these flows with the global commands:

```
router(config)# ip flow-export version 5
router(config)# ip flow-export destination <ip_address> 2000
router(config)# ip flow-export source FastEthernet0
```

Use the IP address of the server running the Flow Sensor and the configured listening port. UDP port 2000 is used as an example. The ‘ip flow-export source’ command is used to set up the source IP address of the exports sent by the equipment.

If your router uses the BGP protocol, you can configure AS to be included in exports with command:

```
router(config)# ip flow-export version 5 [peer-as | origin-as]
```

The following commands break up flows into shorter segments: 1 minute for active traffic and 30 seconds for inactive traffic. Flow Sensor drops flows older than 5 minutes!

```
router(config)# ip flow-cache timeout active 1
router(config)# ip flow-cache timeout inactive 30
```

In enable mode you can see current NetFlow configuration and state.

```
router# show ip flow export
router# show ip cache flow
router# show ip cache verbose flow
```

Configuring NDE on a CatOS Device

In privileged mode on the Supervisor Engine enable NDE:

```
switch> (enable) set mls nde <ip_address> 2000
```

Use the IP address of the server running the Flow Sensor and the configured listening port. UDP port 2000 is used only as an example.

```
switch> (enable) set mls nde version 5
```

The following command is required to set up flow mask to full flows.

```
switch> (enable) set mls flow full
```

The following commands break up flows into shorter segments: ~1 minute for active flows and ~ 30 seconds for inactive flows. Flow Sensor drops flows older than 5 minutes!

```
switch> (enable) set mls agingtime long 8
switch> (enable) set mls agingtime 4
```

If you want to account all traffic within the specified VLANs rather than inter VLAN traffic use CatOS 7.2 or higher and issue the following command:

```
switch> (enable) set mls bridged-flow-statistics enable
```

Enable NDE:

```
switch> (enable) set mls nde enable
```

To see current NetFlow configuration and state issue the following commands:

```
switch> (enable) show mls nde
switch> (enable) show mls debug
```

Configuring NDE on a Native IOS Device

To configure NDE use the same commands as for the IOS device. In the enable mode on the Supervisor Engine, issue the following to set up the NetFlow export version 5.

```
switch(config)# mls nde sender version 5
```

The following commands break up flows into shorter segments: ~1 minute for active flows and ~ 30 seconds

for inactive flows. Flow Sensor drops flows older than 5 minutes!

```
switch(config)# mls aging long 8
switch(config)# mls aging normal 4
```

On the Supervisor Engine 1 issue the following to put full flows into the NetFlow exports:

```
switch(config)# mls flow ip full
```

If you have a Supervisor Engine 2 or 720 running IOS version 12.1.13(E) or higher, issue the following commands instead:

```
switch(config)# mls flow ip interface-full
switch(config)# mls nde interface
```

Configuring NDE on a 4000 Series Switch

Configure the switch the same as an IOS device, but instead of command 'ip route cache flow' use command 'ip route-cache flow infer-fields'. This series requires a Supervisor IV with a NetFlow Services daughter card to support NDE.

Configuring NDE on IOS XE

Traditional NetFlow is being replaced with flexible NetFlow on newer IOS versions.

```
conf t
flow exporter WGFlowSensor
destination <ip_address>
source gi0/0/1
transport udp 9991
export-protocol netflow-v5
flow monitor WGFlowSensor
record netflow ipv4 original-input
exporter WGFlowSensor
cache timeout active 120 #in seconds
exit
int gi0/0/2
ip flow monitor WGFlowSensor input
exit
exit
wr mem
```

Configuring NDE on IOS XR

A sample configuration for IOS XR:

```
flow exporter-map wanguard
 version v9
  options interface-table timeout 300
  options vrf-table timeout 300
  options sampler-table timeout 300
 !
 transport udp <port>
```

```
 source Loopback8648
 destination <ip_address>
!
flow monitor-map IPV4-FMM
 record ipv4
 exporter wanguard
 cache entries 16384
 cache timeout active 60
 cache timeout inactive 30
!
flow monitor-map IPV6-FMM
 record ipv6
 exporter wanguard
 cache entries 16384
 cache timeout active 60
 cache timeout inactive 30
!
sampler-map 1-of-128
 random 1 out-of 128
!

interface TenGigE0/0/2/1
 description Upstream Interface
 ...
 flow ipv4 monitor IPV4-FMM sampler 1-of-128 ingress
 flow ipv4 monitor IPV4-FMM sampler 1-of-128 egress
 flow ipv6 monitor IPV6-FMM sampler 1-of-128 ingress
 flow ipv6 monitor IPV6-FMM sampler 1-of-128 egress
!
```

Configuring NDE on a Juniper Router (non-MX)

Juniper supports flow exports by the routing engine sampling packet headers and aggregating them into flows. Packet sampling is done by defining a firewall filter to accept and sample all traffic, applying that rule to the interface and then configuring the sampling forwarding option.

```
interfaces {
       ge-0/1/0 {
              unit 0 {
                     family inet {
                            filter {
                                   input all;
                                   output all;
                            }
                            address 192.168.1.1/24;
                     }
              }
       }
}
firewall {
       filter all {
              term all {
                     then {
                            sample;
                            accept;
                     }
```

```
                }
        }
}

forwarding-options {
        sampling {
                input {
                        family inet {
                                rate 100;
                        }
                }
                output {
                        cflowd 192.168.1.100 {
                                port 2000;
                                version 5;
                        }
                }
        }
}
```

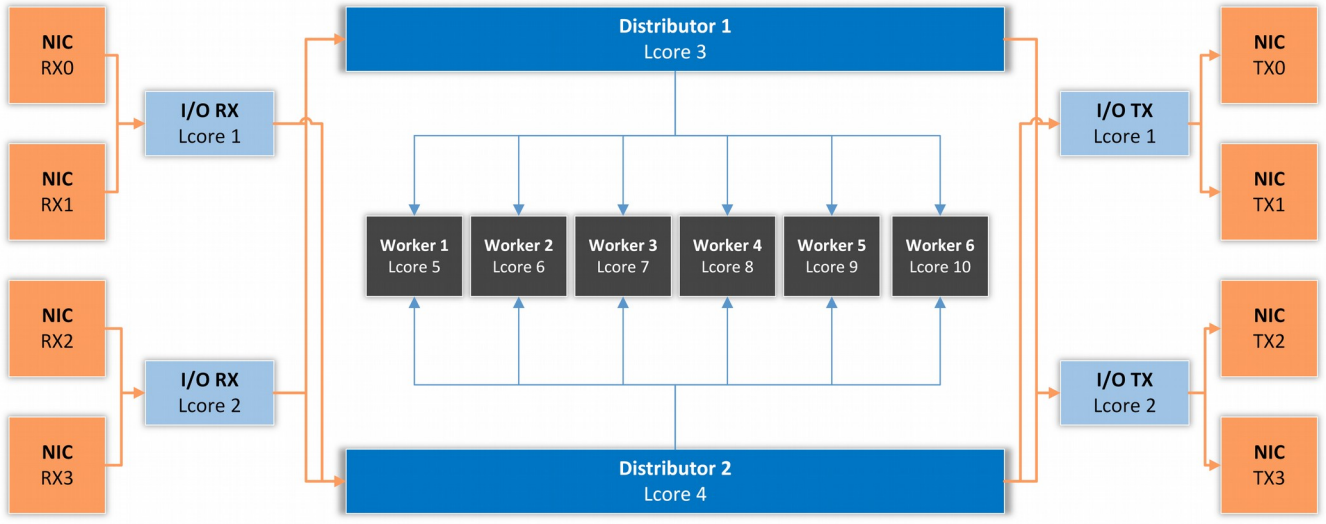
Appendix 3 – DPDK Configuration

Wansight 7.1 supports DPDK version 18.11.x on CPU microarchitectures starting with Nehalem (Sandy Bridge, Ivy Bridge, Haswell, Broadwell, Skylake, etc.). The code is currently optimized for Broadwell.

To use DPDK 18.11, follow the installation guide from http://www.dpdk.org and allocate at least 4GB of RAM to hugepages with a 1 GB page size. There are several BIOS optimization settings required, as well as a number of kernel parameters that increase the performance of the server. You can purchase appliances preconfigured and optimized for DPDK from https://www.andrisoft.com/hardware/anti-ddos-appliance.

Application Workflow

The architecture of the application is similar to the one presented in the following diagram which illustrates a specific case of two I/O RX and two I/O TX lcores (logical CPU cores) off-loading the packet Input/Output overhead incurred by four NIC ports, with each I/O lcore handling RX/TX for two NIC ports. The RX lcores are dispatching the packets toward two Distributor cores which are distributing them to six Worker lcores.



I/O RX Lcore performs packet RX from the assigned NIC RX rings and then dispatches the received packets to one or more distributor lcores using RSS or a round-robin algorithm.

Distributor Lcore reads packets from one or more I/O RX lcores, extracts packet metadata, performs the Dataplane firewall's functionality, and dispatches packet metadata to one or more Worker lcores.

Worker Lcore performs the most heavy weight and CPU-intensive tasks such as traffic analysis and attack detection.

I/O TX Lcore performs packet TX for a predefined set of NIC ports.

The application needs to use one **Master Lcore** to aggregate data from the workers.

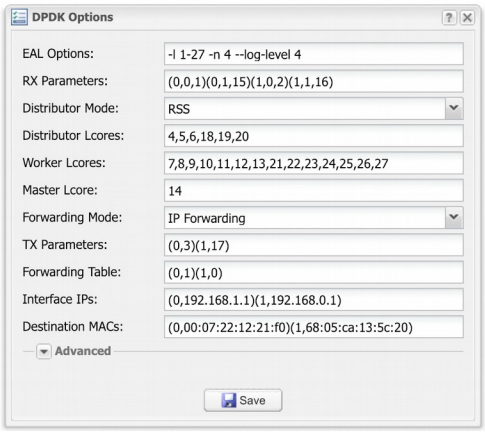
DPDK Capture Engine Options

- **EAL Options** – See the DPDK Getting Started Guide for more information on this mandatory parameter
- **RX Parameters** – The syntax is "(PORT,QUEUE,LCORE).." and represents a list of NIC RX ports and queues handled by the I/O RX lcores. This parameter also implicitly defines the list of I/O RX lcores. This is a mandatory parameter
- **Distributor Mode** – Specify the algorithm used to dispatch packets from the RX to the Distributor lcores:
  - *Round-robin* – The load is shared equally between the Distributor lcores. This is the best option when the packets are not forwarded
  - *RSS* – The packets with the same RSS value are always dispatched to the same Distributor lcore. This is the best option when packets are forwarded, mainly because it maintains the order of the packets
  - *Custom* – Select this option to be able to specify the Distributor lcore for each RX port. In this case, the RX Parameters syntax becomes "(PORT,QUEUE,LCORE,DISTRIBUTOR_LCORE_NO).."
- **Distributor Lcores** – Enter the lcore of the Distributor thread, or a list of lcores separated by comma. This is a mandatory parameter
- **Worker Lcores** – The list of worker lcores. This is a mandatory parameter
- **Master LCORE** – Set an lcore to be used exclusively for thread management purposes. The recommended value is the hyper-thread core of CPU 0 because its performance is not important. This is a mandatory parameter
- **Forwarding Mode** – Specify the TX functionality:
  - *Disabled* – The packets are not forwarded, so the application behaves like a passive sniffer
  - *Transparent Bridge* – All Ethernet frames are forwarded without any intervention, so the application works like a transparent bridge. This is the fastest forwarding method. The packets are processed in batches, so the latency will be high if the application forwards just a few packets/s (with hundreds of packets/s the latency is <1 ms)
  - *IP Forwarding* – The application performs several tasks for each packet. If it's an ARP packet querying for the MAC address of one of the interfaces defined below it responds to that query. On all other packets, it rewrites the source MAC address with the output interface MAC, and it rewrites the destination MAC with the MAC address defined below. The application is not performing RFC 1812 checks and is not decreasing the TTL value. This forwarding method is necessary when the server is deployed out-of-line with traffic redirected by BGP. For latency considerations see the previous option
- **TX Parameters** – The syntax is "(PORT,LCORE).." and it defines a list of NIC TX ports handled by the I/O TX lcores. This parameter also implicitly defines the list of I/O TX lcores. This parameter is mandatory when the Forwarding Mode is not set to Disabled
- **Forwarding Table** – The syntax is "(PORT_IN,PORT_OUT).." and it defines the output interface depending on the input interface
- **Interface IPs** – The syntax is "(PORT,IPV4).." and it defines the IP of each port. This parameter is used when the Forwarding Mode is set to IP Forwarding but it does not ensure a true TCP/IP stack on the interface. The application will respond to ARP requests, but it's highly recommended to set the ARP table manually on the router because the application could respond to ARP requests with a high delay due to bulk processing

- **Destination MACs** – The syntax is "(PORT,MAC_ADDRESS).." and it defines the gateway MAC address for each port. This option is used when the Forwarding Mode is set to IP Forwarding

DPDK Configuration Example

Execute the script usertools/cpu_layout.py from the your dpdk directory to see the CPU layout of your server. The following configuration assumes this CPU layout: Core 0 [0, 14], Core 1 [1, 15], Core 2 [2, 16], Core 3 [3, 17], Core 4 [4, 18], Core 5 [5, 19], Core 6 [6, 20], Core 8 [7, 21], Core 9 [8, 22], Core 10 [9, 23], Core 11 [10, 24], Core 12 [11, 25], Core 13 [12, 26], Core 14 [13, 27].



EAL Options contains the parameter "-l 1-27" which configures DPDK to use the lcores 1 to 27 (28 lcores = 14-core CPU with Hyper-threading enabled). The parameter "-n 4" configures DPDK to use 4 memory channels which is the maximum of what the reference Intel Xeon CPU (14-core Broadwell) supports.

The RX parameters configure the application to listen to the first two DPDK-enabled interfaces (0 and 1), on two NIC queues (0 and 1), and to use two CPU cores for this task (15 and 16 are the hyper-threads of cores 1 and 2).

The Distributor Mode setting ensures that the packets will be forwarded in the same order.

Three CPU cores are used for the Dataplane firewall and to distribute packets to the workers: 4, 5 and 6 (18, 19 and 20 are hyper-threads).

Seven CPU cores are used for packet analysis and attack detection: 7 to 13 (21 to 27 are hyper-threads).

The Master lcore is the hyper-thread of CPU core 0 which is used by the OS.

The TX parameters configure the application to use a single CPU core for TX. Lcore 3 sends packets over port 0, while the lcore 17 (hyper-thread of CPU core 3) sends packets over port 1.

The Forwarding Table value specifies that incoming packets on port 0 should be sent to port 1, and vice versa.

The next two parameters set the IPs and the destination MACs for both ports.

Appendix 4 – Software Changelog

Wanguard 7.1

Release date: January 7 2019
Release notes listed at https://www.andrisoft.com/blog/news/item/wanguard-7-1
Latest bug fixes listed at https://www.andrisoft.com/support/portal/bugtracking

Wanguard 7.0

Release date: March 12 2018
Release notes listed at https://www.andrisoft.com/blog/news/item/wanguard-7-0

Wanguard 6.3

Release date: May 30 2017
Release notes listed at https://www.andrisoft.com/blog/news/item/wanguard-6-3

Wanguard 6.2

Release date: March 23 2016
Release notes listed at https://www.andrisoft.com/blog/news/item/wanguard-6-2

Wanguard 6.1

Release date: December 3 2015
Release notes listed at https://www.andrisoft.com/blog/news/item/wanguard-6-1

Wanguard 6.0

Release date: February 16 2015
Release notes listed at https://www.andrisoft.com/blog/news/item/wanguard-6-0