

EmerNet

Network Collector

Version 6.0.51



Emerald Management Suite

IEA Software, Inc.

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OVERVIEW

EmerNet is an integrated network data collector offering flow based charting of service bandwidth utilization via Emerald service monitoring as well as flow based usage rating thru Emerald rating system. The following flow protocols are supported via UDP on IPv4 and IPv6 NetFlow versions 1, 5, 7, 9 and IPFIX.

INSTALLATION

EmerNet collector is included as part of the Emerald distribution however it is an optional component and must be selected for install during the installation of Emerald. If you will be installing EmerNet on a separate server dedicated for network data collection you may choose to install only the EmerNet component.

CONFIGURATION

Configuring EmerNet is accomplished via integrated configuration server. By default when Emerald is installed EmerNet listens for incoming http requests on port 8018 of the localhost interface. (<http://localhost:8018>)

Windows platform

- From Start Menu, Program Files, Emerald, select EmerNet Config
- Alternately manually browse to <http://127.0.0.1:8018>
- To run in debug mode stop Emerald Network Collector from windows services manager and from CLI within Emerald folder type: **emernet -debug 15**

Linux platform

- From Linux command line switch to the /usr/local/emerald folder and type: **./emernet -debug 15** if the EmerNet collector is not already running.
- From a web browser connect to the server on port 8018. <http://127.0.0.1:8018>

The configuration web server is normally available via localhost and cannot be accessed directly from a remote network interface. To temporarily allow remote configuration from CLI: **./emernet -config**

General Options

Flow exporter access to EmerNet and related flow processing options are managed from general options.

Field	Description						
Configuration server	When enabled the configuration web server is started with EmerNet. When disabled the configuration server is only available when started manually by running <code>./emernet -config</code>						
Configuration server port	TCP port the configuration server listens for incoming HTTP requests						
NetFlow/IPFIX listen UDP port	UDP port to receive incoming flow data from exporters via IPv4 and IPv6. By default port 4739 is used. Please make sure all flow exporters are authorized via Allowed export hosts field below.						
Allowed NetFlow/IPFIX export hosts	List of IP addresses or address ranges of network flow exporters allowed to transmit flow data to EmerNet. One or more address or range is required using one of the following formats: <ul style="list-style-type: none"> • x.x.x.x (Single IPv4 address) • x.x.x.x/y (IPv4 CIDR range) • x.x.x.* (IPv4 wildcard octet address range) • x.x.x.x-y.y.y.y (IPv4 address range) • www.iea-software.com (IPv4 and IPv6 name resolution) • 2001:db8::1 (Single IPv6 address) • 2001:db8::/118 (IPv6 CIDR range) • 2001:db8::1-2001:db8::f (IPv6 address range) 						
Enable service monitoring	Allows incoming flows to be processed by service monitor						
Enable usage rating	Allows incoming flows to be processed by rating system. If rating feature is not used rating should be disabled.						
Time reference	Determines how timestamps associated with individual flows are handled. <table border="1"> <thead> <tr> <th>Option</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Exporter</td> <td>Flows are processed using timestamps from the exporter's clock. Assuming exporters have reasonably accurate clocks this is the most accurate and recommended setting.</td> </tr> <tr> <td>Local</td> <td>EmerNet local clock rather than the exporter's clock is used. To the extent possible packet relative flowtimes are preserved. This option should only be enabled if the exporter cannot maintain reasonably accurate time.</td> </tr> </tbody> </table>	Option	Description	Exporter	Flows are processed using timestamps from the exporter's clock. Assuming exporters have reasonably accurate clocks this is the most accurate and recommended setting.	Local	EmerNet local clock rather than the exporter's clock is used. To the extent possible packet relative flowtimes are preserved. This option should only be enabled if the exporter cannot maintain reasonably accurate time.
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Local	EmerNet local clock rather than the exporter's clock is used. To the extent possible packet relative flowtimes are preserved. This option should only be enabled if the exporter cannot maintain reasonably accurate time.						

Account & rating refresh	Interval at which service monitor configuration and all applicable service records are refreshed from Emerald. If rating is enabled rating configuration is also refreshed at configured interval. The default recommended setting is 900 seconds (15 minutes).
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Database Configuration

Select the Database Configuration menu option. After changing the settings, click continue. Please note these settings are commonly shared between all Emerald services. Therefore, if you already have Emerald or other Emerald services installed and configured on this machine, these settings should already be set and you should ignore the database configuration menu. Changing these settings will affect all other Emerald suite applications as well.

- Select a data source item. This is the ODBC DSN that you will use to connect to the Emerald database. If you do not have a DSN defined, you can select (new) to create a new DSN.
- Fill in the username and password to connect to the database as.

Emerald Configuration

Most settings related to EmerNet collector are performed from within Emerald administrative menus. Refer to Emerald admin guide sections "Service Monitoring" and "Rating" menus for information and configuration related to each system. The following offers NetFlow/IPFIX specific configuration advice.

Service Monitor

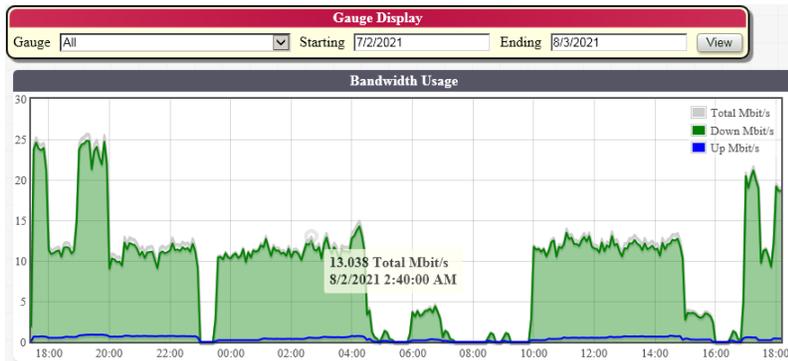
Flow monitoring is configured (Emerald Admin / Reports & Logs / Service Monitoring) in a similar way to other supported monitoring protocols.

To use service monitoring it must be enabled from [general options](#) menu.

Specific to NetFlow/IPFIX configuration is the ability to assign a flow filters to service monitors enabling a series of rules to define conditions under which flows should be counted. For example a flow filter might be defined to count only web traffic or count only local or only external Internet traffic.

Any number of service monitors can be activated targeting the same accounts to separately collect different parameters using different flow filters so long as each filter references a separate gauge. For example service monitor "A" collects data on local network consumption via "Local Network" gauge while service monitor "B"

collects data on consumption related to external access via "External Network" gauge. With both monitors active service level reporting menu provides separate usage charting for both local vs external network access.



The source "Service custom data" uses custom data field "NetFlow IP Range" (ID 11) in addition to standard Inventory and RADIUS based sources. Any services with an address or IP range configured in this field will have data collected. It is also possible to assign multiple service monitors targeting different sources for the same gauge. For example Service monitor "A" collects "Local Network" data

using source "Service custom data". Service monitor "B" collects "Local Network" data using "service assigned inventory". In this case "Local Network" data is recorded and combined from both the service custom data field and address associated with assigned inventory.

When configuring gauges used by flow based service monitors the gauges "Sampling Interval" should not be set higher than 15 minutes as higher values are ignored. EmerNet adjusts its internal collection resolution to match sampling interval.

There is exactly a one hour delay from the time of bandwidth consumption to the time data appears in the accounts gauge reporting chart. The delay is intended to account for unexpected conditions such as export delays, long lived flows and clock drift between exporters.

By default when a change is made either to service monitor configuration or individual services a delay of up to a maximum of 15 minutes applies before EmerNet is updated with configuration changes. Maximum delay is managed via "Accounts and rating refresh" setting of [general options](#) menu.

Rating

Rating of network flow traffic depends on the assignment of the "NetFlow IP Range" custom data fields to all service types that will be billed for NetFlow traffic.

"NetFlow IP Range" represents the IP address or address mask of the IP or network that traffic destined to or originating from will be billed. This field must be specified in order for the end user to be billed for their network traffic. It is recommended this data field be set required for NetFlow based service types to prevent operators from forgetting to enter the end users IP. "NetFlow Collector IP" is an optional field setting the exporter address responsible for exporting of traffic for this account. This is useful only when there are multiple exporters throughout the border and cores of the network and you need to prevent transit between routers from causing the customer to be double billed. Please see the Rating section of the Emerald Administrators guide for details on configuring rating for network traffic.

If rating feature will not be used it is recommended that it be disabled from the [general options](#) menu.

Debug and Logging

This section is used to assist in troubleshooting and monitoring the EmerNet server. It is recommended all debug options be disabled when in production use unless there is a specific need to enable them.

To run EmerNet collector in debug mode from CLI stop Emerald Network Collector service from Windows or Linux services manager. From the main Emerald folder run `./emernet -debug 15`

When in this mode all messages are sent immediately to the screen and shall not be routed to either log file or syslog server.

Field	Description														
Debug options	<p>Enables logging of optional informational data to EmerNet log file and syslog server.</p> <table border="1"> <thead> <tr> <th>Option</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Database queries</td> <td>Outputs debug log entries of SQL queries executed by EmerNet except for any queries executed by the rating system.</td> </tr> <tr> <td>Flow Templates</td> <td>Information about incoming templates and template matching</td> </tr> <tr> <td>Network flows</td> <td>Information about each flow including source and destination addresses, ports bandwidth, time and duration</td> </tr> <tr> <td>Extra detail</td> <td>Disables duplicate log rate limiting and includes additional statistics about service monitoring data</td> </tr> <tr> <td>Configuration options</td> <td>Outputs running configuration parameters on startup</td> </tr> <tr> <td>Section tracing</td> <td>Debug related to the entrance and exit from certain routines</td> </tr> </tbody> </table>	Option	Description	Database queries	Outputs debug log entries of SQL queries executed by EmerNet except for any queries executed by the rating system.	Flow Templates	Information about incoming templates and template matching	Network flows	Information about each flow including source and destination addresses, ports bandwidth, time and duration	Extra detail	Disables duplicate log rate limiting and includes additional statistics about service monitoring data	Configuration options	Outputs running configuration parameters on startup	Section tracing	Debug related to the entrance and exit from certain routines
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Log file	<p>Full path + filename where log entries are to be written on the filesystem local to EmerNet. If log file is not specified default location Emerald/log/emernet.log will be used. The following pattern substitutions may be used when configuring filename based on current date to provide for automatic rotation of log files.</p> <table border="1"> <thead> <tr> <th>Pattern</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>YYYY</td> <td>Current four digit year (2020)</td> </tr> <tr> <td>YY</td> <td>Current two digit year (20)</td> </tr> <tr> <td>MM</td> <td>Current month of year (07)</td> </tr> <tr> <td>DD</td> <td>Current day of month (10)</td> </tr> </tbody> </table> <p>Example log file where a new log is created each month: C:\program files\emerald\log\emernet_YYMM.log</p> <p>EmerNet does not automatically remove or archive log files.</p>	Pattern	Description	YYYY	Current four digit year (2020)	YY	Current two digit year (20)	MM	Current month of year (07)	DD	Current day of month (10)				
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Syslog Server	<p>DNS name or IP address of syslog server to transmit log messages. If a DNS name is configured using a DNS name having multiple IP addresses of the same address family syslog messages are broadcasted to each IP address of the same family associated with DNS name.</p> <p>When enabled log messages are transmitted to syslog server in addition to Log file configured above. All syslog messages from Emerald are transmitted using facility LOCAL2 and a severity of NOTICE regardless of type or content of message.</p> <p>Transmitted syslog messages are not encrypted, acknowledged or authenticated. It is not recommended syslog be transmitted over the Internet.</p>
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COLLECTOR MONITORING

EmerNet includes online statistics to provide insights into the operation of flow collector, service monitor and flow rating systems.

Flow statistics

Statistical counters for flow collection and service monitoring. If rating is enabled rating specific counters are available from [rating statistics](#) menu. Statistics are automatically reset after 24 hrs.

Flow statistics starting Jul 17 21:17:17 2021 - 5 mins, 1 secs					
Description	Value	Description	Value	Description	Value
Packets accepted	101785021	Packets accepted (bandwidth)	12.214 GB	Packets unauthorized	0
Packets malformed	0	Flows processed	203571029	Flows ignored	0
Flows invalid	0	Templates received	0	Template missing	1
Template incomplete	0	Templates malformed	0	Service monitor services	5
Service monitor flow filters	0	Service monitor time slot transfers	5	Service monitor time slot rollbacks	0
Gauge records uploaded	0	Gauge records discarded	0	Gauge batches completed	0
Gauge batch failures	0	Pipeline backpressure	2	Resource allocation failures	0

Parameter	Description
Packets accepted	Valid incoming flow packets from any flow exporter that are not malformed or unauthorized.
Packets accepted (bandwidth)	Total bandwidth of accepted flow packets from any exporter excluding bandwidth for any unauthorized or malformed packets.
Packets unauthorized	Flow packets discarded because they were received from exporters that do not match the allowed export host list in the general options menu.
Packets malformed	Flow packets discarded because they violate standards or contain invalid data.
Flows processed	Individual flows that were not ignored or invalid which were ultimately processed
Flows ignored	Flows discarded because they contain a zero byte count and therefore would not contribute to service monitoring or rating.
Flows invalid	Flows discarded because they reference an unsupported address family or ending flow timestamp precedes starting timestamp.
Templates received	Valid v9 and IPFIX non-option templates received that are either new to the collector or update an existing flow template within collector.
Template missing	V9 and IPFIX flows discarded because a template necessary to decode them was not known to EmerNet. This counter typically increments for a short period of time on initial collector startup until the exporter retransmits its flow templates. If

	counter is continuously incremented this can indicate an exporter problem or significant data loss.
Template incomplete	V9 and IPFIX flows discarded because they reference templates that do not contain minimum required attributes: source and destination IPv4 or IPv6 address and byte count. This field may regularly increment normally if other data not related to normal source and destination traffic flows is normally also exported. This could also indicate exporter is misconfigured.
Templates malformed	Template records discarded because they are not properly formatted or data fields are inconsistent or out of range. This field typically indicates a problem with either the exporter or EmerNet.
Service monitor services	When using Emerald service monitor to collect NetFlow data this reports the number of Emerald services + unique gauge instances that have been loaded from Emerald for monitoring since last refresh of service monitoring configuration.
Service monitor flow filters	Reflects the total number of flow filters configured via Emerald Admin / Reports & Logs / Flow Filters since last refresh of service monitoring configuration.
Service monitor time slot transfers	Generally this is the same or slightly less than service monitor services. It represents the number of active bandwidth buckets successfully transferred to the replacement service monitoring configuration for uninterrupted data collection. When new services are added to service monitor not previously known to Emerald these services have no pre-existing data to transfer. If timeslot transfers are persistently significantly less than 'service monitor services' counter this likely indicates a problem within EmerNet.
Service monitor time slot rollbacks	Time slot rollbacks normally should never occur. A rollback indicates one or more exporter's clocks are inconsistent by many hours. This causes existing collection buckets to be ignored leading to service monitor data loss. For best accuracy all exporters should have their clocks synchronized to a common source. If this is not possible set Time Reference to "Local" from the general options menu.
Gauge records uploaded	Service monitor gauge data points successfully uploaded to Emerald
Gauge records discarded	Service monitor gauge data points permanently dropped instead of uploaded to Emerald. This is caused by either memory exhaustion or exceeding internal queue limit of 10 million data points for an extended period of time.
Gauge batches completed	Successful upload of a batch of gauge data points
Gauge batch failures	Failures to upload gauge data points to Emerald. This is typically caused by temporary loss of connectivity with database. Failed batches are automatically retried and no data is lost.
Pipeline backpressure	Incremented when downstream flow processing is sufficiently backlogged as to result in a delay of upstream queuing. If this counter is rapidly and persistently incremented collector may not be keeping up with rate of new requests resulting in loss of flow data. If this occurs please consider the following: <ul style="list-style-type: none"> • Debugging options should normally be disabled when running collector in production. If options such as Network flows and extra detail are enabled logging of associated large volume of data severely limit collector performance. • If you will not be using flow rating disable "Enable usage rating" from general options menu. Disabling usage rating significantly increases flow processing performance. • If EmerNet collector will be running on a virtual machine consider allocating additional processor threads to improve overall throughput.
Resource allocation failures	If incremented check to make sure operating system has sufficient free memory available. Allocation failures affect ability to store flow templates and queue service monitoring data points resulting in data loss.

Refresh service monitor

Refresh local service monitoring data from Emerald including any new or changed services and service monitor settings from Emerald.

Rating upload queue

Upload queue displays interim rating results from all rating flows pending upload to Emerald. This view is normally reset as Emerald is updated. Each row reflects the rated usage of a single service. If multiple rates are defined a service may have more than one row associated with them. When usage rating is disabled upload queue display is unavailable.

Rating upload queue						
Rate ID	Rule ID	Customer ID	Account ID	Count	Data	Cost
6	21	-1	142	0.008519999999999998	8520	0.008520
5	4	-1	142	8.4797870000000071	8479787	2.119947

Field	Description
Rate ID	The rate identifier of a configured Emerald Rate available from the ID column of the rate listing within Emeralds Admin / Rating / Rates menu.
Rule ID	Rating rule invoked to rate the applicable flows available from the ID column of the Rule Set listing within Emerald Admin / Rating / Rule Sets.
Customer ID	The Emerald MBR being billed for usage. In most cases Customer ID is displayed as '-1' meaning that the MBR directly associated with the service responsible for generating the actual network usage (See Account ID below). Generally whenever Customer ID is not '-1' the rate is being used to charge a reseller or other third party not directly associated with the service.
Account ID	The Emerald service responsible for the generating network usage.
Count	Reflects the number of 'Intervals' as configured in the rating rule set (See RuleID above) that have been rated.
Data	Data always reflects the number of bytes recorded.
Cost	The configured cost based on Count, Data and possibly specifics of individual flows and classifiers. Costs are defined from the Emerald Admin / Rating / Rule Sets menu.

Rating Statistics

If usage rating is enabled the status and performance of the rating system is monitored thru following displays.

Rating statistics		
System Performance		
Description	Avg	Last
Rate history upload	45ms	47ms
Upload commit	93ms	93ms
Classifier	0ms	0ms
Rating calculation	1ms	0ms
Rule reload	453ms	453ms
Current Activity		
Description	Status	Last
Rating startup	Idle	Tue Jul 25 11:50:30 2006
History upload	Idle	Tue Jul 25 22:25:04 2006
History commit	Idle	Tue Jul 25 22:25:04 2006
Classifier query	Idle	N/A
Rule reload	Idle	Tue Jul 25 11:50:30 2006
Memory cleanup	Idle	Tue Jul 25 19:50:35 2006
Totals download	Idle	N/A
Counters		
Description	Value	
Memory errors	0	
Database errors	0	
Configuration errors	0	
Initialization errors	0	
Insufficient data errors	0	
Flow buffers exceeded	0	
Warnings	0	
Rating requests	67847	
Reqs checked out	2	
Rule matches	229110	
Classifier cache hits	0	
Classifier cache misses	0	
Successful rating requests	67847	
History upload transactions	43	

System Performance / Current Activity

Field	Description
Rate history upload	Amount of time to upload a single usage record to the database.
Upload commit	Time needed to commit a history upload batch transaction
Classifier	Time required to match a network flow with an Emerald service.
Rating calculation	Time required to rate a single network flow record
Rule reload	Time required to refresh all applicable rating rules and classifiers.

Counters

Field	Description
Memory errors	Count of all memory allocation errors encountered. If counter ever increases consider adding more physical or virtual memory to the collector.
Database errors	Total count of database errors encountered, normally this may increment slightly if connections need to be reestablished to the database server or during times when the database server is unavailable. You should consult the EmerNet log file to view detailed information about any database errors.
Configuration errors	Configuration errors are caused by invalid or inconsistent rating configurations for example the referencing of rating rules that don't exist or selecting an unknown rule match type. If EmerNet is running with a clean configuration with no inconsistent data it will not replace its configuration during a rule refresh if the new configuration is inconsistent. The Emerald user interface effectively prevents the possibility of configuration errors however user customizations or direct configuration may lead to the problem. If this counter is incremented view the EmerNet log file for detailed information about the configuration error and how to correct it.
Initialization errors	Initialization errors point to an internal problem within EmerNet itself and should be reported to your support representative.
Insufficient data errors	These occur when there is not enough or incorrect information presented to be able to properly rate a given flow record. See the EmerNet log file for details.
Warnings	Count of warning level messages recorded to the EmerNet log file.
Rating Requests	Total number of rating requests processed
Reqs checked out	Reflects number of flow processors currently processing rating requests
Rule matches	Amount of rating rule matches, usually many times higher than the number of rating requests.

Classifier cache hits	This should never increment, using rating classifiers based on database queries with EmerNet must be avoided. All NetFlow classifiers included with Emerald load all their data into memory using upload attributes.
Classifier cache misses	This should never increment, using rating classifiers based on database queries with EmerNet must be avoided. All NetFlow classifiers included with Emerald load all their data into memory using upload attributes.
Successful rating requests	The number of rating requests successfully processed, ideally this number should match the 'Rating Requests' number above.
History upload transactions	Count of historical uploads transactions done since EmerNet startup. This does not reflect the number of Emerald (RateHistory table) updates rather the number of history update transactions that usually contain several individual updates.

Reload rating rules

Reload refreshes all applicable rating rules and rating classifiers otherwise rating configuration is refreshed regularly based on "Account and rating refresh" setting within the general options menu. When rating is disabled reload is unavailable.

CONFIGURING NETFLOW & IPFIX EXPORTERS

The following checklist can help to ensure seamless integration between flow exporters and Emerald.

- To authorize access to receive flows the IP address of NetFlow and IPFIX devices exporting flows to EmerNet are applied to "allowed export host" field of [general options](#) menu.
- Select a NetFlow or IPFIX version mutually supported by exporter and EmerNet.

Version	IPv6	Flows Per Packet	Format	Comments																
NetFlow v1	No	24	Fixed	Each NetFlow version fully provide all data fields used by EmerNet. While these formats offer a simple fixed form all flows are limited to IPv4 only.																
NetFlow v5	No	30	Fixed																	
NetFlow v7	No	27	Fixed																	
NetFlow v9	Yes	Variable	Template	<p>NetFlow V9 and IPFIX is template based with formatting determined by flow exporter. The minimum EmerNet requires to process a flow is Src IP, Dst IP and a byte count. For best results to ensure full access to flow filtering and rating features all recommended fields in the table below should also be provided.</p> <p>EmerNet does not support flow duration in nanoseconds or microseconds. Absolute first and last flow times should be presented in either seconds or milliseconds. IDs 21 and 22 should only be used with V9 and is not recommended for IPFIX.</p> <table border="1"> <thead> <tr> <th>ID</th> <th>Attribute</th> <th>Required</th> <th>Recommended</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>octetDeltaCount</td> <td>Yes</td> <td></td> </tr> <tr> <td>2</td> <td>packetDeltaCount</td> <td>No</td> <td></td> </tr> <tr> <td>4</td> <td>protocolIdentifier</td> <td>No</td> <td>Yes</td> </tr> </tbody> </table>	ID	Attribute	Required	Recommended	1	octetDeltaCount	Yes		2	packetDeltaCount	No		4	protocolIdentifier	No	Yes
ID	Attribute	Required	Recommended																	
1	octetDeltaCount	Yes																		
2	packetDeltaCount	No																		
4	protocolIdentifier	No	Yes																	
IPFIX	Yes	Variable	Template																	

				7	sourceTransportPort	No	Yes
				8	sourceIPv4Address	IPv4	
				11	destinationTransportPort	No	Yes
				12	destinationIPv4Address	IPv4	
				27	sourceIPv6Address	IPv6	
				28	destinationIPv6Address	IPv6	
				21	flowEndSysUpTime	No	Yes - IPFIX 150 + 151 or 152 + 153
				22	flowStartSysUpTime	No	
				150	flowStartSeconds	No	
				151	flowEndSeconds	No	Yes - V9 21 + 22
				152	flowStartMilliseconds	No	
				153	flowEndMilliseconds	No	

- Total duration of a flow must never exceed 30 minutes. For highest accuracy active flow duration should be limited to 5 minutes or less.
- IPFIX exporters should be configured to send flow timestamps in seconds or milliseconds. Microseconds and nanoseconds are not supported.
- To ensure accuracy all exporters should synchronize their clocks with a common time source. If not possible or time between exporters is otherwise expected to be significantly different set time reference setting in the [general options](#) menu to "Local".
- Prior to using EmerNet in production all debugging options in the [Debug and Logging](#) menu should be disabled particularly "network flows" and "extra detail" settings as this will severely impact performance and cause a very high volume of data to be written to log files.
- Exporters should be organized and configured to restrict duplicative export of the same flows by multiple exporters. EmerNet has no provisions to facilitate data deduplication across exporters. If necessary exporters can be restricted via service monitor flow filters or rating rules.
- To minimize packet loss connect exporters via as direct a path as possible to the EmerNet flow collector.