

An open source network traffic performance monitoring and diagnostics tool.



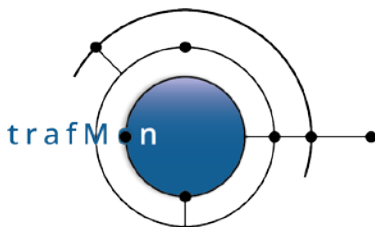
www.trafmon.org

Software Installation Guide

Thomas Grootaers, Luc Lechien

Software Release 1.0

2020-09



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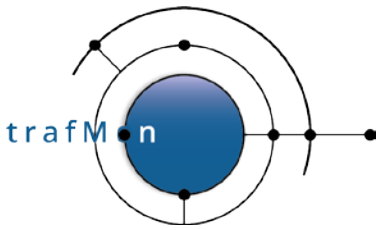
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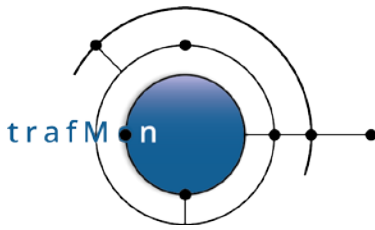
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DOCUMENT HISTORY

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1.0	Sept 2020	First issue



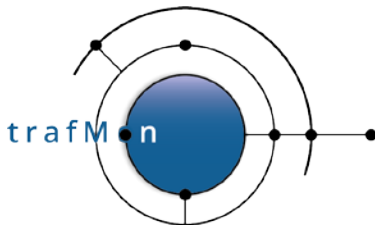
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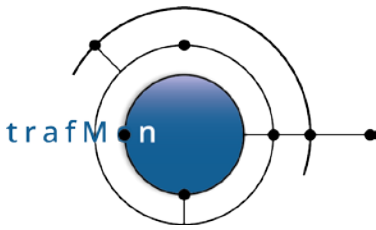
Lastly, the authors wish to acknowledge the strong support of ESA staff members: Manfred Lugert, Erling Kristiansen, Johan Stjernevi, Manfred Bertelsmeier, Gioacchino Buscemi, Michele Iapaolo, Andrea Cogliandro and Claudia Neroni, as well as of officers of the Belgian BELSPO Federal Service, Jacques Nijskens, Agnès Grandjean and Hendrick Verbeelen.



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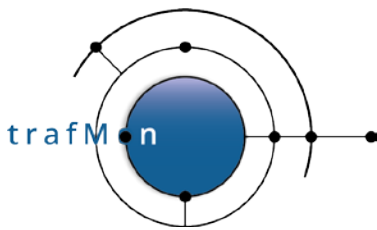
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ACRONYMS AND ABBREVIATIONS



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1. TRAFMON COMPUTING ENVIRONMENT

1.1 TRAFMON MACHINES ARCHITECTURE

The trafMon tool deployment typically involves two types of components:

- The traffic probe machine and
- The central processing and/or database server.

1.1.1 The Traffic Probe Machine

The traffic probe is typically a physical (micro) computer, dedicated to this task, and that the user would replicate in the different locations/sites where traffic of interest is to be monitored.

The use of virtual machine is discouraged for this, because of the necessary accuracy in network packet sampling timestamp and the performance required to absorb the potential traffic peaks.

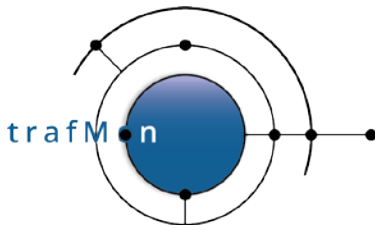
The probe runtime software consists in a pipeline of two permanent processes linked by an in-memory shared circular buffer. The father process performs the actual in situ protocol decoding by inspecting the successive packets (Ethernet frames) directly in the kernel-resident buffer and transmitting its filtered decoding results to its child. The child process is in charge of the stateful analysis of protocol exchanges, of the accumulation of the traffic observations statistics and of the continuous delivery of the resulting observations to one (or more) central collector(s).

Multi-core CPU (or multi-CPU) architecture is exploited by letting the father process locks itself on one core and the child assigning itself to the remaining ones.

The size of the RAM is capital to create the largest possible in-memory kernel packet capture ring buffer and the shared memory inter-process queue.

One probe can have several probing ports: typically dedicated Ethernet interfaces (whose on-chip packet reassembly and upper protocol pre-processing is voluntarily de-activated), without being assigned an IP address.

Practical tests, conducted in 2016 on modern computer hardware, through the replay at full speed of pre-captured traffic dumps, have demonstrated that the probe can afford fully filled (1500 bytes) packets data rate at 2.3 Gbps. Thus, when mirroring a Fast-Ethernet switch traffic, the best is to mirror to a 10 Gbps interface, to avoid the switch dropping mirror packets in excess, and to dimension the probe kernel capture buffer in such a way as to cope with high rate burst of traffic.



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In current version, passive taps, where packets in each direction are mirrored to 2 separate Ethernet ports, are not supported: minor changes are required in the software to respect order of occurrence of packets in stateful analysis.

The probe computer performances is thus determined by the multi-CPU speed, the RAM speed and the amount of RAM. One (or more) 10 Gbps native Ethernet port is preferred as dedicated traffic capture interface.

The remote administration and the probe-to-collector UDP-based data flow can be ideally conducted via one (or two) separate Fast-Ethernet port(s), because data rate is less an issue. USB-to-Ethernet adapter(s) can even be used for circumventing base computer limitations.

1.1.2 The Central Server Machine

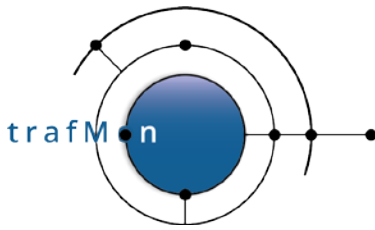
The central trafMon collector process is relatively lightweight. Its role is mostly to dump the raw observations received by the disseminated probes into ASCII log files. It is a bit more involved in buffering and conciliating individual packet observations from different probes to detect packet losses or to compute packet one-way latencies (and jitter – to be done).

When NetFlow/sFlow/IPFIX add-on is also needed, the CERT® SiLK rflowpack daemon can co-exist on the collector computer. It also simply dumps the flow records packets into ASCII logs.

So, the central raw data collection is only demanding in sufficient disk capacity for the temporary logs, but more significantly for storing archives of raw data logs.

What is quite heavier is the regular process of raw observations pre-processing, and database loading and update.

When NetFlow/sFlow/IPFIX data source is also used, the CERT® SiLK rfilter command is involved in extracting the collected records. Unfortunately, its **finest granularity is one hour!** So every hour, a rather big NetFlow observations file is produced. And its per-flow records can lapse over several minutes. So a local pre-processing of this big log file is required to the volume of each reported dataflow during every minute of its duration. The time taken by the processing can form a non-negligible part of the overall lapse of a regular observations pre-processing batch; hence influencing the highest affordable frequency at which this database refresh can be conducted (hopefully every 10 minutes). In that case of use this NetFlow observations preliminary treatment reveals dimensioning for required computing performance of the data collection function.



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When the database server is running on a separate computer, the performance of the regular batch processing is mostly impacted by the database server disk I/O rate (e.g. multiple high-performance SSD devices configured in hardware striping: RAID 0) and RAM size and speed. And the affordable history length of the per-minute (and per-hour) detailed performance figures is determined by the database files disk partition capacity (partition of more than one 2 TB implies the use of UEFI and GPT in booting and disk partitioning).

The trafMon runtime database is solicited by three different types of requests:

- The regular database loading and aggregation mostly consists in bulk loading (LOAD DATA LOCAL INFILE) into TEMPORARY tables, then updating the persistent tables, through dedicated SQL stored procedures, at 1 minute, 1 hour and 1 day granularity with aggregated fresh data.
- The daily update of volume related data tables feeding the synthetic views of traffic in terms of Activity/Location/Host and peer Countries is a rather heavy processing, conducted by recurrent stored procedures.
- The on-the-fly report generation, where the menu bar dynamic contents is updated by PHP online queries. The generation of details reports does simply retrieve the relevant records out of prepared database tables. But the generation of synthesis reports rely on a potentially heavy stored procedure, which retrieves data from daily aggregated volume tables, but further aggregate them based on the dynamically selected report parameters.

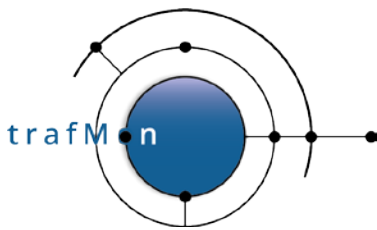
The regular loading typically induces a peak load every 10 minutes (all the time) and a longer load, once per hour, for the NetFlow data.

The daily work, also encompassing the more seldom database clean-up maintenance must be carefully spread over the night.

The on-the-fly report generation cannot be controlled, but typically happens during the day. It is the less predictable while the more demanding database activity, imposing short response time due to its interactive nature.

In summary, the operational database server must be chosen as best-on-market, with carefully tuned hardware components and operating system configuration.

The Web interface and report generation function can theoretically run together with the collector function and maybe the database service. But it induces peak of Tomcat/Java processing of the database retrieved data upon formatting of a requested report. The Tomcat process consumes a lot of RAM and competes therefore with the MySQL server and the disk I/O buffers.



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Note that nothing prevents that those central functions are assigned to one or more virtual server, provided that the reporting has enough CPU and RAM and that the database service has high data rate disk I/O (SSD, hardware RAID 1 and sizeable high-speed RAM buffers) and a lot of high-speed RAM also available to the MySQL server.

1.2 OPERATING SYSTEMS

The specific trafMon software has been developed on Linux, more specifically tested on an old Debian (x86 32 bit) and operated on not fully up-to-date CentOS 7.2 and 7.3 releases (x86_64).

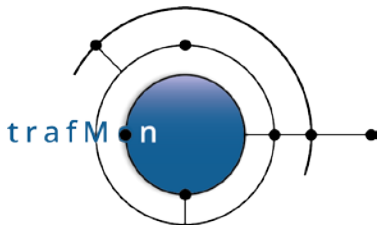
It is for sure that the trafMon probe (***tmon_probe***) and trafMon collector (***tmon_collector***) will be easily compiled on any vanillas of Linux, and even of BSD and other *NIX versions. But the probe has specific performance enhancements only available on Linux (packet capture ring buffer, deactivation of Ethernet card specific TCP/IP protocol handling, process locking on specific CPU core).

In a first time, the pre-compiled **binary distribution packages** will be available for **CentOS Linux release 7.3.1611 (Core), Linux kernel 3.10.0-514.26.1.el7.x86_64**. This is our baseline for the whole software installation. Nevertheless, the Angular.js development environment for the JavaScript menu bar is built on Microsoft Windows™ and the Eclipse BIRT Designer, for editing the trafMon report templates, has been indifferently run on the CentOS and on MS Windows systems.

For add-on support of NetFlow/sFlow/IPFIX, two binaries of the CERT® SiLK open source distribution are required: **rwflowpack** and **rwfilter**. Although we were running them on the same CentOS baseline server platform, it is perfectly possible to have them installed on other supported operating systems. The link with the trafMon processing chain is that the processed output of the **rwfilter** is saved, every hour, as a file in the raw observation spool directory together with the output log files produced by the **tmon_collector**.

The MySQL database can be installed and run on any platform supported by the MySQL 5.6 release. This can be commercial or open source distribution of Linux of other UNIX™ variants (e.g. Solaris™) or even a Microsoft Windows platform.

Our installation of the BIRT Report Engine runtime is using Apache Tomcat 7, installed on our central CentOS 7.3 server. But it can run in other J2EE application servers instead (IBM WebSphere®, Oracle WebLogic®, Red Hat JBoss®), among others the OpenText BIRT iHub™ commercial server (OpenText® bought Actuate® Corporation, the company that has developed BIRT). So you have the choice of the Java server component and therefore on its underlying operating system platform.



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2. OBTAINING THE THIRD-PARTY SOFTWARE

2.1 OPERATING SYSTEM

As mentioned above, several different operating systems variants and releases could be used for supporting the different main and optional components involved by the trafMon tool. For the sake of simplicity we are here describing the installation we made for an operational environment in the 2016-2017 timeframe.

There, our baseline operating system was CentOS 7.3 for x86_64 for Intel 64 bit. At the time of writing (September 2020) CentOS 7 latest release is CentOS 7.8.2003 (End-of-life 30 June 2024) and the latest Main Version is CentOS 8.2 2004 (<https://www.centos.org/download/>).

The installation guide can be found at <https://docs.centos.org/en-US/centos/install-guide/>.

For the probe, we would start from the *Minimal ISO* image and *Minimal Install*. Then fetch the several RPM packages via YUM, identifying the main required packages from the list in Appendix 4.1.

For the central collection, database and reporting server (assuming a single server for all three functions), the gnome and X11 GUI client applications are useful (*Server with GUI*). This implies a quite more voluminous installation. Anyway, you can also start from a *Minimal Install* and fetch the (long list of) RPM packages via YUM, identifying the main required packages from the list in Appendix 4.2.

2.2 PACKET CAPTURE LIBRARIES AND TOOLS

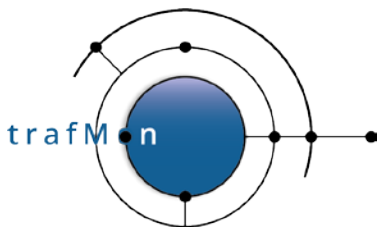
The trafMon Probe needs to load the `libpcap` library. This library is also involved by two applications that dissect and display the packets stacker protocol headers: the ancient `tcpdump` and the quite powerful `wireshark` GUI (and its `tshark` terminal command line alternative). These packages are, of course, necessary on the probe systems, but also on the central server to analyse saved traffic pcap files in parallel with their corresponding collector output observations.

These packages are installed by:

```
# yum install wireshark-gnome tcpdump libpcap-devel
```

2.3 OPTIONAL NET-SNMP SUPPORT

Both the trafMon probe (*tmon_probe*) and the central trafMon collector (*tmon_collector*) can be conditionally compiled with SNMP support.



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In this case, each instance embeds an SNMP agent responding to a Get-only custom MIB definition and can generate SNMP traps upon special conditions.

The respective SNMP MIB definitions (**TRAFMON-PRB-MIB** and **TRAFMON-PRB-MIB**) are presented in appendix to the *trafMon Administration Guide*.

In order to run the SNMP-enabled binaries of the `tmon_probe` and of the `tmon_collector`, the RPM packages `net-snmp`, `net-snmp-agent-libs` and `net-snmp-libs` are required.

But it is a good practice to also install the command-line utilities to query the agents and to receive the traps: RPM `net-snmp-utils`.

For permitting re-compilation (on a system with the development packages installed), the RPM `net-snmp-devel` is also necessary.

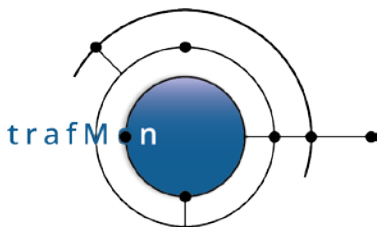
2.4 TRAFMON MANDATORY RUN-TIME LIBRARIES

The `tmon_probe` requires the following libraries

```
$ ldd tmon_probe
linux-vdso.so.1 => (0x00007ffef2f40000)
libxml2.so.2 => /lib64/libxml2.so.2 (0x00007fe7f5b32000)
libpcap.so.1 => /lib64/libpcap.so.1 (0x00007fe7f58f0000)
libcrypto.so.10 => /lib64/libcrypto.so.10 (0x00007fe7f5506000)
libnetsnmpagent.so.20 => not found
libnetsnmphelpers.so.20 => not found
libnetsnmpmibs.so.20 => not found
libnetsnmp.so.20 => not found
libc.so.6 => /lib64/libc.so.6 (0x00007fe7f5143000)
libdl.so.2 => /lib64/libdl.so.2 (0x00007fe7f4f3f000)
libz.so.1 => /lib64/libz.so.1 (0x00007fe7f4d29000)
liblzma.so.5 => /lib64/liblzma.so.5 (0x00007fe7f4b02000)
libm.so.6 => /lib64/libm.so.6 (0x00007fe7f4800000)
/lib64/ld-linux-x86-64.so.2 (0x00007fe7f5eb3000)
libpthread.so.0 => /lib64/libpthread.so.0 (0x00007fe7f45e4000)
```

The `tmon_collector` requires the following libraries

```
$ ldd /opt/tmon/bin/tmon_collector
linux-vdso.so.1 => (0x00007fff0dded000)
libxml2.so.2 => /lib64/libxml2.so.2 (0x00007fe4c2fa7000)
libpcap.so.1 => /lib64/libpcap.so.1 (0x00007fe4c2d65000)
libcrypto.so.10 => /lib64/libcrypto.so.10 (0x00007fe4c297b000)
libnetsnmpmibs.so.31 => /lib64/libnetsnmpmibs.so.31 (0x00007fe4c24c2000)
libsensors.so.4 => /lib64/libsensors.so.4 (0x00007fe4c22b2000)
libdl.so.2 => /lib64/libdl.so.2 (0x00007fe4c20ae000)
librpm.so.3 => /lib64/librpm.so.3 (0x00007fe4c1e47000)
librpmio.so.3 => /lib64/librpmio.so.3 (0x00007fe4c1c19000)
libnetsnmpagent.so.31 => /lib64/libnetsnmpagent.so.31
(0x00007fe4c19aa000)
```



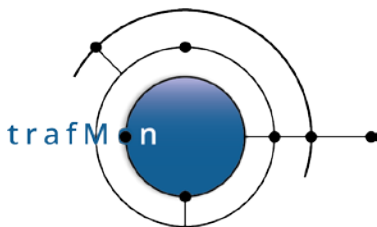
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```
libwrap.so.0 => /lib64/libwrap.so.0 (0x00007fe4c179f000)
libnetsnmp.so.31 => /lib64/libnetsnmp.so.31 (0x00007fe4c149c000)
libssl.so.10 => /lib64/libssl.so.10 (0x00007fe4c122e000)
libm.so.6 => /lib64/libm.so.6 (0x00007fe4c0f2c000)
libc.so.6 => /lib64/libc.so.6 (0x00007fe4c0b6a000)
libz.so.1 => /lib64/libz.so.1 (0x00007fe4c0954000)
liblzma.so.5 => /lib64/liblzma.so.5 (0x00007fe4c072e000)
libperl.so => /usr/lib64/perl5/CORE/libperl.so (0x00007fe4c039f000)
libresolv.so.2 => /lib64/libresolv.so.2 (0x00007fe4c0185000)
libnsl.so.1 => /lib64/libnsl.so.1 (0x00007fe4bfff6c000)
libcrypt.so.1 => /lib64/libcrypt.so.1 (0x00007fe4bfd34000)
libutil.so.1 => /lib64/libutil.so.1 (0x00007fe4bfb31000)
libpthread.so.0 => /lib64/libpthread.so.0 (0x00007fe4bf915000)
/lib64/ld-linux-x86-64.so.2 (0x00007fe4c3328000)
libnss3.so => /lib64/libnss3.so (0x00007fe4bf5ea000)
libbz2.so.1 => /lib64/libbz2.so.1 (0x00007fe4bf3da000)
libelf.so.1 => /lib64/libelf.so.1 (0x00007fe4bflc2000)
libpopt.so.0 => /lib64/libpopt.so.0 (0x00007fe4befb7000)
libselenium.so.1 => /lib64/libselenium.so.1 (0x00007fe4bed90000)
libcap.so.2 => /lib64/libcap.so.2 (0x00007fe4beb8b000)
libacl.so.1 => /lib64/libacl.so.1 (0x00007fe4be981000)
liblua-5.1.so => /lib64/liblua-5.1.so (0x00007fe4be753000)
libdb-5.3.so => /lib64/libdb-5.3.so (0x00007fe4be395000)
libgssapi_krb5.so.2 => /lib64/libgssapi_krb5.so.2 (0x00007fe4be146000)
libkrb5.so.3 => /lib64/libkrb5.so.3 (0x00007fe4bde5f000)
libcom_err.so.2 => /lib64/libcom_err.so.2 (0x00007fe4bdc5a000)
libk5crypto.so.3 => /lib64/libk5crypto.so.3 (0x00007fe4bda28000)
libfreebl3.so => /lib64/libfreebl3.so (0x00007fe4bd824000)
libnssutil3.so => /lib64/libnssutil3.so (0x00007fe4bd5f7000)
libplc4.so => /lib64/libplc4.so (0x00007fe4bd3f2000)
libplds4.so => /lib64/libplds4.so (0x00007fe4bd1ed000)
libnspr4.so => /lib64/libnspr4.so (0x00007fe4bcfaf000)
libpcre.so.1 => /lib64/libpcre.so.1 (0x00007fe4bcd4e000)
libattr.so.1 => /lib64/libattr.so.1 (0x00007fe4bcb48000)
libkrb5support.so.0 => /lib64/libkrb5support.so.0 (0x00007fe4bc939000)
libkeyutils.so.1 => /lib64/libkeyutils.so.1 (0x00007fe4bc735000)
librt.so.1 => /lib64/librt.so.1 (0x00007fe4bc52c000)
```

Where the Net-SNMP components are conditionally linked (see section 2.2 above).

Most of the *tmon_collector* libraries are silently added by the standard way to link with NetSNMP, although most being not actually used. For instance, the same *tmon_collector* linked without enabling SNMP results in quite shorter dependency list:

```
$ ldd tmon_collector
linux-vdso.so.1 => (0x00007ffcefb9a000)
libxml2.so.2 => /lib64/libxml2.so.2 (0x00007fbcac4dd000)
libpcap.so.1 => /lib64/libpcap.so.1 (0x00007fbcac29c000)
libcrypto.so.10 => /lib64/libcrypto.so.10 (0x00007fbcabeb1000)
libc.so.6 => /lib64/libc.so.6 (0x00007fbcabaf0000)
libdl.so.2 => /lib64/libdl.so.2 (0x00007fbcab8ec000)
libz.so.1 => /lib64/libz.so.1 (0x00007fbcab6d5000)
liblzma.so.5 => /lib64/liblzma.so.5 (0x00007fbcab4af000)
libm.so.6 => /lib64/libm.so.6 (0x00007fbcab1ad000)
```



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```
/lib64/ld-linux-x86-64.so.2 (0x00007fbcac85e000)
libpthread.so.0 => /lib64/libpthread.so.0 (0x00007fbcaaf90000)
```

And even, the program does not involve POSIX threads (libpthread.so.0 is useless).

What is relevant from this is:

- **libxml2.so.2** implies the RPM [libxml2-devel](#) and its dependencies
Used for reading and parsing the trafMon run-time configuration file
- **libpcap.so.1** implies the RPM [libpcap-devel](#) and its dependencies
Used by the probe for capturing network packets
- **libcrypto.so.10** implies the RPM [openssl-devel](#) and its dependencies
Used for the production and verification of per-probe one-way packet identifying MD5 hash signature

The rest comes with the operating system and with the C development tools.

2.5 PYTHON VERSION 2.X

I don't remember whether Python is part of the standard installation of CentOS. But care must be taken that the trafMon data management scripts are written for Python 2.x.

In our baseline, the yum package is [python.x86_64.2.7.5-88.el7](#)

You could require to use the EPEL repository for YUM, registered via

```
# yum install epel-release
```

To install python, if needed, execute:

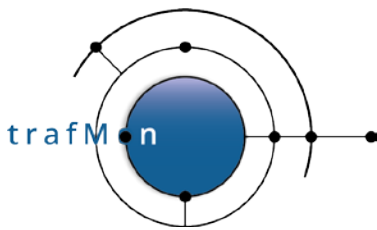
```
# yum install python2
```

and ensure that the command `/usr/bin/python` executes `python2`:

```
# ls -l /usr/bin/python
lrwxrwxrwx. 1 root root 7 Jul 7 2017 /usr/bin/python -> python2
```

2.6 GEOIP™ AND MAXMIND®

The MaxMind, Inc Company offers two modules for Python implementing the reading and matching of IP addresses in their GeoIP databases. the first module – `maxminddb` – is (also) provided under the open source Apache Software License 2.0, the second one – `GeoIP` – is provided under the open source GNU LGPL 2.1 or greater.



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```
# pip install GeoIP
# pip install maxminddb
```

The Company is also providing free access to GeoLite2 semi-accurate version of their commercial product. But, since the legal enforcement of privacy protection of personal data (in particular in California and the EU), users must first register at their site before getting the database files: <https://dev.maxmind.com/geoip/geoip2/geoip2/>. Please carefully analyse the licensing conditions.

Previously, it sufficed to fetch the following two database files as:

```
# cd /tmp
# wget http://geolite.maxmind.com/download/geoip/database/GeoLite2-
City.mmdb.gz
# wget
http://download.maxmind.com/download/geoip/database/asnum/GeoIPASNum.dat.gz
```

2.7 MYSQL DATABASE MANAGEMENT SYSTEM AND CONNECTORS

2.7.1 Database Server and Client Utilities

trafMon has been developed with version 5.6 of the MySQL Community DBMS. Probably, it will work seamlessly with a newer 5.x release, but probably not with version 8.

There are several ways to install the MySQL Community server. We are using YUM and the EPEL repository:

Then install the MySQL repository configuration for yum:

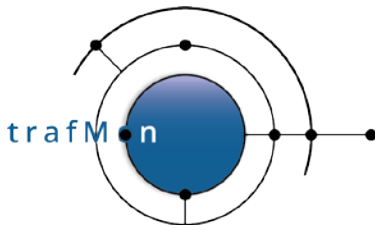
```
# yum install mysql-community-release
```

Then install the MySQL server, client and libraries

```
# yum install mysql-community-server
```

Note: This could result in trying to install an inappropriate version of the MySQL Community server.

In such case, look at <https://dev.mysql.com/>, then follow the link for the required MySQL Community Server version.



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Select “Red Hat Enterprise Linux / Oracle Linux” as target Operating System, and the proper OS Version (e.g. “Red Hat Enterprise Linux 7 / Oracle Linux 7 (x86, 64 bit”), then download the “RPM Bundle” (without login: *just start my download*).

Extract the tarfile in a temporary directory, go there and execute

```
# yum localinstall mysql-community-server-* mysql-community-client-*  
mysql-community-common-* mysql-community-libs-*
```

The security hardening of the MySQL server is outside the scope of the present document. Please search the Web for related instructions.

2.7.2 MySQL Connectors

In trafMon, the MySQL server is accessed via three interpreted languages:

- PHP (for the reporting JavaScript menu bar),
- Python and
- Java.

The two first connectors can be installed via YUM:

```
yum install php-mysql  
yum install mysql-connector-python
```

For the third one (Java), as it is used by the three installation of BIRT, the most easy is to download the corresponding jar file to a temporary directory.

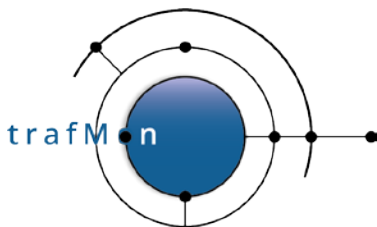
- Browse to <https://downloads.mysql.com/archives/c-j/>
- Select the most recent connector corresponding to the MySQL version (e.g. connector 4.1.48) and select “Platform Independent”
- Download and decompress the file to a temporary directory (e.g. /tmp/mysql-connector-java-5.1.48-bin.jar)

Below we will copy it into the three BIRT environments (designer, batch reporter, Tomcat interactive reporter)

2.7.3 PhpMyAdmin Web Administration Tool

This tool is quite useful to install, in order to inspect and also administer the trafMon database(s). It offers an easy-to-use workbench GUI published in HTTPS and accessible via Web browser.

```
yum install phpMyAdmin.noarch
```

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It is accessible at <http://localhost/phpmyadmin> (with or without HTTPS SSL protection, or maybe also remotely via hostname depending on your way to tune `/etc/httpd/conf.d/phpMyAdmin.conf`).

2.8 BIRT RUNTIME ENGINE AND REPORT VIEWER

BIRT consists in two separate environments:

- The BIRT Designer is part of the development environment of trafMon. It permits to build or edit report templates. It is a “perspective” for the Eclipse IDE, also available as a shrink wrapped standalone BIRT RCP Designer application.
- The BIRT Runtime Engine and Report Viewer is a J2EE application to be run in a java application server. This part implements the engine that retrieves actual data (e.g. from an SQL database, that populated the various components of a report template and generates the graphical report, either as an electronic document (e.g. a PDF file), or as a single HTML page or as a multipage Web document browsed via the BIRT Report Viewer.

Here we explain how to install the BIRT Runtime with an Apache Tomcat application server.

First, Tomcat can be most easily installed (on CentOS) via its RPM package:

```
# yum install tomcat
```

This also installs the [java openjdk](#) providing the necessary java runtime environment.

At the minimum, you must create role and a user for accessing the trafMon BIRT reporting application:

In the file `/etc/tomcat/tomcat-users.xml`, add a role and a user for the trafMon: add following two lines inside the tag `<tomcat-users>`:

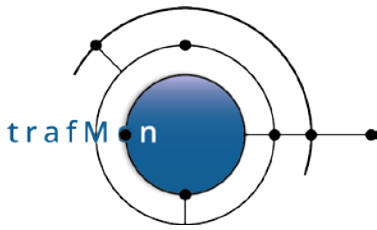
```
<role rolename="trafmon_role"/>
<user username="trafmon" password="tmonpass" roles="
trafmon_role"/>
```

The username and password will be needed to access the BIRT reports.

Then define the protected access to the application. In the file `/etc/tomcat/tomcat-users.xml`, add following two lines at end of the tag `<web-app>`:

```
<security-constraint>

  <web-resource-collection>
    <web-resource-name>Protected Context</web-resource-name>
    <url-pattern>/*</url-pattern>
    <http-method>GET</http-method>
```



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```
<http-method>POST</http-method>
</web-resource-collection>

<auth-constraint>
  <!-- role-name indicates roles that are allowed to access
       diff the web resource specified above -->
  <role-name>trafmon_role</role-name>
</auth-constraint>

<user-data-constraint>
  <transport-guarantee>CONFIDENTIAL</transport-guarantee>
</user-data-constraint>

</security-constraint>/

<security-role>
  <role-name>trafmon_role</role-name>
</security-role>

<login-config>
  <auth-method>BASIC</auth-method>
  <realm-name>
    Enter credentials to access the trafMon Reports
  </realm-name>
</login-config>

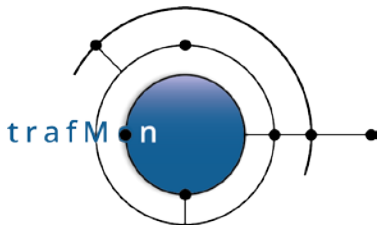
<error-page>
  <exception-type>java.lang.Throwable</exception-type>
  <location>/error.jsp</location>
</error-page>
```

Also tune the java options. In the file `/etc/tomcat/tomcat.conf`, assign `JAVA_OPTS` as

```
JAVA_OPTS="-Djava.security.egd=file:/dev/./urandom
-Djava.awt.headless=true -Xmx4096m -XX:MaxPermSize=2048m
-XX:+UseConcMarkSweepGC"
```

Then, fetch the BIRT Runtime and install it in the Tomcat context. This is explained in the URL page <https://www.eclipse.org/birt/documentation/integrating/viewer-setup.php>.

- Download the BIRT Runtime zip file from <http://download.eclipse.org/birt/downloads/> and expand it, e.g. as `/opt/birt-runtime-4_5_0` directory; this will be the location of the BIRT Runtime used for batch generation of report PDF files, via the script `/opt/birt-runtime-4_5_0/ReportEngine/genReport.sh`



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NOTE: in our ancient CentOS 7.3 installation, BIRT was at release 4.5.0 (at the time of writing, the directory would be `birt-runtime-4.8.0-20180626/` maybe implying a specific version/release of the [java openjdk](#) RPM package).

- Copy the [MySQL Connector for Java](#) (see subsection 2.7.2 above) under
`/opt/birt-runtime-4_5_0/ WebViewerExample/WEB-INF/lib/`
- Create a directory
`birt` will be the name of the Tomcat Web Application
- recursively copy the content of WebViewerExample subdirectory under the above created path and assign ownership

```
# cd /opt/birt-runtime-4_5_0/WebViewerExample/  
# cp -R * /var/lib/tomcat/webapps/birt/  
# chown -R tomcat:tomcat /var/lib/tomcat/webapps/birt/
```

2.9 BIRT DESIGNER

The BIRT Designer component is necessary as soon as you need to change something in the pre-designed collection of trafMon report templates. So it is a good idea to install it. It is the GUI editor of existing or new report templates. Several tutorials are accessible via <https://www.eclipse.org/birt/documentation/>, and a rather complete book “*BIRT, A Field Guide*” is published by Addison Wesley.

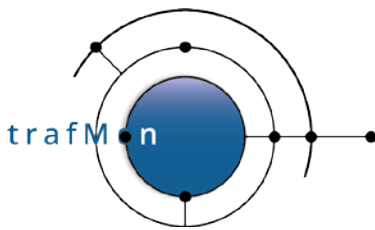
You could install it on your Linux server, in which case it will be accessible through X11. You can also install it directly on your preferred Microsoft Windows (or Apple iMac) desktop.

Note that BIRT is not compatible with the latest version(s) of the Java Runtime Environment. An ancient version of the JRE could need to be installed and made the default version for Eclipse or BIRT application.

As explained on the download page <https://download.eclipse.org/birt/downloads/>, there are three ways to install the BIRT Designer:

- As a full download of the Eclipse IDE, with BIRT perspective pre-installed (**All-in-One**),
- As an Eclipse plug-in perspective for an already installed Eclipse IDE
- As a shrink wrap standalone application

Here also, the [MySQL Connector for Java](#) (see subsection 2.7.2 above) must be added. For instance, copy the under your eclipse directory. Then, while editing/creating a Data



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source, use the “Manager driver ...” pop-up to add/select the full pathname to the MySQL Connector jar file.

NOTE:

The BIRT report template XML files (*.rptdesign), as well as the BIRT libraries and script files, will coexist in two places.

The files in your Eclipse workspace/project are editable and can be tested when run from the Designer.

But the file involved in the BIRT Reporter are placed on the server under `/var/lib/tomcat/webapps/birt/trafMon_reports/` and must be owned by the tomcat user:

```
# chown -R tomcat:tomcat
    /var/lib/tomcat/webapps/birt/trafMon_reports/
```

2.10 NPN AND BOWER FOR COMPLETING THE JAVASCRIPT MENU-BAR APPLICATION

The trafMon menu-bar JavaScript application relies on a series of third-party JavaScript components from AngularJS and from jQuery that you will have to download yourself.

For this you will need the `Bower` utility, itself installed by the `npm` is the package manager for `Node.js`.

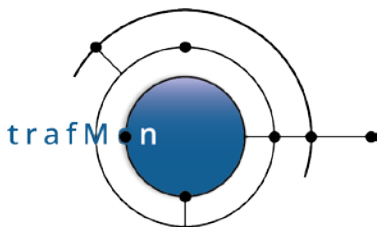
`Npm` is available as a RPM package downloadable via `yum`. In turn, the `npm` utility can install `bower`.

```
# yum install tomcat
# npm install bower
```

See section on page 29 for the installation of the necessary third-party JavaScript components.

2.11 OPTIONAL CERT® SILK SOFTWARE

If you intend to take party of the trafMon extension to the NetFlow/sFlow/IPFIX source of traffic observations, you need to install the CERT® SILK Software.



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In fact, trafMon is only relying on its NetFlow receiver and extraction utilities, and don't make use of the more security-oriented traffic analysis suite.

Our ancient operational trafMon installation, where NetFlow v5 then v9 feeds were used, was integrating Silk 3.14.0. This was exhibiting two bugs in the v9 records we were processing.

One was a bad interpretation of some flow record timestamps (producing observations in the future or in the past). Some people complained about timestamps problems, but I don't know if these have been solved, and has no way to test anymore.

The other was a wrong interpretation of the post-processing volumes issued by the NetFlow v9 gateways. For this we implemented a conditional fix that was used in our environment and proposed for integration in the SiLK code base. Apparently this fix is now integrated as default behaviour and a "quirk" option allows to re-establish the (wrong) handling for matching the NetFlow interpretation of some network device brands.

So the best is to download the latest version of SiLK, extract, compile and install it:

- Ensure that you have Gnome glib2 installed on your system

```
# rpm -q -a | grep glib2
...
glib2-devel-2.46.2-4.el7.x86_64
glib2-2.46.2-4.el7.x86_64
...
```

Or fetch it

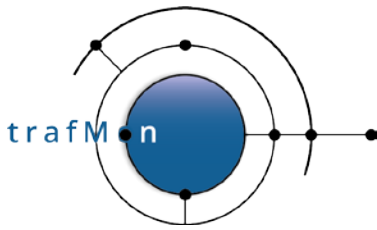
```
# yum install glib2-devel.x86_64 glib2.x86_64
```

- Download, compile and install the CERT libfixbuf: the compressed tarfile is available at <https://tools.netsa.cert.org/fixbuf/download.html>. In the expanded sources directory, simply let the library install itself under standard `/usr/local` default root:

```
# cd libfixbuf-x.y.z/
# ./configure
# make
# make install
```

- Download, compile and install the CERT SiLK: the compressed tarfile is available at <https://tools.netsa.cert.org/silk/download.html>. In the expanded sources directory, simply let the library install itself under standard `/usr/local` default root:

```
# cd silk-x.y.z/
# ./configure
# make
# make install
```



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3. INSTALLING TRAFMON EXECUTABLES

The trafMon software itself is provided in sources, to be compiled, or in packages with the executable binaries, scripts and configuration sample files. Those software distributions are provided at

<https://www.trafmon.org/downloads/>

3.1 INSTALLING THE EXECUTABLE TRAFMON PACKAGE

In a first time, executable packages will be available only as compressed tarfiles. No RPM are initially produced. The **compiled binaries are produced on CentOS 6.7 and 7.3**. The executable package will contain the necessary files for both the probe and the central server systems (including configuration samples and scripts for the database, BIRT/Tomcat and HTTPD, and the optional NetFlow/sFlow/IPFIX SiLK-based data feed).

The executable package is provided in two variants:

- Binaries without embedded SNMP (sub-)agent: **trafMon-x.y.x.el6.x86_64.tbz** or **trafMon-x.y.x.el7.x86_64.tbz**
- Binaries with embedded SNMP (sub-)agent, relying on Net-SNMP: **trafMon_SNMP-x.y.x.el6.x86_64.tbz** or **trafMon_SNMP-x.y.x.el7.x86_64.tbz**

It must be typically extracted under /opt:

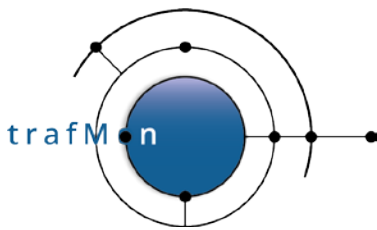
```
# cd /opt
# tar xvf path-to-trafmon-x.y.z...tbz
# mv trafMon-* trafMon
```

This creates directory /opt/trafMon, with

- a sub-directory **bin/** with `tmon_collector`, `tmon_probe`, `trafMon_updateIpInfo.py`, `trafMon_loader.py`, `trafMon_FormatNetFlow.py`, `trafMon_volumeReportGen.py`, `trafMon_detailReportGen.py`, `trafMon_probeResurrect.sh.sample`, `trafMon_serverResurrect.sh.sample`

The files `tmon_probe` and `trafMon_probeResurrect.sh` are used on a trafMon Probe system;

The other files are for the central trafMon Collector system (*assuming that the trafMon Collector, with optional SiLK NetFlow Collector, the MySQL database and the Tomcat/BIRT reporting are running on the same system*)



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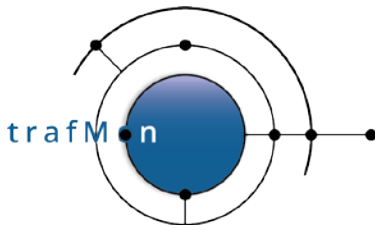
- a sub-directory **trafMon_db/** containing a text file, `db_privileges`, showing the two MySQL database users to create, the database radix pattern and the privileges they must be assigned for. It also contains the SQL script to create the reference database, with stored procedures, table templates and protocol service ports, which must be run (once) as database administrator: root;
- a sub-directory **trafMon_web/** with the JavaScript/PHP web application handling the interactive menu-bar for the on-demand generation of synthesis and/or detail reports.
- a sub-directory **trafMon_reports/** containing the set of pre-designed trafMon BIRT report templates, as well as the common Library files and common Script file:

```
trafMon_reports/ManagerReport.rptdesign
trafMon_reports/ManagerReport_exploded.rptdesign
trafMon_reports/ManagerReport_exploded_stack.rptdesign
trafMon_reports/ManagerReport_stack.rptdesign
trafMon_reports/OperatorReport.rptdesign
trafMon_reports/OperatorReport_exploded.rptdesign
trafMon_reports/OperatorReport_conv.rptdesign
trafMon_reports/OperatorReport_conv_exploded.rptdesign
trafMon_reports/TwoWayDelays.rptdesign
trafMon_reports/OneWayLatencies.rptdesign
trafMon_reports/OneWay_Counters.rptdesign
trafMon_reports/FTP_Summary.rptdesign
trafMon_reports/FTP_Details.rptdesign
trafMon_reports/FTP_Counters.rptdesign
trafMon_reports/TCP_Details.rptdesign
trafMon_reports/TCP_Counters.rptdesign
trafMon_reports/UDP_Counters.rptdesign
trafMon_reports/ICMP_Counters.rptdesign
trafMon_reports/IP_Counters.rptdesign
trafMon_reports/IP_Size_distribution.rptdesign
trafMon_reports/Library/trafMonDb.rptlibrary
trafMon_reports/Library/trafMonLibrary.rptlibrary
trafMon_reports/Library/url.rptlibrary
trafMon_reports/Scripts
trafMon_reports/Scripts/FormatFileSize.js
```

This `trafMon-reports/` directory and its content has to be copied as `/var/lib/tomcat/webapps/birt/trafMon-reports/`

- a sub-directory **etc/trafMon/** with following sample configuration file:
 - **xml/tmon.dtd** is the syntax definition, with explanations in comments, of the run time configuration file common to the `tmon_collector` and to every `tmon_probe` instance;

It has to be copied to `/etc/trafMon/xml/tmon.dtd`



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- o **xml**/singleProbe_sample.xml (xml/multiProbes_sample.xml) or is an example configuration file that a user must edit/replace as /etc/trafMon/xml/tmon.xml on the central system running tmon_collector and on (every) system running a tmon_probe;
- o **diag**/myProbe.diag.sample and diag/myCollector.diag.sample are example configuration files, respectively for a tmon_collector and for a tmon_probe instances, defining the required verbosity per software module and destination log file for the activity tracing/debugging messages;

According to the content of the xml/tmon.xml, every trafMon collector and trafMon probe instance is given a name. The diagnostics tracing file for a given component “*comp-name*” is sought from the local /etc/trafMon/diag/*comp-name*.diag

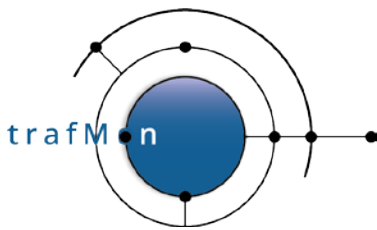
- o **cred**/db.cred.sample is a sample configuration file, for the central collector system, which registers
 - the current run time database name db_name (where new observations are loaded with update of the aggregated data,
 - the db_url of the MySQL server (unix local socket or TCP/IP address/port),
 - the user name (trafMon_loader_user) and encoded password (trafMon_loader_pwd) used for accessing the database in read/write mode,
 - the user name (trafMon_report_user) and encoded password (trafMon_report_pwd) used for accessing the database in read-only mode or for executing stored procedures (which may then modify the database),

A file with similar content must be created as /etc/trafMon/cred/db.cred;

- o **report**/detailReportGen_flowMatch.genAddrs.sample is a sample configuration file for the optional batch generation of detailed protocol PDF reports for flow matching any of their two IP addresses with one of the configured regular expression patterns.

The operational configuration file(s) is (are) /etc/trafMon/diag/*name*.genAddrs, where *name* is used as the name of a directory root for the corresponding report tree generated by the (regular) run of trafMon_detailReportGen.py -f *name*.genAddrs;

- o ipInfo.ini.sample is an example configuration file (that can be regularly updated) where as much as possible of your own Organisation private/public IP address ranges are classified as pertaining to a given ACTIVITY and



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placed in a specified LOCATION (can be a mix of room, building, site or other specifiers, meaningful to you to partition the space of your infrastructure. Note that the City and Country of known addresses are currently not used in reports.

This type of file is specified as `-p` option argument to the script `trafMon_updateIpInfo.py`;

- `TRAFMON-COL-MIB.txt` and `TRAFMON-PRB-MIB.txt` are the custom SNMP MIB definitions implemented by the sub-agents (optionally) present in, respectively, the `tmon_collector` and the `tmon_probe` programs;
- `crontab.probe.sample`, `crontab.root.sample`, `crontab.trafmon.sample` are examples of crontab files to be used in different contexts (systems and accounts);

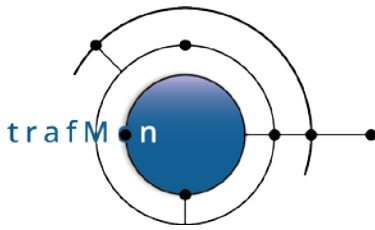
`crontab.probe.sample` is for the trafMon probe systems. Either the `tmon_probe` is run as `root`, in which case the crontab samples is for the `root` account, or the `tmon_probe` binary is assigned capabilities that allow an unprivileged user (e.g. `trafmon`) to tune network interfaces and capture packets, in which case, the two sample crontab commands are to be split in the respective crontab files of `root` and `trafmon` accounts;

`crontab.trafmon.sample` is an example of content of the crontab for the `trafmon` unprivileged user to be created on the trafMon central server, and `crontab.root.sample` is a crontab content example for the `root` super-user account on that server;

- `trafMon.logrotate.sample` is the typical content to rotate logs created by the trafMon application on both types of systems: for trafMon probe and for trafMon collector; `mysql.logrotate.sample` is a commented enhanced logrotate configuration for the `mysqld` service.
- a sub-directory **`etc/silk/`** with following sample configuration file (assuming that SiLK™ has been installed under `/usr/local/` and will store its NetFlow records logs under `/var/silk/`):
 - `rwflowpack.conf.sample`: defines the site-specifics for the service daemon (receiving the NetFlow/sFlow/IPFIX packets and storing the observations in log files): list of devices sending NetFlow/sFlow/IPFIX packets (SiLK “sensors” of type “probe”)

Check that this file is still compatible with the template provided with your SiLK distribution (i.e. `/usr/local/share/silk/etc/rwflowpack.conf`).

Copy it to `/usr/local/etc/rwflowpack.conf` and tune it for your case;



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- o `sensor.conf.sample`: defines the various sources of NetFlow/sFlow/IPFIX packets.

Create a similar file, adapted to your custom case, as `/var/silk/twoway-silk.conf`, as referred to by the configuration item `SITE_CONFIG=` in `/usr/local/etc/rwflowpack.conf`;

- o `twoway-silk.conf` (you could use the SiLK distribution version instead (`/usr/local/share/silk/twoway-silk.conf`), but ensure that enough sensors – sources of NetFlow/sFlow/IPFIX records - are defined.

Create a similar file `/var/silk/twoway-silk.conf`, as referred to by the configuration item `SITE_CONFIG=` in `/usr/local/etc/rwflowpack.conf`;

- a sub-directory `testing/` with several utilities and sample config files supporting testing activities: more verbose diagnostic traces, using `tmon_probe` replaying a packet capture file (at full speed or respecting the original inter-packet delay), TCP/UDP packet generator program and multi-protocol traffic generator scripts

3.2 OPTIONALLY INSTALLING THE TRAFMON SOURCES

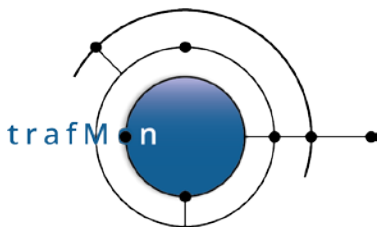
3.3 INSTALLING A PROBE SYSTEM

3.3.1 Unprivileged Unix Account `trafmon` for `tmon_probe`

The best is to create a specific account `trafmon` of group `trafmon` that will run the probe as unprivileged user and will produce log files, typically under `/var/log/trafMon/`

```
# groupadd trafmon
# useradd -g trafmon trafmon
# passwd trafmon
New password:
Retype new password:
# mkdir /var/log/trafMon/
# chown trafmon:trafmon /var/log/trafMon/
```

Once you have extracted (or re-created) the `trafMon` executable distribution tarfile (or the relevant part thereof) under `/opt`, you can change the ownership of the `/opt/trafmon` subtree:



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```
# chown -R trafmon:trafmon /opt/trafMon
```

Now that the `/opt/trafMon/bin/tmon_probe` belongs to the group `trafmon`, we can give it the permission to tune the Ethernet card config (no reassembly, no checksum computation ...) and to capture packet in promiscuous mode when executed by a member of the group `trafmon`:

```
# setcap cap_net_raw,cap_net_admin=eip /opt/trafMon/bin/tmon_probe
# getcap /opt/trafMon/bin/tmon_probe
/opt/tmon/bin/tmon_probe = cap_net_admin,cap_net_raw+eip
```

3.3.2 Configuring `/etc/trafMon`

```
# mkdir -p /etc/trafMon/{xml,diag}
# chown -R trafmon:trafmon /etc/trafMon/
# su - trafmon
trafmon% cp /opt/etc/trafMon/xml/tmon.dtd /etc/trafMon/xml/tmon.dtd
trafmon% cp /opt/etc/trafMon/xml/singleProbe_sample.xml
                                                    /etc/trafMon/xml/tmon.xml
<edit /etc/trafMon/xml/tmon.xml>
```

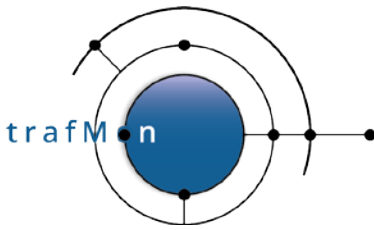
IMPORTANT: this `tmon.xml` runtime configuration file is common to (all) probe instance(s) and to the central collector; hence the tuning must cover both the probe and collector sides altogether. The DTD file is fully commented for helping to understand the `trafMon` XML configuration and the possible choices for arguments.

Select the name and IP address of the Probe and of the Collector components. Adapt the name of the Probe capture interface(s) and, if needed, remove the lines concerning the second interface. Correct, if necessary, the pathname, on the central server, where the collector will produce its observations log files.

For further explanations see the *trafMon Configuration and Administration Guide*.

Create a configuration for the tuning of diagnostic trace messages produced by the probe. Its radix name must be that chosen for this `trafMon` probe instance in the XML configuration file:

```
trafmon% cp /opt/etc/trafMon/diag/myProbe.diag.sample
                                                    /etc/trafMon/xml/<probename>.diag
```



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3.3.3 Logrotate

```
# cp /opt/etc/trafMon/trafMon.logrotate.sample /etc/logrotate.d/trafmon
```

Edit the file `/etc/logrotate.d/trafmon` for number and size of files to keep and the period.

Look at the logrotate task in the file `/opt/etc/trafMon/crontab.probe.sample` and create a similar one in the crontab for root:

```
# crontab -e
```

3.3.4 Crontab for Permanently Running the Probe

For this, it is preferable to wait that the central `tmon_collector` is configured and running. Otherwise, the probe will accumulate observations and continuously retry to forward them to the not yet responding collector.

Tune, as needed, the script

`/opt/trafMon/bin/trafMon_probeResurrect.sh.sample` to produce an executable script `/opt/trafMon/bin/trafMon_probeResurrect.sh`

Look at the `trafMon_probeResurrect.sh` line in the file

`/opt/etc/trafMon/crontab.probe.sample` and create a similar one in the crontab for trafmon (Put a hash mark '#' in front, until you want the probe to actually start):

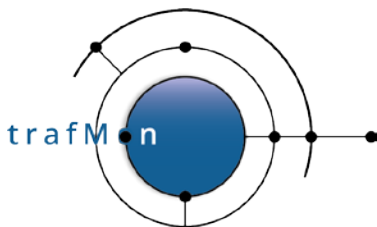
```
# crontab -l trafmon -e
```

3.4 INSTALLING THE CENTRAL SERVER

3.4.1 Unprivileged Unix Account trafmon for tmon_collector

The best is to create a specific account `trafmon` of group `trafmon` that will run the collector. Decide where you want the collected probe(s) observations to be spooled: e.g. under `/var/trafMon/collector/` and where to produce the logs, typically under `/var/log/trafMon/`

```
# groupadd trafmon
# useradd -g trafmon trafmon
# passwd trafmon
New password:
Retype new password:
```



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```
# mkdir /var/trafMon/  
# mkdir /var/log/trafMon/  
# chown trafmon:trafmon /var/trafMon/ /var/log/trafMon/  
# su - trafmon  
trafmon% mkdir /var/trafMon/collector/  
trafmon% mkdir /var/trafMon/GeoIP  
trafmon% cd /var/trafMon/GeoIP  
trafmon% mv /tmp/GeoLite2-City.mmdb.gz /tmp/GeoIPASNum.dat.gz .  
trafmon% gunzip *
```

Once you have extracted (or re-created) the trafMon executable distribution tarfile (or the relevant part thereof) as **/opt/trafMon**, you can change the ownership of the **/opt/trafMon** subtree:

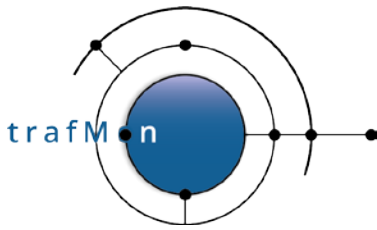
```
# chown -R trafmon:trafmon /opt/trafmon
```

3.4.2 Install the trafMon Menu Bar JavaScript Application

Use bower to install the external javaScript components (from AngularJS and JQuery) in the app local directory 'bower_components':

```
trafmon % cd /opt/trafMon/trafMon_web/app/  
trafmon % cat .bowerrc  
{  
  "directory": "bower_components"  
}  
trafmon % bower install angular angular-animate angular-aria angular-  
cookies  
trafmon % bower install angular-material angular-messages angular-resource  
trafmon % bower install angular-route angular-sanitize angular-spinner  
trafmon % bower install angular-touch bootstrap jquery jquery-ui spin.js  
trafmon % ls bower_components/  
angular          angular-material  angular-route    bootstrap  
angular-animate  angular-messages  angular-sanitize  jquery  
angular-aria     angular-mocks     angular-spinner  jquery-ui  
angular-cookies  angular-resource  angular-touch    spin.js
```

Verify that the pathnames in **index.html** are correctly referring inside the substructure of every installed package under **bower_components/**.



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Recursively copy the JavaScript application under the root URL of the Apache HTTPD server, and adapt owner, group and mode.

```
# cd /opt/trafMon
# cp -R trafMon_web/app/ /var/www/html/trafMon
# chown -R apache:apache /var/www/html/trafMon
# chmod -R o-rwx /var/www/html/trafMon
```

Adapt `/var/www/html/trafMon/scripts/services/birturl.js` to refer to your own HTTPD server.

Later, edit encoded password in `/var/www/html/trafMon/php/include.php` as per section 3.4.3 below.

3.4.3 Create the MySQL User Accounts and the `trafMon_template` database

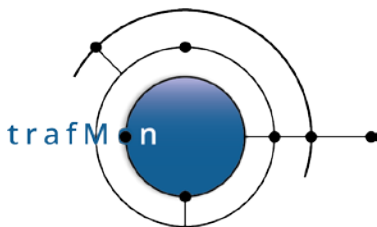
It is assumed that two MySQL user accounts are involved by the trafMon application:

- **tmon_db** (from any host, hence the pattern ``tmon_db@%``) is the read-write account used to create the database with observations, regularly loading the new observations and updating the aggregated persistent tables. Hence it is assigned full privileges on the trafMon databases (those whose name start with 'trafMon', hence the pattern ``trafMon%``),
- **tmon_birt** (from any host, hence the pattern ``tmon_birt@%``) is the unprivileged account used to query the database and execute stored procedure (that could themselves modify the database). Hence it is assigned SELECT/EXECUTE privileges on the trafMon databases (those whose name start with 'trafMon', hence the pattern ``trafMon%``).

1. Choose plain text passwords for `tmon_db` and `tmon_birt`
2. Obtain the ROT13 encoded strings for both password (e.g. via cryptii.com/pipes/rot13)
3. Obtain the BASE64 encoded string for `tmon_birt` (e.g. via cryptii.com/pipes/binary-to-base64 with View as Text)
4. Produce an updated script from `/opt/tmon/trafMon_db/db_users_sample.sql`, by replacing UNPRIVILEGED_PASSWORD and READ/WRITE_PASSWORD by the plain text passwords chosen under point 1 above
5. Create the database users:

```
trafmon % mysql -u root -p < /opt/tmon/trafMon_db/db_users.sql
Enter password:
```

6. Save the user/password for silent use by the trafmon crontab tasks



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Create a private read-only file in home directory of user `trafmon` (with your chosen plain password for `tmon_birt`):

```
trafmon % cat ~/.my.cnf
user=tmon_birt
password= UNPRIVILEGED_PASSWORD
trafmon % chmod 0400 ~/.
```

7. Store the ROT13 passwords to be used by the scripts:

Create a private read-only file `/etc/trafMon/cred/db.cred` with the ROT13 values for `trafMon_loader_pwd =` and for `trafMon_report_pwd =`, by updating `/opt/trafMon/etc/trafMon/cred/db.cred.sample`:

```
trafmon % cat /etc/trafMon/cred/db.cred
[DatabaseURL]
db_name = trafMon
db_url = unix:///var/lib/mysql/mysql.sock
#db_name = trafMon_2
#db_url = tcp://db_server:3306

[TMonloaderCredentials]
trafMon_loader_user = tmon_db
trafMon_loader_pwd = ROT13_OF_PRIVILEGED_PASSWORD

[TMonReportCredentials]
trafMon_report_user = tmon_birt
trafMon_report_pwd = ROT13_OF_UNPRIVILEGED_PASSWORD

trafmon % chmod 0400 /etc/trafMon/cred/db.cred
trafmon % chmod 0500 /etc/trafMon/cred/
```

8. Store the ROT13 passwords to be used by the menu-bar PHP accesses:

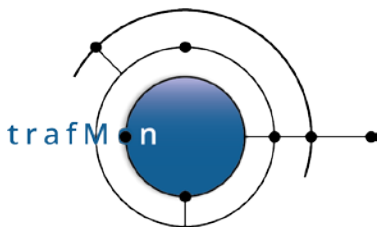
Edit `/var/www/html/trafMon/php/include.php`

9. Update the base64 password used by the BIRT Engine processing the trafMon report templates. As this must be done both for the Tomcat on-demand and for the batch BIRT run-time environments, the best is to modify the `/opt/trafMon/trafMon_reports/` before copying this to Tomcat

In the file

`/opt/trafMon/trafMon_reports/Library/trafMonDb.rptlibrary`, go to the line with `"odaPassword"` ;

and replace the value with your BASE64 encoded password for `tmon_birt` :



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```
<encrypted-property name="odaPassword"
  encryptionID="base64">BASE64_OF_UNPRIVILEGED_PASSWORD==</encrypted-
  property>
```

Then load and populate the database `trafMon_template`:

```
trafmon % cd /opt/trafMon/trafMon_db
trafmon % mysql -u root -p < trafMon_templateDB.sql
```

You can then use <http://localhost/phpmyadmin/> to adapt/complement the list of known TCP and UDP service port numbers and, where applicable, their respective priorities (when the peer port numbers of a flow correspond both to a known service):

Review the table ``protocol_table`` in the database ``trafMon_template``

3.4.4 Install the trafMon BIRT Report Templates in Tomcat Environment

```
# cd /opt/trafMon/
# cp -R trafMon_reports/ /var/lib/tomcat/webapps/birt/
# chown -R tomcat:tomcat /var/lib/tomcat/webapps/birt/
# chmod -R o-rwx /var/lib/tomcat/webapps/birt/trafMon_reports/
```

3.4.5 Configuring /etc/trafMon

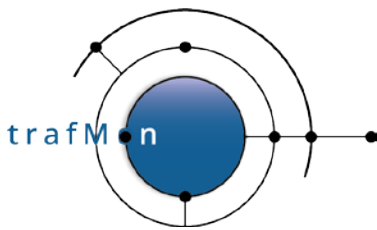
```
# chown -R trafmon:trafmon /etc/trafMon/
# su - trafmon
trafmon% cp /opt/etc/trafMon/xml/tmon.dtd /etc/trafMon/xml/tmon.dtd
```

IMPORTANT: the `tmon.xml` runtime configuration file is common to (all) probe instance(s) and to the central collector; it has been tuned on the initial probe system. It has then to be remotely copied from the probe to the collector system.

```
trafmon% scp probeHost:/etc/trafMon/xml/tmon.xml /etc/trafMon/xml/tmon.xml
```

For further explanations see the *trafMon Configuration and Administration Guide*.

Create a configuration for the tuning of diagnostic trace messages produced by the collector. Its radix name must be that chosen for this trafMon collector instance in the XML configuration file:



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```
trafmon% cp /opt/etc/trafMon/diag/myCollector.diag.sample  
           /etc/trafMon/xml/<collectorname>.diag
```

Structure your own known network universe of IPv4 addresses into ACTIVITIES (a partition of your organisation to which ranges of your IPv4 address space are assigned – this can be business units, departments, projects ... or whatever is meaningful in your own context). Also structure your own known network universe of IPv4 addresses into LOCATIONS (can be a mix of sites, building names, room names as suits your view of the topological distribution of IPv4 address ranges)

This is a rather tedious work that will involve potentially many people for numerous sections of your organisation, but it will widely influence the meaningfulness of the produced trafMon synthesis reports.

Create a file `/etc/trafMon/ipInfo.ini` file, derived from the provided example `/opt/trafMon/etc/trafMon/ipInfo.ini.sample`. For your own IPv4 addresses, the relevant fields are `activity` and `location`. But you could also mention known external IPv4 ranges to which you statically specify the `country` and maybe the `city`.

This file can be maintained/updated at any time during the trafMon operations, as it is reloaded in the database as part of the regular execution of `trafMon_updateIpInfo.py`.

3.4.6 Logrotate

```
# cp /opt/etc/trafMon/trafMon.logrotate.sample /etc/logrotate.d/trafmon
```

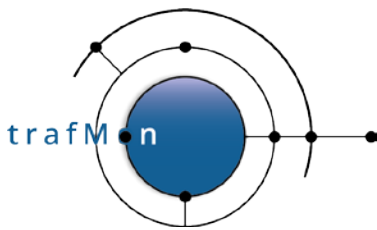
Edit the file `/etc/logrotate.d/trafmon` for number and size of files to keep and the period.

3.4.7 Crontab for root

Look at the `/opt/etc/trafMon/crontab.root.sample` and create a similar one in the crontab for root:

```
# crontab -e
```

Ensure that the MySQL and Tomcat servers are indeed (re)started by the respective commands `/sbin/service mysqld restart` and `/sbin/service tomcat restart`, or replace those strings with the correct command, but keeping the surrounding quotation, so that each command appears as a single argument to the resurrect script.



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3.4.8 Optional Launch of NetFlow SiLK™ Receiver

Create the data spool for SiLK received NetFlow/sFlow/IPFIX record logs.

```
# mkdir -p /var/silk/data
# chown -R trafmon:trafmon /var/silk/
```

Create a file `/usr/local/etc/rwflowpack.conf`, compatible with the version distributed with your SiLK installation (i.e. `/usr/local/share/silk/etc/rwflowpack.conf`), and with the adapted pathnames and other configuration items as in `/opt/trafMon/etc/silk/rwflowpack.conf.sample`

Obtain the list of network devices (source IP addresses and destination UDP/TCP port numbers) that will forward NetFlow v5/v9, sFlow and/or IPFIX packets to your central server. Copy the sample configuration `/opt/trafMon/etc/silk/sensor.conf` to its run-time location and adapt its content to your case of use:

```
trafmon % cp /opt/trafMon/etc/silk/sensor.conf /var/silk/
<edit /var/silk/sensor.conf>
```

Copy the silk distribution file `/usr/local/share/silk/two-way-silk.conf` to its run-time location and, if necessary, increase the number of sensors to fit your case (as in `/opt/trafMon/etc/silk/two-way-silk.conf`):

```
trafmon % cp /usr/local/share/silk/two-way-silk.conf /var/silk/
<add missing sensors to /var/silk/two-way-silk.conf>
```

If it isn't yet, copy the `rwflowpack` start/stop script to `/etc/init.d` and specify its auto-start runlevels:

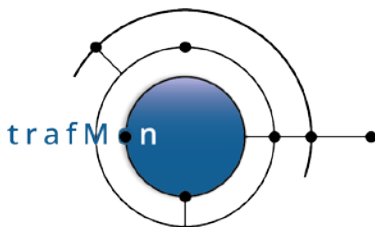
```
# [ ! -x /etc/init.d/rwflowpack ] && install -m 0700 -o root -g root
    /usr/local/share/silk/etc/init.d/rwflowpack
/etc/init.d/rwflowpack
# sed -I -e "s/^# chkconfig: - /# chkconfig: 345 /"
```

And start the `rwflowpack` receiver:

```
# service rwflowpack start
```

The process must run under account `trafmon`. When NetFlow records are delivered to the correct TCP/UDP port number, log files must be created and updated under `/var/silk/data/ext2ext/YYYY/`

```
# du -a /var/silk/data/
...
```



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3.4.9 Crontab for trafmon account, and Launch of tmon_collector

First you have to create the location where the tmon_collector observations log will be created, as well as the directory for batch PDF reports.

```
# mkdir /var/trafMon/{collector,reports}
# chown -R trafmon:trafmon /var/trafMon/
```

The provided template **crontab.trafmon.sample** is rather complete. It is perhaps best to comment some lines and gain experience with the product behaviour in order to be able to adapt the correct tuning of the schedule of auxiliary tasks.

The most important, initially is the automatic launch and restart of the tmon_collector (line with `trafMon_serverResurrect.sh`), where the proper name of the collector instance must replace the `TMonServer`. So start with only this line being commented-out in the crontab for user trafmon:

```
trafmon % crontab -e
<adapt and activate the trafMon_serverResurrect.sh task executed every
minute>
```

Then activate the task with **trafMon_probeResurrect.sh** in the crontab for user trafmon, remotely for (every) probe system.

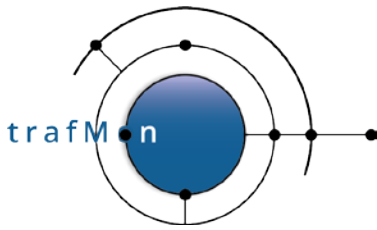
You should see the observations files created and gradually populated under `/var/trafMon/collector/`. Also look at the log file `/var/log/trafmon/collector.log` (and on the probe system(s), at `/var/log/trafmon/probe.log`)

Thereafter, you can activate the regular data loading in the database, e.g. every 10 minutes:

```
trafmon % crontab -e
<uncomment the line with trafMon_loader.py then trafMon_updateIpInfo.py -p
>
```

Use the *phpMyAdmin* to verify that

1. the database (e.g. trafMon) has been created,
2. and it is populated with tables that contain aggregated detailed protocol observations and discovered flows.

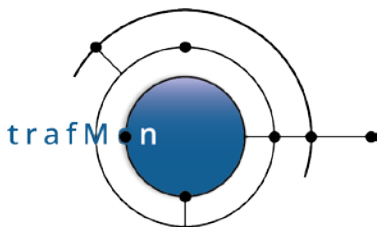


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Follow the activity in `/var/log/trafmon/loader.log`.

Here you should be able to generate the detail reports, via the menu bar.

Note: the aggregation over activities/locations, needed for producing the synthesis reports is only executed once per day. So those reports will only be available starting from the second day of work.



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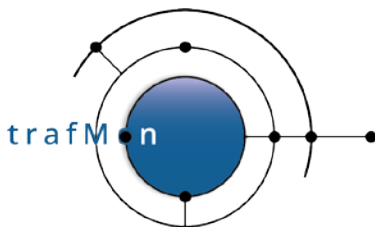
4. APPENDICES

For information, guiding you in installing your probes and central collector systems, the following sections present reference list of packages that have been previously installed on CentOS 7.3 systems respectively supporting the probes and the central collector-database-reporting systems

4.1 CENTOS 7.3 PACKAGE LIST FOR PROBE SYSTEMS

- dejavu-sans-fonts-2.33-6.el7.noarch
- audit-2.4.1-5.el7.x86_64
- filesystem-3.2-20.el7.x86_64
- libXv-1.0.10-2.el7.x86_64
- microcode_ctl-2.1-12.el7.x86_64
- ncurses-base-5.9-13.20130511.el7.noarch
- xorg-x11-utils-7.5-13.1.el7.x86_64
- parted-3.1-23.el7.x86_64
- nss-softokn-freebl-3.16.2.3-13.el7_1.x86_64
- iptables-services-1.4.21-16.el7.x86_64
- authconfig-6.2.8-10.el7.x86_64
- libstdc4.8.5-4.el7.x86_64
- vim-filesystem-7.4.160-1.el7.x86_64
- xfsprogs-3.2.2-2.el7.x86_64
- pcre-8.32-15.el7.x86_64
- xorg-x11-fonts-100dpi-7.5-9.el7.noarch
- tar-1.26-29.el7.x86_64
- audit-libs-2.4.1-5.el7.x86_64
- libsemanage-python-2.1.10-18.el7.x86_64
- libsysfs-2.1.0-16.el7.x86_64
- nspr-4.10.8-2.el7_1.x86_64
- setools-libs-3.3.7-46.el7.x86_64
- rootfiles-8.1-11.el7.noarch
- libdb-5.3.21-19.el7.x86_64
- glibc-common-2.17-106.el7_2.4.x86_64
- iwl5000-firmware-8.83.5.1_1-43.el7.noarch
- gawk-4.0.2-4.el7.x86_64
- device-mapper-1.02.107-5.el7_2.1.x86_64
- iwl6000g2b-firmware-17.168.5.2-43.el7.noarch
- libffi-3.0.13-16.el7.x86_64
- python-perf-3.10.0-327.10.1.el7.x86_64
- iwl6000-firmware-9.221.4.1-43.el7.noarch
- libgcrypt-1.5.3-12.el7_1.1.x86_64
- glibc-headers-2.17-106.el7_2.4.x86_64
- iwl7260-firmware-22.0.7.0-43.el7.noarch
- pll-kit-0.20.7-3.el7.x86_64
- tuned-2.5.1-4.el7_2.2.noarch
- net-tools-2.0-0.17.20131004git.el7.x86_64
- diffutils-3.3-4.el7.x86_64
- kexec-tools-2.0.7-38.el7_2.1.x86_64
- kernel-3.10.0-327.10.1.el7.x86_64
- nss-sysinit-3.19.1-19.el7_2.x86_64

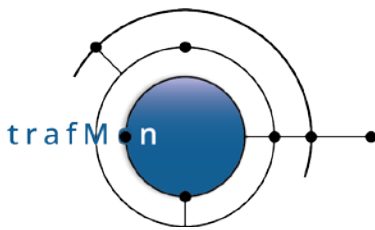
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- grub2-tools-2.02-0.34.el7.centos.x86_64
- e2fsprogs-libs-1.42.9-7.el7.x86_64
- dump-0.4-0.22.b44.el7.x86_64
- grub2-2.02-0.34.el7.centos.x86_64
- libunistring-0.9.3-9.el7.x86_64
- nss-tools-3.19.1-19.el7_2.x86_64
- newt-0.52.15-4.el7.x86_64
- kernel-3.10.0-327.4.4.el7.x86_64
- libdaemon-0.14-7.el7.x86_64
- keyutils-libs-1.5.8-3.el7.x86_64
- zlib-devel-1.2.7-15.el7.x86_64
- less-458-9.el7.x86_64
- elfutils-devel-0.163-3.el7.x86_64
- pkgconfig-0.27.1-4.el7.x86_64
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- perl-Text-ParseWords-3.29-4.el7.noarch
- acl-2.2.51-12.el7.x86_64
- perl-Time-HiRes-1.9725-3.el7.x86_64
- mozjs17-17.0.0-12.el7.x86_64
- perl-Filter-1.49-3.el7.x86_64
- libselinux-utils-2.2.2-6.el7.x86_64
- perl-Time-Local-1.2300-2.el7.noarch
- libmodman-2.0.1-8.el7.x86_64
- perl-File-Temp-0.23.01-3.el7.noarch
- compat-glibc-2.12-4.el7.centos.x86_64
- perl-Getopt-Long-2.40-2.el7.noarch
- libverto-0.2.5-4.el7.x86_64
- perl-ExtUtils-Manifest-1.61-244.el7.noarch
- xz-devel-5.1.2-12alpha.el7.x86_64
- libblkid-2.23.2-26.el7.x86_64
- libthai-0.1.14-9.el7.x86_64
- dbus-python-1.1.1-9.el7.x86_64
- systemtap-sdt-devel-2.8-10.el7.x86_64
- fontpackages-filesystem-1.44-8.el7.noarch
- gettext-0.18.2.1-4.el7.x86_64
- rpm-devel-4.11.3-17.el7.x86_64
- grubby-8.28-17.el7.x86_64
- libsepol-devel-2.1.9-3.el7.x86_64



An open source network traffic performance monitoring and diagnostics tool.

- newt-python-0.52.15-4.el7.x86_64
- tcp_wrappers-devel-7.6-77.el7.x86_64
- python-slip-0.4.0-2.el7.noarch
- libxcb-1.11-4.el7.x86_64
- libXfixes-5.0.1-2.1.el7.x86_64
- NetworkManager-libnm-1.0.6-27.el7.x86_64
- libXrandr-1.4.2-2.el7.x86_64
- libXinerama-1.1.3-2.1.el7.x86_64
- fipscheck-1.4.1-5.el7.x86_64
- mesa-libGL-10.6.5-3.20150824.el7.x86_64
- rpm-libs-4.11.3-17.el7.x86_64
- perl-ExtUtils-MakeMaker-6.68-3.el7.noarch
- util-linux-2.23.2-26.el7.x86_64
- cups-libs-1.6.3-22.el7.x86_64
- dhcp-common-4.2.5-42.el7.centos.x86_64
- gtk2-2.24.28-8.el7.x86_64
- lsscsi-0.27-3.el7.x86_64
- net-snmp-devel-5.7.2-24.el7.x86_64
- iptables-1.4.21-16.el7.x86_64
- libpcap-devel-1.5.3-8.el7.x86_64
- kmod-20-5.el7.x86_64
- libgnome-keyring-3.8.0-3.el7.x86_64
- iputils-20121221-7.el7.x86_64
- git-1.8.3.1-6.el7.x86_64
- cronie-anacron-1.4.11-14.el7.x86_64
- libcollection-0.6.2-25.el7.x86_64
- rpcbind-0.2.0-33.el7_2.x86_64
- hwdata-0.252-8.1.el7.x86_64
- libevent-2.0.21-4.el7.x86_64
- plymouth-0.8.9-0.24.20140113.el7.centos.x86_64
- tcp_wrappers-7.6-77.el7.x86_64
- libsoup-2.48.1-3.el7.x86_64
- libmpc-1.0.1-3.el7.x86_64
- ebttables-2.0.10-13.el7.x86_64
- bind-license-9.9.4-29.el7_2.2.noarch
- libndp-1.2-4.el7.x86_64
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- dmidecode-2.12-9.el7.x86_64
- pth-2.0.7-23.el7.x86_64
- libICE-1.0.9-2.el7.x86_64
- gpgme-1.3.2-5.el7.x86_64
- libXmu-1.1.2-2.el7.x86_64
- libXxf86misc-1.0.3-7.1.el7.x86_64
- xorg-x11-fonts-ISO8859-1-100dpi-7.5-9.el7.noarch
- xorg-x11-xinit-1.3.4-1.el7.x86_64
- gdb-7.6.1-80.el7.x86_64
- firewallld-0.3.9-14.el7.noarch
- libgcc-4.8.5-4.el7.x86_64
- kernel-3.10.0-327.el7.x86_64
- setup-2.8.71-6.el7.noarch
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- kbd-misc-1.15.5-11.el7.noarch
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- iprutils-2.4.8-1.el7.x86_64
- xz-libs-5.1.2-12alpha.el7.x86_64
- passwd-0.79-4.el7.x86_64

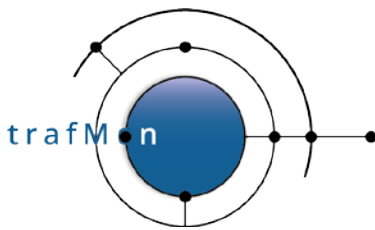
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- libsepol-2.1.9-3.el7.x86_64
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- libselinux-2.2.2-6.el7.x86_64
- openssl098e-0.9.8e-29.el7.centos.2.x86_64
- info-5.1-4.el7.x86_64
- sed-4.2.2-5.el7.x86_64
- audit-libs-python-2.4.1-5.el7.x86_64
- compat-libcap1-1.10-7.el7.x86_64
- libcom_err-1.42.9-7.el7.x86_64
- compat-libgfortran-41-4.1.2-44.el7.x86_64
- popt-1.13-16.el7.x86_64
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- nss-util-3.19.1-4.el7_1.x86_64
- iwl13945-firmware-15.32.2.9-43.el7.noarch
- grep-2.20-2.el7.x86_64
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- dbus-libs-1.6.12-13.el7.x86_64
- iwl6000g2a-firmware-17.168.5.3-43.el7.noarch
- readline-6.2-9.el7.x86_64
- iwl7265-firmware-22.0.7.0-43.el7.noarch
- libgpg-error-1.12-3.el7.x86_64
- ivtv-firmware-20080701-26.el7.noarch
- libattr-2.4.46-12.el7.x86_64
- iwl2030-firmware-18.168.6.1-43.el7.noarch
- libcap-2.22-8.el7.x86_64
- iwl135-firmware-18.168.6.1-43.el7.noarch
- cpio-2.11-24.el7.x86_64
- iwl1000-firmware-39.31.5.1-43.el7.noarch
- libnl3-3.2.21-10.el7.x86_64
- iwl5150-firmware-8.24.2.2-43.el7.noarch
- elfutils-libs-0.163-3.el7.x86_64
- gpg-pubkey-f4a80eb5-53a7ff4b
- lua-5.1.4-14.el7.x86_64
- epel-release-7-5.noarch
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- libcap-ng-0.7.5-4.el7.x86_64
- dracut-033-360.el7_2.x86_64
- libidn-1.28-4.el7.x86_64
- nss-3.19.1-19.el7_2.x86_64
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- libassuan-2.1.0-3.el7.x86_64
- aide-0.15.1-9.el7.x86_64
- libxml2-2.9.1-6.el7_2.2.x86_64
- groff-base-1.22.2-8.el7.x86_64
- rmt-1.5.2-13.el7.x86_64
- libgomp-4.8.5-4.el7.x86_64
- openssl-libs-1.0.1e-51.el7_2.4.x86_64
- xz-5.1.2-12alpha.el7.x86_64
- openssl-1.0.1e-51.el7_2.4.x86_64
- slang-2.2.4-11.el7.x86_64
- sysvinit-tools-2.88-14.ds.f.el7.x86_64
- rdma-7.2.4.1_rc6-2.el7.noarch
- tcp_wrappers-libs-7.6-77.el7.x86_64
- dracut-network-033-360.el7_2.x86_64
- ethtool-3.15-2.el7.x86_64
- libpng12-1.2.50-7.el7_2.x86_64



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- pciutils-libs-3.2.1-4.el7.x86_64
- lm_sensors-libs-3.3.4-11.el7.x86_64
- libtasn1-3.8-2.el7.x86_64
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- gdbm-1.10-8.el7.x86_64
- elfutils-libelf-devel-0.163-3.el7.x86_64
- libteam-1.17-5.el7.x86_64
- libpng-1.5.13-7.el7_2.x86_64
- glib2-2.42.2-5.el7.x86_64
- mesa-libgbm-10.6.5-3.20150824.el7.x86_64
- shared-mime-info-1.1-9.el7.x86_64
- perl-parent-0.225-244.el7.noarch
- libcroco-0.6.8-5.el7.x86_64
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- gobject-introspection-1.42.0-1.el7.x86_64
- perl-Pod-Escapes-1.04-286.el7.noarch
- vim-minimal-7.4.160-1.el7.x86_64
- perl-Encode-2.51-7.el7.x86_64
- perl-libs-5.16.3-286.el7.x86_64
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- libss-1.42.9-7.el7.x86_64
- perl-Carp-1.26-244.el7.noarch
- kmod-libs-20-5.el7.x86_64
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- freetype-2.4.11-11.el7.x86_64
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- perl-Socket-2.010-3.el7.x86_64
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- perl-Pod-Simple-3.28-4.el7.noarch
- compat-glibc-headers-2.12-4.el7.centos.x86_64
- perl-File-Path-2.09-2.el7.noarch
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- perl-Data-Dumper-2.145-3.el7.x86_64
- perl-Test-Harness-3.28-3.el7.noarch
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- libtiff-4.0.3-14.el7.x86_64
- python-2.7.5-34.el7.x86_64
- emacsfilesystem-24.3-18.el7.noarch
- gzip-1.5-8.el7.x86_64
- xdg-utils-1.1.0-0.16.20120809git.el7.noarch
- python-decorator-3.4.0-3.el7.noarch
- cracklib-dicts-2.9.0-11.el7.x86_64
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- harfbuzz-0.9.36-1.el7.x86_64
- libmount-2.23.2-26.el7.x86_64
- fontconfig-2.10.95-7.el7.x86_64
- pyobject3-base-3.14.0-3.el7.x86_64
- popt-devel-1.13-16.el7.x86_64
- plymouth-core-libs-0.8.9-0.24.20140113.el7.centos.x86_64

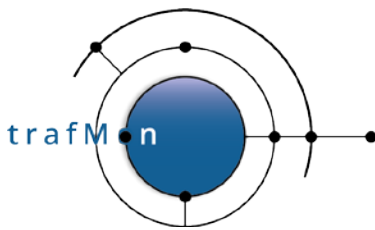
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- libX11-common-1.6.3-2.el7.noarch
- yum-metadata-parser-1.1.4-10.el7.x86_64
- libcom_err-devel-1.42.9-7.el7.x86_64
- libselinux-python-2.2.2-6.el7.x86_64
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- python-slip-dbus-0.4.0-2.el7.noarch
- libXau-1.0.8-2.1.el7.x86_64
- libutempter-1.1.6-4.el7.x86_64
- alsa-lib-1.0.28-2.el7.x86_64
- binutils-2.23.52.0.1-55.el7.x86_64
- fipscheck-lib-1.4.1-5.el7.x86_64
- libssh2-1.4.3-10.el7.x86_64
- curl-7.29.0-25.el7.centos.x86_64
- rpm-4.11.3-17.el7.x86_64
- libuser-0.60-7.el7_1.x86_64
- policycoreutils-2.2.5-20.el7.x86_64
- dhcp-libs-4.2.5-42.el7.centos.x86_64
- python-urlgrabber-3.10-7.el7.noarch
- hardlink-1.0-19.el7.x86_64
- libnetfilter_conntrack-1.0.4-2.el7.x86_64
- iproute-3.10.0-54.el7.x86_64
- kpartx-0.4.9-85.el7.x86_64
- initscripts-9.49.30-1.el7.x86_64
- polkit-pkla-compat-0.1-4.el7.x86_64
- cronie-1.4.11-14.el7.x86_64
- os-prober-1.58-5.el7.x86_64
- dnsmasq-2.66-14.el7_1.x86_64
- ppp-2.4.5-33.el7.x86_64
- libpciaccess-0.13.4-2.el7.x86_64
- plymouth-scripts-0.8.9-0.24.20140113.el7.centos.x86_64
- trousers-0.3.13-1.el7.x86_64
- glib-networking-2.42.0-1.el7.x86_64
- fxload-2002_04_11-16.el7.x86_64
- alsa-tools-firmware-1.0.28-2.el7.x86_64
- libjpeg-turbo-1.2.90-5.el7.x86_64
- json-c-0.11-4.el7_0.x86_64
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- virt-what-1.13-6.el7.x86_64
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- pygpgme-0.3-9.el7.x86_64
- libXt-1.1.4-6.1.el7.x86_64
- yum-3.4.3-132.el7.centos.0.1.noarch
- libXaw-1.0.12-5.el7.x86_64
- libXp-1.0.2-2.1.el7.x86_64
- xorg-x11-server-utils-7.7-14.el7.x86_64
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- rsyslog-7.4.7-12.el7.x86_64
- compat-libtiff3-3.9.4-11.el7.x86_64
- dejavu-fonts-common-2.33-6.el7.noarch
- gnuplot-4.6.2-3.el7.x86_64
- xorg-x11-apps-7.7-6.el7.x86_64



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- libXtst-1.2.2-2.1.el7.x86_64
- libdmx-1.1.3-3.el7.x86_64
- ddd-3.3.12-20.el7.x86_64
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- vim-common-7.4.160-1.el7.x86_64
- xorg-x11-fonts-Type1-7.5-9.el7.noarch
- xorg-x11-fonts-misc-7.5-9.el7.noarch
- python-IPy-0.75-6.el7.noarch
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- device-mapper-libs-1.02.107-5.el7_2.1.x86_64
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- gd-2.0.35-26.el7.x86_64
- motif-2.3.4-7.el7.x86_64
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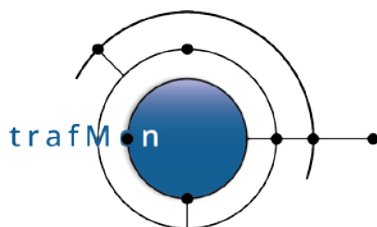
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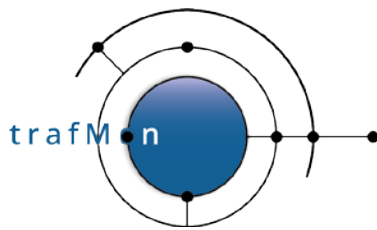
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- abrt-desktop-2.1.11-45.el7.centos.x86_64
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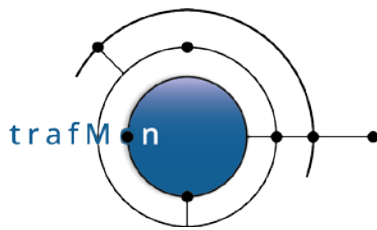
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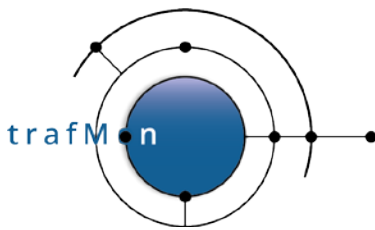
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- dmraid-events-1.0.0.rc16-28.el7.x86_64
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- dosfstools-3.0.20-9.el7.x86_64
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- dracut-network-033-463.el7_3.2.x86_64
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- elfutils-0.166-2.el7.x86_64
- elfutils-devel-0.166-2.el7.x86_64
- elfutils-libelf-0.163-3.el7.x86_64
- elfutils-libelf-0.166-2.el7.i686
- elfutils-libelf-0.166-2.el7.x86_64
- elfutils-libelf-devel-0.166-2.el7.x86_64
- elfutils-libs-0.163-3.el7.x86_64
- elfutils-libs-0.166-2.el7.x86_64
- emacs-filesystem-24.3-19.el7_3.noarch
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- enchant-1.6.0-8.el7.x86_64
- enscript-1.6.6-6.el7.x86_64
- eog-3.14.3-1.el7.x86_64
- epel-release-7-7.noarch
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- ethtool-4.5-3.el7.x86_64
- evince-3.14.2-17.el7.x86_64
- evince-libs-3.14.2-17.el7.x86_64



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- evolution-data-server-3.12.11-37.el7.x86_64
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- expat-2.1.0-8.el7.x86_64
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- factseo@delhi's password:
- factseo@delhi ~\$ ssh 141.253.14.70
- factseo@factseo-ctrl ~\$ su
- farstream-0.1.2-8.el7.x86_64
- farstream02-0.2.3-3.el7.x86_64
- fcoe-utils-1.0.31-1.git5dfd3e4.el7_3.1.x86_64
- festival-1.96-28.el7.x86_64
- festival-freebsoft-utils-0.10-7.el7.noarch
- festival-lib-1.96-28.el7.x86_64
- festival-speechtools-libs-1.2.96-28.el7.x86_64
- festvox-slt-arctic-hts-0.20061229-28.el7.noarch
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- file-5.11-33.el7.x86_64
- file-libs-5.11-31.el7.x86_64
- file-libs-5.11-33.el7.x86_64
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- file-roller-nautilus-3.14.2-10.el7.x86_64
- filesystem-3.2-20.el7.x86_64
- filesystem-3.2-21.el7.x86_64
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- fipscheck-lib-1.4.1-5.el7.x86_64
- firefox-52.2.0-1.el7.centos.x86_64
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- folks-0.10.1-2.el7.x86_64
- fontconfig-2.10.95-10.el7.x86_64
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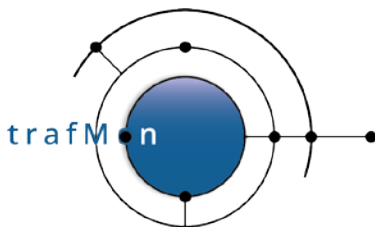
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- glib2-2.46.2-4.el7.x86_64
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- glib2-devel-2.46.2-4.el7.x86_64
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- glibc-headers-2.17-157.el7_3.4.x86_64
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- glusterfs-libs-3.7.9-12.el7.centos.x86_64
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- gnome-abrt-0.3.4-8.el7.x86_64
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- gnome-bluetooth-3.14.1-1.el7.x86_64
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- gnome-boxes-3.14.3.1-10.el7.x86_64
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- gnome-clocks-3.14.1-2.el7.x86_64
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- gnome-contacts-3.14.2-4.el7.x86_64
- gnome-desktop3-3.14.2-2.el7.x86_64
- gnome-dictionary-3.14.2-2.el7.x86_64
- gnome-disk-utility-3.14.0-2.el7.x86_64



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- gnome-font-viewer-3.14.1-4.el7.x86_64
- gnome-getting-started-docs-3.14.1.0.2-3.el7.noarch
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- gnome-icon-theme-extras-3.12.0-1.el7.noarch
- gnome-icon-theme-symbolic-3.12.0-2.el7.noarch
- gnome-initial-setup-3.14.4-5.el7.x86_64
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- gnome-keyring-pam-3.14.0-1.el7.x86_64
- gnome-menus-3.13.3-3.el7.x86_64
- gnome-online-accounts-3.14.5-5.el7.x86_64
- gnome-online-miners-3.14.3-1.el7.x86_64
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- gnome-packagekit-installer-3.14.3-7.el7.x86_64
- gnome-packagekit-updater-3.14.3-7.el7.x86_64
- gnome-screenshot-3.14.0-3.el7.x86_64
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- gnome-session-xsession-3.14.0-5.el7.x86_64
- gnome-settings-daemon-3.14.4-12.el7.x86_64
- gnome-shell-3.14.4-53.el7.x86_64
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- gnome-shell-extension-apps-menu-3.14.4-21.el7.noarch
- gnome-shell-extension-common-3.14.4-21.el7.noarch
- gnome-shell-extension-launch-new-instance-3.14.4-21.el7.noarch
- gnome-shell-extension-places-menu-3.14.4-21.el7.noarch
- gnome-shell-extension-window-list-3.14.4-21.el7.noarch
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- gnome-system-monitor-3.14.1-4.el7.x86_64
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- gnome-weather-3.14.1-1.el7.noarch
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- gnu-free-sans-fonts-20120503-8.el7.noarch
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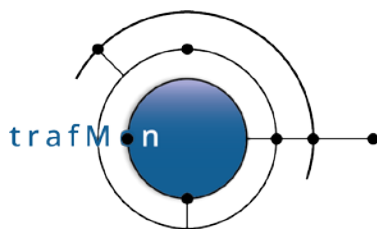
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- gsettings-desktop-schemas-3.14.2-1.el7.x86_64
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- gupnp-0.20.13-1.el7.x86_64
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- gutenprint-5.2.9-18.el7.x86_64
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- gvfs-1.22.4-8.el7.x86_64
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- gvfs-archive-1.22.4-8.el7.x86_64
- gvfs-fuse-1.22.4-8.el7.x86_64
- gvfs-goa-1.22.4-8.el7.x86_64
- gvfs-gphoto2-1.22.4-8.el7.x86_64
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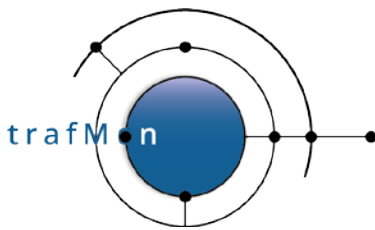
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- iwll5150-firmware-8.24.2.2-49.el7.noarch
- iwll6000-firmware-9.221.4.1-49.el7.noarch
- iwll6000g2a-firmware-17.168.5.3-49.el7.noarch
- iwll6000g2b-firmware-17.168.5.2-49.el7.noarch
- iwll6050-firmware-41.28.5.1-49.el7.noarch
- iwll7260-firmware-22.0.7.0-49.el7.noarch
- iwll7265-firmware-22.0.7.0-49.el7.noarch
- jakarta-taglibs-standard-1.1.2-14.el7_1.noarch
- jansson-2.4-6.el7.x86_64
- jasper-libs-1.900.1-30.el7_3.x86_64
- java-1.7.0-openjdk-1.7.0.141-2.6.10.1.el7_3.x86_64
- java-1.7.0-openjdk-headless-1.7.0.141-2.6.10.1.el7_3.x86_64
- java-1.8.0-openjdk-1.8.0.131-3.b12.el7_3.x86_64
- java-1.8.0-openjdk-headless-1.8.0.131-3.b12.el7_3.x86_64
- javamail-1.4.6-8.el7.noarch
- javapackages-tools-3.4.1-11.el7.noarch
- jbigkit-libs-2.0-11.el7.x86_64
- jline-1.0-8.el7.noarch
- jomolhari-fonts-0.003-17.el7.noarch
- json-c-0.11-4.el7_0.x86_64
- json-glib-1.0.2-1.el7.x86_64
- kbd-1.15.5-12.el7.x86_64
- kbd-legacy-1.15.5-12.el7.noarch
- kbd-misc-1.15.5-12.el7.noarch
- kernel-3.10.0-327.10.1.el7.x86_64
- kernel-3.10.0-327.22.2.el7.x86_64
- kernel-3.10.0-327.4.4.el7.x86_64
- kernel-3.10.0-327.4.5.el7.x86_64
- kernel-3.10.0-514.26.1.el7.x86_64
- kernel-headers-3.10.0-514.26.1.el7.x86_64
- kernel-tools-3.10.0-514.26.1.el7.x86_64
- kernel-tools-libs-3.10.0-514.26.1.el7.x86_64
- kexec-tools-2.0.7-50.el7.x86_64
- keybinder3-0.3.0-1.el7.x86_64
- keyutils-1.5.8-3.el7.x86_64



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- keyutils-libs-1.5.8-3.el7.x86_64
- keyutils-libs-devel-1.5.8-3.el7.x86_64
- khmeros-base-fonts-5.0-17.el7.noarch
- khmeros-fonts-common-5.0-17.el7.noarch
- kmod-20-5.el7.x86_64
- kmod-20-9.el7.x86_64
- kmod-libs-20-5.el7.x86_64
- kmod-libs-20-9.el7.x86_64
- kpartx-0.4.9-99.el7_3.3.x86_64
- kpatch-0.3.2-1.el7.noarch
- krb5-devel-1.14.1-27.el7_3.x86_64
- krb5-libs-1.13.2-12.el7_2.x86_64
- krb5-libs-1.14.1-27.el7_3.x86_64
- krb5-workstation-1.14.1-27.el7_3.x86_64
- langtable-0.0.31-3.el7.noarch
- langtable-data-0.0.31-3.el7.noarch
- langtable-python-0.0.31-3.el7.noarch
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- ldns-1.6.16-10.el7.x86_64
- ledmon-0.79-4.el7.x86_64
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- libabw-0.1.1-2.el7.x86_64
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- libaio-0.3.109-13.el7.x86_64
- libao-1.1.0-8.el7.x86_64
- libappstream-glib-0.3.6-1.el7.x86_64
- libarchive-3.1.2-10.el7_2.x86_64
- libassuan-2.1.0-3.el7.x86_64
- libasyncns-0.8-7.el7.x86_64
- libatasmart-0.19-6.el7.x86_64
- libattr-2.4.46-12.el7.x86_64
- libavc1394-0.5.3-14.el7.x86_64
- libbasicobjects-0.1.1-27.el7.x86_64
- libblkid-2.23.2-33.el7_3.2.x86_64
- libbluray-0.2.3-5.el7.x86_64
- libcacard-2.5.2-2.el7.x86_64
- libcanberra-0.30-5.el7.x86_64
- libcanberra-gtk2-0.30-5.el7.x86_64
- libcanberra-gtk3-0.30-5.el7.x86_64
- libcap-2.22-8.el7.x86_64
- libcap-ng-0.7.5-4.el7.x86_64
- libcdio-0.92-1.el7.x86_64
- libcdio-paranoia-10.2+0.90-11.el7.x86_64
- libcdr-0.1.1-1.el7.x86_64
- libcgrouper-0.41-11.el7.x86_64
- libcgrouper-tools-0.41-11.el7.x86_64
- libchamplain-0.12.4-5.el7.x86_64
- libchamplain-gtk-0.12.4-5.el7.x86_64
- libchewing-0.3.4-6.el7.x86_64
- libcmis-0.5.1-2.el7.x86_64
- libcollection-0.6.2-27.el7.x86_64
- libcom_err-1.42.9-7.el7.x86_64
- libcom_err-1.42.9-9.el7.x86_64
- libcom_err-devel-1.42.9-9.el7.x86_64
- libconfig-1.4.9-5.el7.x86_64
- libcroco-0.6.8-5.el7.x86_64
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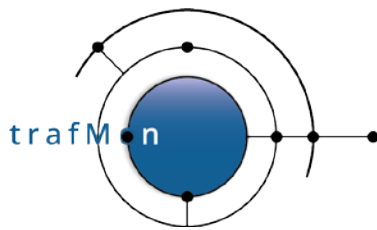
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- libdnet-1.12-13.1.el7.x86_64
- libdrm-2.4.67-3.el7.x86_64
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- libdvnav-5.0.3-1.el7.x86_64
- libdvread-5.0.3-3.el7.x86_64
- libdwarf-20130207-4.el7.x86_64
- libedit-3.0-12.20121213cvs.el7.x86_64
- libepoxy-1.2-2.el7.x86_64
- liberation-fonts-common-1.07.2-15.el7.noarch
- liberation-mono-fonts-1.07.2-15.el7.noarch
- liberation-sans-fonts-1.07.2-15.el7.noarch
- liberation-serif-fonts-1.07.2-15.el7.noarch
- libestr-0.1.9-2.el7.x86_64
- libetonyek-0.1.2-4.el7.x86_64
- libevdev-1.4.1-1.el7.x86_64
- libevent-2.0.21-4.el7.x86_64
- libexif-0.6.21-6.el7.x86_64
- libexttextcat-3.4.1-3.el7.x86_64
- libffi-3.0.13-16.el7.x86_64
- libffi-3.0.13-18.el7.i686
- libffi-3.0.13-18.el7.x86_64
- libfixbuf-1.7.1-1.el6.x86_64
- libfixbuf-devel-1.7.1-1.el6.x86_64
- libfontenc-1.1.2-3.el7.x86_64
- libfprint-0.5.0-4.el7.x86_64
- libfreehand-0.1.1-1.el7.x86_64
- libgcc-4.8.5-11.el7.i686
- libgcc-4.8.5-11.el7.x86_64
- libgcc-4.8.5-4.el7.x86_64
- libgcrypt-1.5.3-12.el7_1.1.x86_64
- libgcrypt-1.5.3-13.el7_3.1.x86_64
- libgdata-0.17.1-1.el7.x86_64
- libgdither-0.6-8.el7.x86_64
- libgee-0.10.1-3.el7.x86_64
- libgee06-0.6.8-3.el7.x86_64
- libglade2-2.6.4-11.el7.x86_64
- libGLEW-1.10.0-5.el7.x86_64
- libgnomekbd-3.6.0-4.el7.x86_64
- libgnome-keyring-3.8.0-3.el7.x86_64
- libgomp-4.8.5-11.el7.x86_64
- libgovirt-0.3.3-4.el7.x86_64
- libgpg-error-1.12-3.el7.x86_64
- libgphoto2-2.5.2-3.el7.x86_64
- libgsf-1.14.26-7.el7.x86_64
- libgtop2-2.28.4-7.el7.x86_64
- libgudev1-219-30.el7_3.9.x86_64
- libgusb-0.1.6-3.el7.x86_64
- libgweather-3.14.1-3.el7.x86_64
- libgxps-0.2.2-9.el7.x86_64
- libhangul-0.1.0-8.el7.x86_64
- libhbaapi-2.2.9-6.el7.x86_64



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- libhbalinux-1.0.17-2.el7.x86_64
- libibverbs-1.2.1-1.el7.x86_64
- libical-1.0.1-1.el7.x86_64
- libICE-1.0.9-2.el7.x86_64
- libicu-50.1.2-15.el7.x86_64
- libidn-1.28-4.el7.x86_64
- libiec61883-1.2.0-10.el7.x86_64
- libieee1284-0.2.11-15.el7.x86_64
- libimobiledevice-1.1.5-6.el7.x86_64
- libini_config-1.3.0-27.el7.x86_64
- libipa_hbac-1.14.0-43.el7_3.18.x86_64
- libiptcdata-1.0.4-11.el7.x86_64
- libiscsi-1.9.0-7.el7.x86_64
- libjpeg-turbo-1.2.90-5.el7.x86_64
- libkadm5-1.14.1-27.el7_3.x86_64
- libkkc-0.3.1-9.el7.x86_64
- libkkc-common-0.3.1-9.el7.noarch
- libkkc-data-0.3.1-9.el7.x86_64
- liblangtag-0.5.4-8.el7.x86_64
- libldb-1.1.26-1.el7.x86_64
- liblouis-2.5.2-10.el7.x86_64
- liblouis-python-2.5.2-10.el7.noarch
- libmbim-1.14.0-2.el7.x86_64
- libmbim-utils-1.14.0-2.el7.x86_64
- libmediaart-0.7.0-1.el7.x86_64
- libmnl-1.0.3-7.el7.x86_64
- libmodman-2.0.1-8.el7.x86_64
- libmount-2.23.2-33.el7_3.2.x86_64
- libmpc-1.0.1-3.el7.x86_64
- libmpcdec-1.2.6-12.el7.x86_64
- libmspack-0.5-0.4.alpha.el7.x86_64
- libmspub-0.1.2-1.el7.x86_64
- libmtp-1.1.6-5.el7.x86_64
- libmusicbrainz5-5.0.1-9.el7.x86_64
- libmwaw-0.3.5-1.el7.x86_64
- libndp-1.2-7.el7.x86_64
- libnetfilter_conntrack-1.0.6-1.el7_3.x86_64
- libnfnetwork-1.0.1-4.el7.x86_64
- libnfsidmap-0.25-15.el7.x86_64
- libnice-0.1.3-4.el7.x86_64
- libnl-1.1.4-3.el7.x86_64
- libnl3-3.2.28-3.el7_3.x86_64
- libnl3-cli-3.2.28-3.el7_3.x86_64
- libnma-1.4.0-2.el7.x86_64
- libnm-gtk-1.4.0-2.el7.x86_64
- libnotify-0.7.5-8.el7.x86_64
- liboauth-0.9.7-4.el7.x86_64
- libodfgen-0.1.4-1.el7.x86_64
- libofa-0.9.3-24.el7.x86_64
- libogg-1.3.0-7.el7.x86_64
- liborcus-0.7.0-6.el7.x86_64
- libosinfo-0.3.0-3.el7.x86_64
- libpagemaker-0.0.3-1.el7.x86_64
- libpath_utils-0.2.1-27.el7.x86_64
- libpcap-1.5.3-8.el7.x86_64
- libpcap-devel-1.5.3-8.el7.x86_64
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- libpeas-1.12.1-2.el7.x86_64

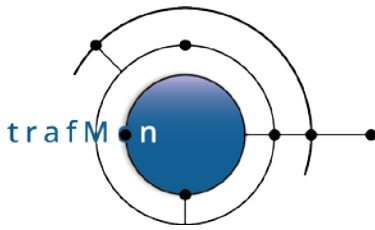
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- libplist-1.10-4.el7.x86_64
- libpng12-1.2.50-10.el7.x86_64
- libpng-1.5.13-7.el7_2.x86_64
- libproxy-0.4.11-10.el7.x86_64
- libproxy-mozjs-0.4.11-10.el7.x86_64
- libpurple-2.10.7-26.el7.x86_64
- libpwquality-1.2.3-4.el7.x86_64
- libqmi-1.16.0-1.el7.x86_64
- libqmi-utils-1.16.0-1.el7.x86_64
- librados2-0.94.5-1.el7.x86_64
- libraw1394-2.1.0-2.el7.x86_64
- librbd1-0.94.5-1.el7.x86_64
- librdmacm-1.1.0-2.el7.x86_64
- libref_array-0.1.5-27.el7.x86_64
- libreoffice-calc-5.0.6.2-5.el7_3.1.x86_64
- libreoffice-core-5.0.6.2-5.el7_3.1.x86_64
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- libreoffice-impress-5.0.6.2-5.el7_3.1.x86_64
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- libreoffice-pdfimport-5.0.6.2-5.el7_3.1.x86_64
- libreoffice-pyuno-5.0.6.2-5.el7_3.1.x86_64
- libreoffice-ure-5.0.6.2-5.el7_3.1.x86_64
- libreoffice-writer-5.0.6.2-5.el7_3.1.x86_64
- libreport-2.1.11-35.el7.centos.x86_64
- libreport-anaconda-2.1.11-35.el7.centos.x86_64
- libreport-centos-2.1.11-35.el7.centos.x86_64
- libreport-cli-2.1.11-35.el7.centos.x86_64
- libreport-filesystem-2.1.11-35.el7.centos.x86_64
- libreport-gtk-2.1.11-35.el7.centos.x86_64
- libreport-plugin-bugzilla-2.1.11-35.el7.centos.x86_64
- libreport-plugin-mailx-2.1.11-35.el7.centos.x86_64
- libreport-plugin-mantisbt-2.1.11-35.el7.centos.x86_64
- libreport-plugin-reportuploader-2.1.11-35.el7.centos.x86_64
- libreport-plugin-rhtsupport-2.1.11-35.el7.centos.x86_64
- libreport-plugin-ureport-2.1.11-35.el7.centos.x86_64
- libreport-python-2.1.11-35.el7.centos.x86_64
- libreport-rhel-anaconda-bugzilla-2.1.11-35.el7.centos.x86_64
- libreport-web-2.1.11-35.el7.centos.x86_64
- libreswan-3.15-8.el7.x86_64
- libvenge-0.0.2-2.el7.x86_64
- librsvg2-2.39.0-1.el7.x86_64
- libsamplerate-0.1.8-6.el7.x86_64
- libsane-hpaio-3.15.9-2.el7.x86_64
- libseccomp-2.3.1-2.el7.x86_64
- libsecret-0.18.2-2.el7.x86_64
- libselinux-2.2.2-6.el7.x86_64



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- libselinux-2.5-6.el7.i686
- libselinux-2.5-6.el7.x86_64
- libselinux-devel-2.5-6.el7.x86_64
- libselinux-python-2.5-6.el7.x86_64
- libselinux-utils-2.5-6.el7.x86_64
- libsemanage-2.1.10-18.el7.x86_64
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- libsemanage-python-2.5-5.1.el7_3.x86_64
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- libsepol-devel-2.5-6.el7.x86_64
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- libSM-1.2.2-2.el7.x86_64
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- libsndfile-1.0.25-10.el7.x86_64
- libsoup-2.48.1-6.el7.x86_64
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- libsss_idmap-1.14.0-43.el7_3.18.x86_64
- libsss_nss_idmap-1.14.0-43.el7_3.18.x86_64
- libsss_sudo-1.14.0-43.el7_3.18.x86_64
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- libstoragegmt-1.3.4-1.el7.x86_64
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- libstoragegmt-python-clibs-1.3.4-1.el7.x86_64
- libsysfs-2.1.0-16.el7.x86_64
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- libtasn1-3.8-3.el7.i686
- libtasn1-3.8-3.el7.x86_64
- libtasn1-devel-3.8-3.el7.i686
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- libtdb-1.3.8-1.el7_2.x86_64
- libteam-1.25-4.el7.x86_64
- libtevent-0.9.28-1.el7.x86_64
- libthai-0.1.14-9.el7.x86_64
- libtheora-1.1.1-8.el7.x86_64
- libtiff-4.0.3-27.el7_3.x86_64
- libtimezonemap-0.4.4-1.el7.x86_64
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- libudisks2-2.1.2-6.el7.x86_64
- libunistring-0.9.3-9.el7.x86_64
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- libusal-1.1.11-23.el7.x86_64
- libusb-0.1.4-3.el7.x86_64
- libusbx-1.0.20-1.el7.x86_64
- libuser-0.60-7.el7_1.x86_64
- libuser-python-0.60-7.el7_1.x86_64

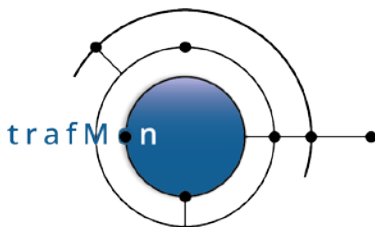
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- libverto-devel-0.2.5-4.el7.x86_64
- libverto-tevent-0.2.5-4.el7.x86_64
- libvirt-client-2.0.0-10.el7_3.9.x86_64
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- libvirt-daemon-config-network-2.0.0-10.el7_3.9.x86_64
- libvirt-daemon-driver-interface-2.0.0-10.el7_3.9.x86_64
- libvirt-daemon-driver-network-2.0.0-10.el7_3.9.x86_64
- libvirt-daemon-driver-nodedev-2.0.0-10.el7_3.9.x86_64
- libvirt-daemon-driver-nwfilter-2.0.0-10.el7_3.9.x86_64
- libvirt-daemon-driver-qemu-2.0.0-10.el7_3.9.x86_64
- libvirt-daemon-driver-secret-2.0.0-10.el7_3.9.x86_64
- libvirt-daemon-driver-storage-2.0.0-10.el7_3.9.x86_64
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- libXinerama-1.1.3-2.1.el7.x86_64
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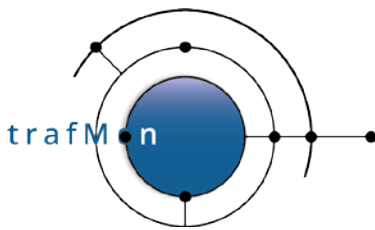
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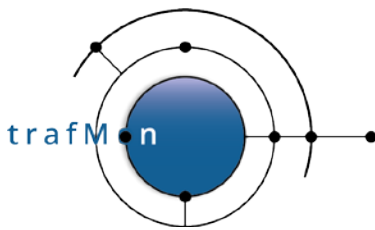
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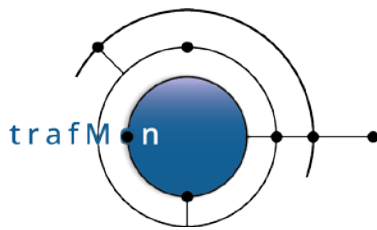
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- polkit-pkla-compat-0.1-4.el7.x86_64
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- poppler-utils-0.26.5-16.el7.x86_64
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- postfix-2.10.1-6.el7.x86_64
- ppp-2.4.5-33.el7.x86_64
- procps-ng-3.3.10-10.el7.x86_64
- procps-ng-3.3.10-5.el7_2.x86_64
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- pygpgme-0.3-9.el7.x86_64
- pygtk2-2.24.0-9.el7.x86_64
- pygtk2-libglade-2.24.0-9.el7.x86_64
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- pyOpenSSL-0.13.1-3.el7.x86_64
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- python2-pyasn1-0.1.9-7.el7.noarch
- python-augeas-0.5.0-2.el7.noarch
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- python-blivet-0.61.15.59-1.el7.noarch
- python-brlapi-0.6.0-13.el7.x86_64
- python-caribou-0.4.16-1.el7.noarch
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- python-configobj-4.7.2-7.el7.noarch
- python-configshell-1.1.fb18-1.el7.noarch
- python-coverage-3.6-0.5.b3.el7.x86_64
- python-cups-1.9.63-6.el7.x86_64
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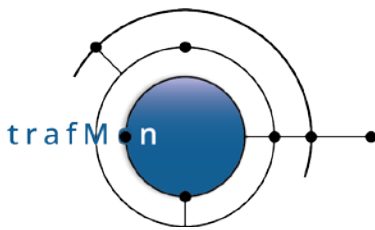
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- qemu-kvm-common-1.5.3-126.el7_3.9.x86_64
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- quota-nls-4.01-14.el7.noarch
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- redhat-rpm-config-9.1.0-68.el7.centos.noarch
- redland-1.0.16-6.el7.x86_64
- rest-0.7.92-5.el7.x86_64
- rfskill-0.4-9.el7.x86_64
- rhino-1.7R4-5.el7.noarch
- rmt-1.5.2-13.el7.x86_64
- rng-tools-5-8.el7.x86_64
- root@factseo-cltr factseo#
- root@factseo-cltr factseo# rpm -a -q
- rootfiles-8.1-11.el7.noarch
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- rpm-4.11.3-21.el7.x86_64
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- rsyslog-7.4.7-16.el7.x86_64
- rsyslog-mmjsonparse-7.4.7-16.el7.x86_64
- rtkit-0.11-10.el7.x86_64
- samba-client-4.4.4-14.el7_3.x86_64
- samba-client-libs-4.4.4-14.el7_3.x86_64
- samba-common-4.4.4-14.el7_3.noarch
- samba-common-libs-4.4.4-14.el7_3.x86_64
- samba-common-tools-4.4.4-14.el7_3.x86_64



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- samba-libs-4.4.4-14.el7_3.x86_64
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- seahorse-3.14.1-1.el7.x86_64
- seavgbios-bin-1.9.1-5.el7_3.3.noarch
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- setup-2.8.71-7.el7.noarch
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- sgabios-bin-0.20110622svn-4.el7.noarch
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- shadow-utils-4.1.5.1-24.el7.x86_64
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- sil-padauk-fonts-2.8-5.el7.noarch
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- speech-dispatcher-0.7.1-15.el7.x86_64
- speech-dispatcher-python-0.7.1-15.el7.x86_64
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- spice-glib-0.31-6.el7_3.2.x86_64
- spice-gtk3-0.31-6.el7_3.2.x86_64
- spice-protocol-0.12.11-1.el7.noarch
- spice-server-0.12.4-20.el7_3.x86_64
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- sssd-client-1.14.0-43.el7_3.18.x86_64
- sssd-common-1.14.0-43.el7_3.18.x86_64
- sssd-common-pac-1.14.0-43.el7_3.18.x86_64
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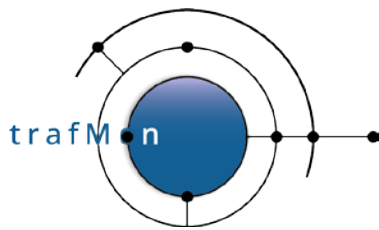
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- tar-1.26-31.el7.x86_64
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- tcpdump-4.5.1-3.el7.x86_64
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- tcp_wrappers-devel-7.6-77.el7.x86_64
- tcp_wrappers-libs-7.6-77.el7.x86_64
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- telepathy-farstream-0.6.0-5.el7.x86_64
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- tomcat-admin-webapps-7.0.69-11.el7_3.noarch
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- tomcat-jsp-2.2-api-7.0.69-11.el7_3.noarch
- tomcat-lib-7.0.69-11.el7_3.noarch
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- tomcat-webapps-7.0.69-11.el7_3.noarch
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- totem-pl-parser-3.10.5-1.el7.x86_64
- traceroute-2.0.22-2.el7.x86_64



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- xmlrpc-c-client-1.32.5-1905.svn2451.el7.x86_64
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- xorg-x11-fonts-75dpi-7.5-9.el7.noarch
- xorg-x11-fonts-cyrillic-7.5-9.el7.noarch
- xorg-x11-fonts-ethiopic-7.5-9.el7.noarch
- xorg-x11-fonts-ISO8859-1-100dpi-7.5-9.el7.noarch
- xorg-x11-fonts-ISO8859-14-100dpi-7.5-9.el7.noarch
- xorg-x11-fonts-ISO8859-14-75dpi-7.5-9.el7.noarch
- xorg-x11-fonts-ISO8859-15-100dpi-7.5-9.el7.noarch
- xorg-x11-fonts-ISO8859-15-75dpi-7.5-9.el7.noarch
- xorg-x11-fonts-ISO8859-1-75dpi-7.5-9.el7.noarch
- xorg-x11-fonts-ISO8859-2-100dpi-7.5-9.el7.noarch
- xorg-x11-fonts-ISO8859-2-75dpi-7.5-9.el7.noarch
- xorg-x11-fonts-ISO8859-9-100dpi-7.5-9.el7.noarch
- xorg-x11-fonts-ISO8859-9-75dpi-7.5-9.el7.noarch
- xorg-x11-fonts-misc-7.5-9.el7.noarch
- xorg-x11-fonts-Typel-7.5-9.el7.noarch
- xorg-x11-font-utils-7.5-20.el7.x86_64
- xorg-x11-server-utils-7.7-14.el7.x86_64
- xorg-x11-utils-7.5-14.el7.x86_64
- xorg-x11-xauth-1.0.9-1.el7.x86_64
- xorg-x11-xbitmaps-1.1.1-6.el7.noarch
- xorg-x11-xinit-1.3.4-1.el7.x86_64
- xorg-x11-xkb-utils-7.7-12.el7.x86_64
- xterm-295-3.el7.x86_64
- xvattr-1.3-27.el7.x86_64
- xz-5.1.2-12alpha.el7.x86_64
- xz-5.2.2-1.el7.x86_64
- xz-devel-5.2.2-1.el7.x86_64
- xz-libs-5.1.2-12alpha.el7.x86_64
- xz-libs-5.2.2-1.el7.i686
- xz-libs-5.2.2-1.el7.x86_64
- yajl-2.0.4-4.el7.x86_64
- yelp-3.14.2-1.el7.x86_64
- yelp-libs-3.14.2-1.el7.x86_64
- yelp-xsl-3.14.0-1.el7.noarch
- yum-3.4.3-132.el7.centos.0.1.noarch
- yum-3.4.3-150.el7.centos.noarch
- yum-langpacks-0.4.2-7.el7.noarch
- yum-metadata-parser-1.1.4-10.el7.x86_64
- yum-plugin-fastestmirror-1.1.31-34.el7.noarch
- yum-plugin-fastestmirror-1.1.31-40.el7.noarch
- yum-utils-1.1.31-40.el7.noarch
- zenity-3.8.0-5.el7.x86_64
- zip-3.0-10.el7.x86_64
- zip-3.0-11.el7.x86_64
- zlib-1.2.7-15.el7.x86_64



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- `zlib-1.2.7-17.el7.i686`
- `zlib-1.2.7-17.el7.x86_64`
- `zlib-devel-1.2.7-17.el7.i686`
- `zlib-devel-1.2.7-17.el7.x86_64`