Netrounds offers four classes of traffic-generating Probes: **vProbe**, **SW Probe**, **HW Probe** and **Agent Probe**, all controlled through Netrounds' unifying Control Center, either hosted or on-premise. External OSS orchestrators easily automate distributed activation tests or assurance monitoring through a feature-rich cloud API, or network operations staff use a user-friendly web portal for on-demand tests or reports of SLA monitoring history. All probe classes share the same code base and have an identical feature set, remotely updated and maintained through Netrounds Control Center.

### Key features: Netrounds Active Probes
- Genuinely software-based
- Instant remote probe deployment
- Traffic generating capabilities
- Versatile features and tools
- Centrally managed
- Programmable through Cloud API

### Main benefits
- Suitable for both virtualized and traditional networks
- No need for field efforts using expensive hardware tools
- Activation tests and active monitoring from end-users’ perspective
- A complete system for assessing end-user related services
- A consistent interface and backend for users and orchestrators
- Leverage abstractions for efficient OSS automation

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**vProbe** and **SW Probe** are both downloadable software and are easily installed by the user, whereas **HW Probe** is an SW Probe pre-installed by Netrounds on certified x86 hardware of various form factors and capacities. All probes have identical traffic-generating capabilities and differ only in terms of packet performance, determined by available CPU resources and interface speeds.
vProbe
- For use in virtualized environments
- Runs as VM on any hypervisor
- Suitable as VNF in ETSI NFV MANO

SW Probe
- Complete appliance with operating system and tools
- Downloadable ISO image for any standard x86 HW
- Available as live USB without installation

HW Probe
- Software delivered on certified x86 HW
- Plug and play
- Either small portable device or rack mounted

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**HW Probe – delivered as pre-installed plug-and-play device from Netrounds**

<table>
<thead>
<tr>
<th></th>
<th>HW-small</th>
<th>HW-medium</th>
<th>HW-medium-plus</th>
<th>HW-large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front</td>
<td><img src="image1" alt="Front image" /></td>
<td><img src="image2" alt="Front image" /></td>
<td><img src="image3" alt="Front image" /></td>
<td><img src="image4" alt="Front image" /></td>
</tr>
<tr>
<td>Back</td>
<td><img src="image5" alt="Back image" /></td>
<td><img src="image6" alt="Back image" /></td>
<td><img src="image7" alt="Back image" /></td>
<td><img src="image8" alt="Back image" /></td>
</tr>
<tr>
<td>Network</td>
<td>3 x 10/100 BASE-T (RJ45)</td>
<td>3 x 10/100/1000 BASE-T (RJ45)</td>
<td>4 x 10/100/1000 BASE-T (RJ45) and optional 2x1G SFP</td>
<td>4 x 10/100/1000 BASE-T (RJ45) and optional 2x10G SFP+</td>
</tr>
<tr>
<td>x86 CPU</td>
<td>1 x AMD Geode LX800, 500 Mhz</td>
<td>1 x AMD Bobcat T40E, 1.0 GHz, dual core</td>
<td>1 x Intel Core i3, 2.9 GHz, dual core</td>
<td>1 x Intel Xeon E3, 3.2 GHz, quad core</td>
</tr>
<tr>
<td>RAM</td>
<td>256 MB</td>
<td>2 GB</td>
<td>4GB</td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>2 GB CF (flash)</td>
<td>16 GB SSD</td>
<td>2 TB HDD</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>30x157x168 mm</td>
<td>(1.2” x 6.2” x 6.6”)</td>
<td>43x290x437 mm</td>
<td>(1.7” x 11.4” x 17.2”)</td>
</tr>
<tr>
<td>Weight</td>
<td>800g (1.8 lb)</td>
<td>5 kg (11 lb)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>---------------</td>
<td>--------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remote control</td>
<td>Remote management done through server-side GUI or cloud API. See separate accompanying datasheet for Netrounds Control Center.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SW Probe – downloadable software for standard x86 hardware**

<table>
<thead>
<tr>
<th></th>
<th>HDD</th>
<th>Bootable USB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>For permanent installation on physical block storage device (HDD)</td>
<td>Live booting from USB memory stick for temporary transformation of any x86 PC hardware into a Netrounds probe</td>
</tr>
<tr>
<td><strong>Delivery format</strong></td>
<td>Delivered as installation ISO image</td>
<td>Delivered as raw disk image, along with executable Windows binary for assisted transfer to USB memory stick</td>
</tr>
<tr>
<td><strong>RAM requirement</strong></td>
<td>256 MB</td>
<td></td>
</tr>
<tr>
<td><strong>Storage requirement</strong></td>
<td>1 GB</td>
<td>None – using RAM disk for temporary storage and image is booted directly from USB device</td>
</tr>
<tr>
<td><strong>NIC driver support</strong></td>
<td>Same as supported by Linux Debian</td>
<td></td>
</tr>
</tbody>
</table>

**vProbe – downloadable software for hypervisor environments**

<table>
<thead>
<tr>
<th></th>
<th>vProbe ISO</th>
<th>vProbe QCOW2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>For permanent installation on virtual block storage device</td>
<td>Pre-installed and bootable appliance</td>
</tr>
<tr>
<td><strong>Delivery format</strong></td>
<td>Delivered as installation ISO image</td>
<td>Delivered as raw disk image in QCOW2 format, suitable for OpenStack Glance</td>
</tr>
<tr>
<td><strong>Orchestration support</strong></td>
<td>Not applicable</td>
<td>Openstack Heat Orchestration Templates (HOT), using cloud-init to transfer authentication parameters into virtual machine running the vProbe</td>
</tr>
<tr>
<td><strong>Hypervisor support</strong></td>
<td>KVM, VMware ESX, Microsoft Hyper-V, Oracle VirtualBox</td>
<td></td>
</tr>
<tr>
<td><strong>vCPU requirement</strong></td>
<td>1 vCPU</td>
<td></td>
</tr>
<tr>
<td><strong>RAM requirement</strong></td>
<td>256 MB</td>
<td></td>
</tr>
<tr>
<td><strong>Storage requirement</strong></td>
<td>1 GB</td>
<td></td>
</tr>
<tr>
<td><strong>NIC driver support</strong></td>
<td>Same as supported by Linux Debian</td>
<td></td>
</tr>
</tbody>
</table>
### General network support

**Transport modes**
- Bridged Ethernet
- IEEE 802.1q VLAN
- IPv4 over Ethernet
- IPv6 over Ethernet

**Physical link configuration**
- Duplex setting (full or half)
- Speed setting (10M-10G)

**MAC addresses**
- Per physical port or VLAN
- Factory default
- User-defined

**Bridge setup**
- Bridge physical ports and/or VLANs
- Multiple bridges per probe (max 16)
- Assign IP hosts to bridges

**VLAN setup**
- Per physical port or VLAN (max 16)
- Full VLAN range (1-4095)
- Priority Code Point (0-7)

**IP host setup**
- Multi-host per probe (max 16)
- One host per physical port or VLAN
- Separate routing tables per host
- DiffServ Code Point (0-63)
- Static addressing (gateway, DNS)
- DHCPv4, DHCPv6, SLAAC
- DHCPv4 vendor class
- Use IP host for management

**DHCPv4 server setup**
- DHCPv4 server for other clients
- Per physical port or VLAN
- Network range
- Network prefix length
- Gateway and DNS

**Interface status**
- Per physical port or VLAN
- Current speed/duplex
- Current MAC and IP address
- TX and RX packets
- TX and RX bytes

### Ethernet interfaces – HW Probe

**Electrical**
- **HW-Small**: 3 x 10/100
- **HW-Medium**: 3 x 10/100/1G
- **HW-MediumPlus**: 4 x 10/100/1G
- **HW-Large**: 4 x 10/100/1G

**Optical**
- **HW-Small**: No optical
- **HW-Medium**: No optical
- **HW-MediumPlus**: 2 x 1G (SX/LX)
- **HW-Large**: 2 x 10G (SR/LR)

### Ethernet interfaces – SW Probe

**NIC Driver support**
- Intel NICs recommended
- NICs supported by Linux Debian

### Ethernet interfaces – vProbe

**Hypervisor NIC driver support**
- KVM/OpenStack
- VMware ESX
- Microsoft Hyper-V
- Oracle VirtualBox

### Supported standards by OSI layer

#### L1 – Physical Layer (HW Probes)
- IEEE 803.2i: 10Base-T
- IEEE 802.3u/x: 100Base-TX
- IEEE 802.3ab: 1000Base-T
- IEEE 802.3ae: 10GBase-SR/LR
- IEEE 802.3ac: 1522 byte “Q-tag”
- IEEE 802.11b/g/n: Wireless LAN
- ETSI/3GPP: GPRS/EDGE/UMTS/LTE

#### L2 – Link Layer
- RFC 826: Address Resolution Protocol (ARP)
- RFC 802.1q: VLAN
- RFC 802.1p: Protocol for Traffic Prioritization
- RFC 802.1ad: QinQ, VLAN stacking
- RFC 802.1ag: Ethernet Loopback
- RFC 2131: Dynamic Host Configuration Protocol, DHCP
- RFC 3046: DHCP Relay Agent Information Option
- RFC 3376: Internet Group Management Protocol, Version 3
- ITU-T Y.1731: OAM functions and mechanisms for Ethernet based networks
- ITU-T Y.1564: Ethernet service activation test methodology
- MEF 6.1.1: Layer 2 Control Protocol Handling

#### L3 – Network Layer
- RFC 791: IPv4
- RFC 792: ICMP
- RFC 2460: IPv6
- RFC 5481: Packet Delay Variation Applicability Statement
- RFC 3393: IP Packet Delay Variation Metric for IP Performance Metrics
- RFC 2474: Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers
- RFC 2680: One-way Loss Ratio
- RFC 2679: Minimum One-way Delay
- RFC 6703: Mean One-way Delay (section 5.2)

#### L4 – Transport Layer
- RFC 736: User Datagram Protocol (UDP)
RFC 793: Transmission Control Protocol (TCP)
RFC 3550: RTP: A Transport Protocol for Real-Time Applications

**L5 – Session Layer**
RFC 3261: SIP: Session Initiation Protocol
RFC 3551: RTP Profile for Audio and Video Conferences with Minimal Control
RFC 3266: SDP: Session Description Protocol
RFC 3264: An Offer/Answer Model with the Session Description Protocol (SDP)
RFC 3515: The Session Initiation Protocol (SIP) Refer Method
RFC 3891: The Session Initiation Protocol (SIP) "Replaces" Header

**L7 – Application Layer**
ITU-T G.711: Pulse code modulation (PCM) of voice frequencies
RFC 1901, 1908 and 2570: SNMP v2 and v3
ITU G.107: The E-model: a computational model for use in transmission planning
ETSI TR 101 290: Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems
RFC 6959: Source Address Validation Improvement (SAVI) Threat Scope
RFC 7230: Hypertext Transfer Protocol—HTTP/1.1
RFC 1345: Network Time Protocol (Version 3)
RFC 1034: Domain Name System

**Internet Performance Support**

**General**
Request/response-based
One-armed (single probe)
Distributed (multiple probes)

**HTTP**
HTTP server (URL target)
Time between requests
Response code validation
Response content validation
Time to first byte received
Page load times
Download rates

**DNS**
DNS server
Lookup address
Time between requests
DNS record type response validation (A, AAAA, CNAME, MX)
Response time measurement

**ICMP (Ping)**
IP hosts (targets)
Time between requests
Payload size (64-1500 Bytes)
DSCP prioritization

**Network Performance Support**

**General**
Probe-to-probe traffic generation
Point-to-point
Hub and spoke
Custom mesh topologies
Destination port (UDP and TCP)
Unidirectional or bidirectional
DSCP and PCP header marking

**UDP**
Unicast or multicast
Generated output bandwidth
Packet size (64-1500 Bytes)

**VoIP-like UDP**
MOS scoring (1-5)
20 concurrent calls per probe
Codec emulation: G.711, G.729, G.723 and GSM-EFR
Media transport generation, not signalling

**Stateful TCP**
No. of point-to-point sessions
Output rate limitation, each direction

**Multi-session TCP**
No. of point-to-point TCP sessions

**QoS Policy Profiling**
Multi-stream generation in each queue
Mix of UDP and TCP to measure queue build-up
Profile generated for each traffic stream

**Y.1731/802.1ag**
Y.1731 Ethernet Loopback, ETH-LB
Y.1731 Delay Measurement, ETH-DM
Y.1731 Synthetic Loss Measurement, ETH-SLM
Participating MEPs (Maintenance Entity Group End Points) as input list
MEG level (0 to 7)
Unavailable Error Seconds (UAS) per Y.1563
Packet size

**IPTV and HTTP Streaming Video**

**General**
Request/response-based
Emulate single client (one probe)
Distributed (multiple probes)
Inline with traffic (interception)
IPTV MPEG
Joining of multicast channels
Probes and input channels selection
MPEG transport stream analysis
MPEG loss (continuity counter)
PCR and RTP packet jitter
Table errors (PAT and PMT)
Missing PID detection

IPTV MPEG inline
Interception of IGMP pass through
Stream analysis of MPEG TS

DVB-C MPEG
Usage of external USB receiver for RF/coax input
Automatic channel scanning and population of channel list
MPEG transport stream analysis
MPEG loss (continuity counter)
PCR and RTP packet jitter
Table errors (PAT and PMT)
Missing PID detection
Concurrent and hybrid IPTV & DVB

IGMP channel zapping
Continuous join and leave cycle
Selection of channels to cycle
Join and leave delay measurements

HTTP Video Streaming (OTT)
Apple HTTP Live Streaming (HLS)
URL input for source of video
Detection of buffer underrun
Loop feature for static videos

VoIP and SIP telephony
General
Hub and spoke
Point-to-point
SIP account inventory
SIP signalling
Registration and unregistration
Invite and and hangup
Cycle length
RTP media stream quality
MOS scoring (1-5)
Rate
Packet loss
Packet disorders
Voice codec (G.711 a-law, G.711 u-law, GSM)

Remote Packet Inspection
General
Packets intercepted remotely from probes
Standard “tcpdump” filters
Standard “pcap” files

Packet capture through server
Filtered packets forwarded from group of probes to Netrounds’ control center for storage and centralized retrieval

Protocol analysis
Packets grabbed in real-time and processed locally on probe through the Darkstat application

Mobile radio
General
Usage of external USB radio modem for GPRS/WCDMA/LTE
Measurements and logging of basic radio parameters
Switch capability between modes

Mobile switcher
Lock to specific APN
Lock to specific radio access technology (GSM, WCDMA, LTE800, LTE900, LTE1800, LTE2100, LTE2600)

Mobile logger
Received Signal Strength Indication (RSSI)
Reference Signal Received Power (RSRP)
Received Signal Code Power (RSCP)
Reference Signal Received Quality (RSRQ)
Chip energy interfering co-channel (Ec/Io)
Signal to Interference + Noise Ratio (SINR)

Details – HW Probe Small

Performance indicators
UDP bidir 100 Mbit/s (1500 bytes)
TCP unidir 100 Mbit/s (using multiple concurrent sessions)
IPTV MPEG 90 Mbit/s (similar to 22 SD channels at 4 Mbit/s)
Packet performance 19 500 pkts/second (pps)
Time accuracy ~ 1 ms assuming stable connection to NTP server

Power supply
DC 18V adapter incl., 110V or 230V
6W consumption

Connectors
Electrical Ethernet 3 x RJ-45
Optical Ethernet none
Serial, RS-232 DB-9
USB 2 x USB2.0
Display none

Dimensions
Size 30x157x168 mm
(H x W x D) (1.2” x 6.2” x 6.6”)
Weight 800g (1.8 lb)
### Details – HW Probe Medium

<table>
<thead>
<tr>
<th>Performance indicators</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UDP unidir</td>
<td>1000 Mbit/s (1500 bytes)</td>
</tr>
<tr>
<td>TCP unidir</td>
<td>1000 Mbit/s (using multiple concurrent sessions)</td>
</tr>
<tr>
<td>IPTV MPEG</td>
<td>300 Mbit/s (similar to 75 SD channels at 4 Mbit/s)</td>
</tr>
<tr>
<td>Packet performance</td>
<td>78 000 pkts/second (pps)</td>
</tr>
<tr>
<td>Time accuracy</td>
<td>~ 1 ms assuming stable connection to NTP server</td>
</tr>
</tbody>
</table>

**Power supply**
- DC 12V adapter incl., 110V or 230V
- 12W consumption
- To be defined

**Connectors**
- Electrical Ethernet: 3 x RJ-45
- Optical Ethernet: none
- Serial, RS-232: DB-9
- USB: 2 x USB2.0
- Display: none

**Dimensions**
- Size: 30x157x168 mm (1.2" x 6.2" x 6.6")
- Weight: 800g (1.8 lb)

### Details – HW Probe MediumPlus

<table>
<thead>
<tr>
<th>Performance indicators</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UDP bidir</td>
<td>1000 Mbit/s (1500 bytes)</td>
</tr>
<tr>
<td>TCP unidir</td>
<td>1000 Mbit/s (using multiple concurrent sessions)</td>
</tr>
<tr>
<td>IPTV MPEG</td>
<td>900 Mbit/s (similar to 225 SD channels at 4 Mbit/s)</td>
</tr>
<tr>
<td>Packet performance</td>
<td>390 000 pkts/second (pps)</td>
</tr>
<tr>
<td>Time accuracy</td>
<td>~ 1 ms assuming stable connection to NTP server</td>
</tr>
</tbody>
</table>

**Power supply**
- AC input, 110-230V, cable included

**Connectors**
- Electrical Ethernet: 4 x RJ-45
- Optical Ethernet: 2xSFP+ slots (optional)
- Serial, RS-232: DB-9
- USB: 2 x USB2.0
- Display: VGA

**Dimensions**
- Size: 43x290x437 mm (1.7" x 11.4" x 17.2")
- Weight: 5 kg (11 lb)

### Details – HW Probe Large

<table>
<thead>
<tr>
<th>Performance indicators</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UDP bidir</td>
<td>4 Gbit/s (1500 bytes)</td>
</tr>
<tr>
<td>TCP unidir</td>
<td>10 Gbit/s (using multiple concurrent sessions)</td>
</tr>
<tr>
<td>IPTV MPEG</td>
<td>3 Gbit/s (similar to 750 SD channels at 4 Mbit/s)</td>
</tr>
<tr>
<td>Packet performance</td>
<td>390 000 pkts/second (pps)</td>
</tr>
<tr>
<td>Time accuracy</td>
<td>~ 1 ms assuming stable connection to NTP server</td>
</tr>
</tbody>
</table>

**Power supply**
- AC input, 110-230V, cable included

**Connectors**
- Electrical Ethernet: 4 x RJ-45
- Optical Ethernet: 2xSFP+ slots (optional)
- Serial, RS-232: DB-9
- USB: 2 x USB2.0
- Display: VGA

**Dimensions**
- Size: 43x290x437 mm (1.7" x 11.4" x 17.2")
- Weight: 5 kg (11 lb)
Netrounds offers a programmable test and assurance infrastructure using distributed and reliable traffic-generating active probes, all easy-to-use and available from the cloud as a SaaS subscription or on-premise deployments.

Netrounds helps getting in-depth understanding of network performance and provides actionable metrics on end-user service experience.

More than 220 network operators, enterprises and consultants worldwide use Netrounds to deliver high end-user experience to their customers.

Founded in 2007, Netrounds is headquartered in Luleå, Sweden, with offices in Boston, MA, USA.