# TNC Endpoint Compliance and Network Access Control Profiles

TCG Members Meeting June 2014 Barcelona

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strongswan

# Where the heck is Rapperswil?

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# HSR - Hochschule für Technik Rapperswil

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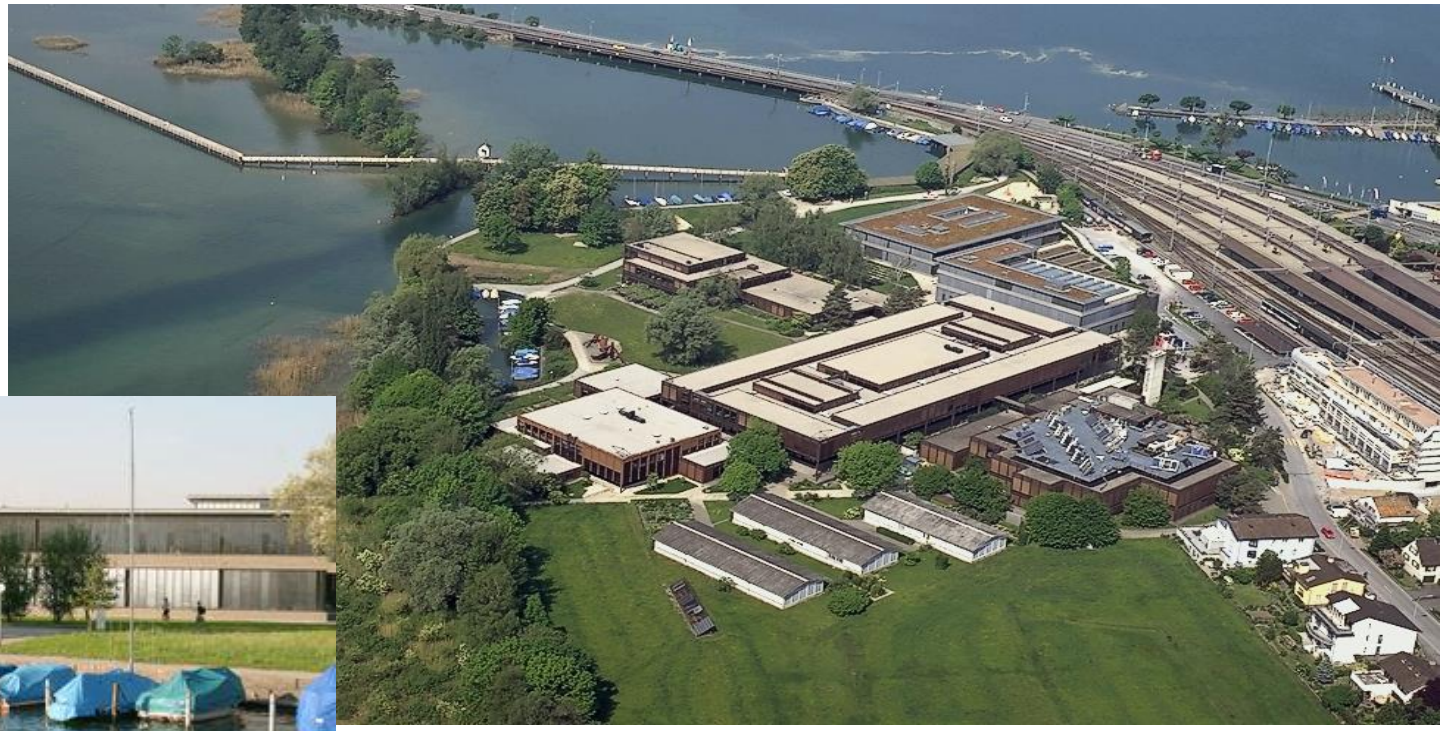
- University of Applied Sciences with about 1500 students
- Faculty of Information Technology (300-400 students)
- Bachelor Course (3 years), Master Course (+1.5 years)



# strongSwan – the OpenSource VPN Solution

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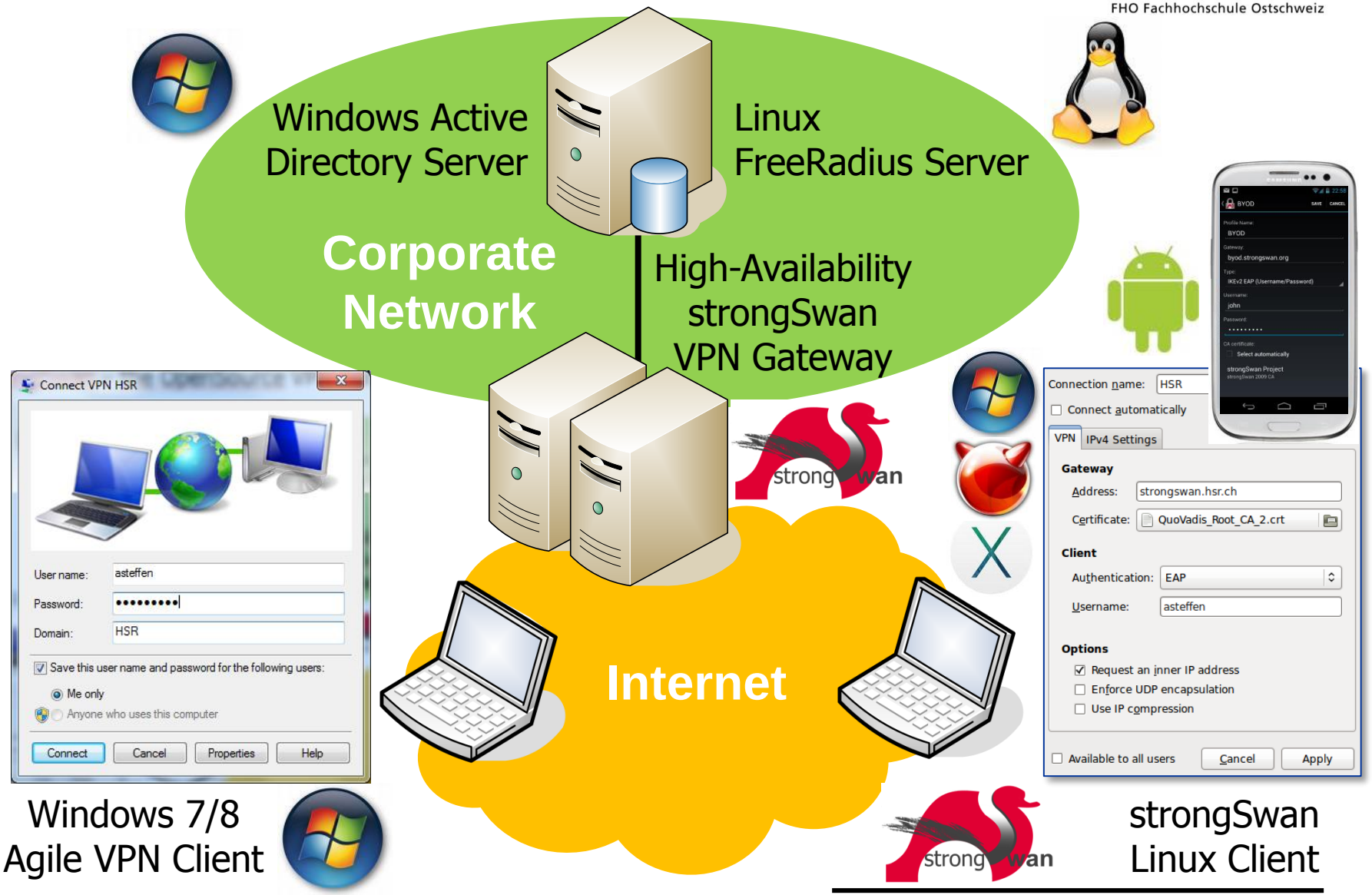

# TNC Network Access Control and Endpoint Compliance Profiles

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## TNC Network Access Control Profile

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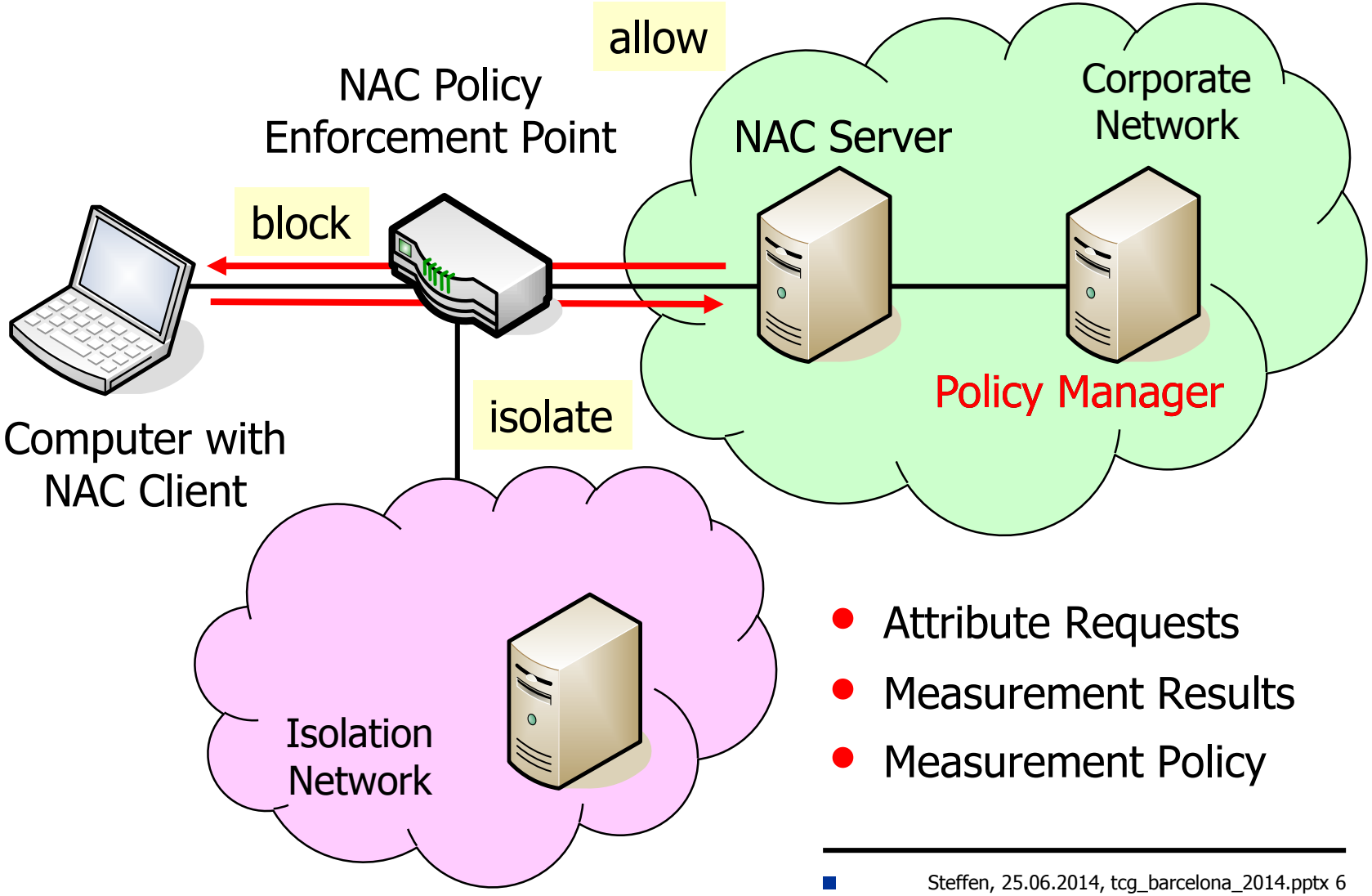
# Network Access Control (NAC)






- Attribute Requests
- Measurement Results
- Measurement Policy

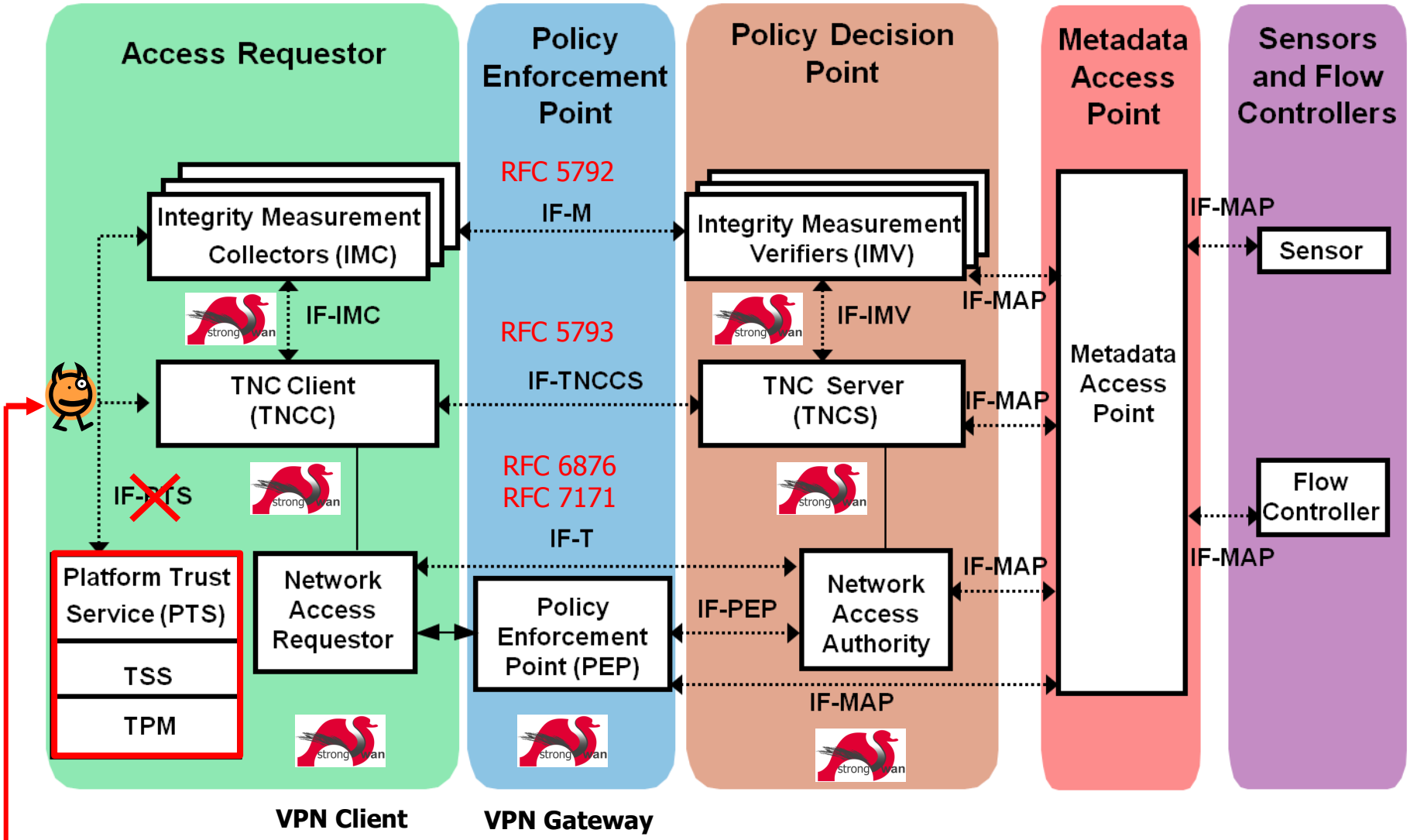
# Network Access Control (NAC)



- User Authentication
  - Layer 2: IEEE 802.1X (LAN switches and WLAN access points)
  - Layer 3: IPsec-based VPN (IKEv2)
  - Layer 4: TLS-based VPN (proprietary methods)
- Configuration Assessment
  - Configuration measurement before network access is granted (e.g. installed software like antivirus scanner and firewall)
  - Compare measurements to network access policies
    ⇨ Integrity check of computer platform
  - Re-assess computer platforms in regular intervals
- Policy Enforcement
  - Enforce security policies onto no-compliant computer platforms

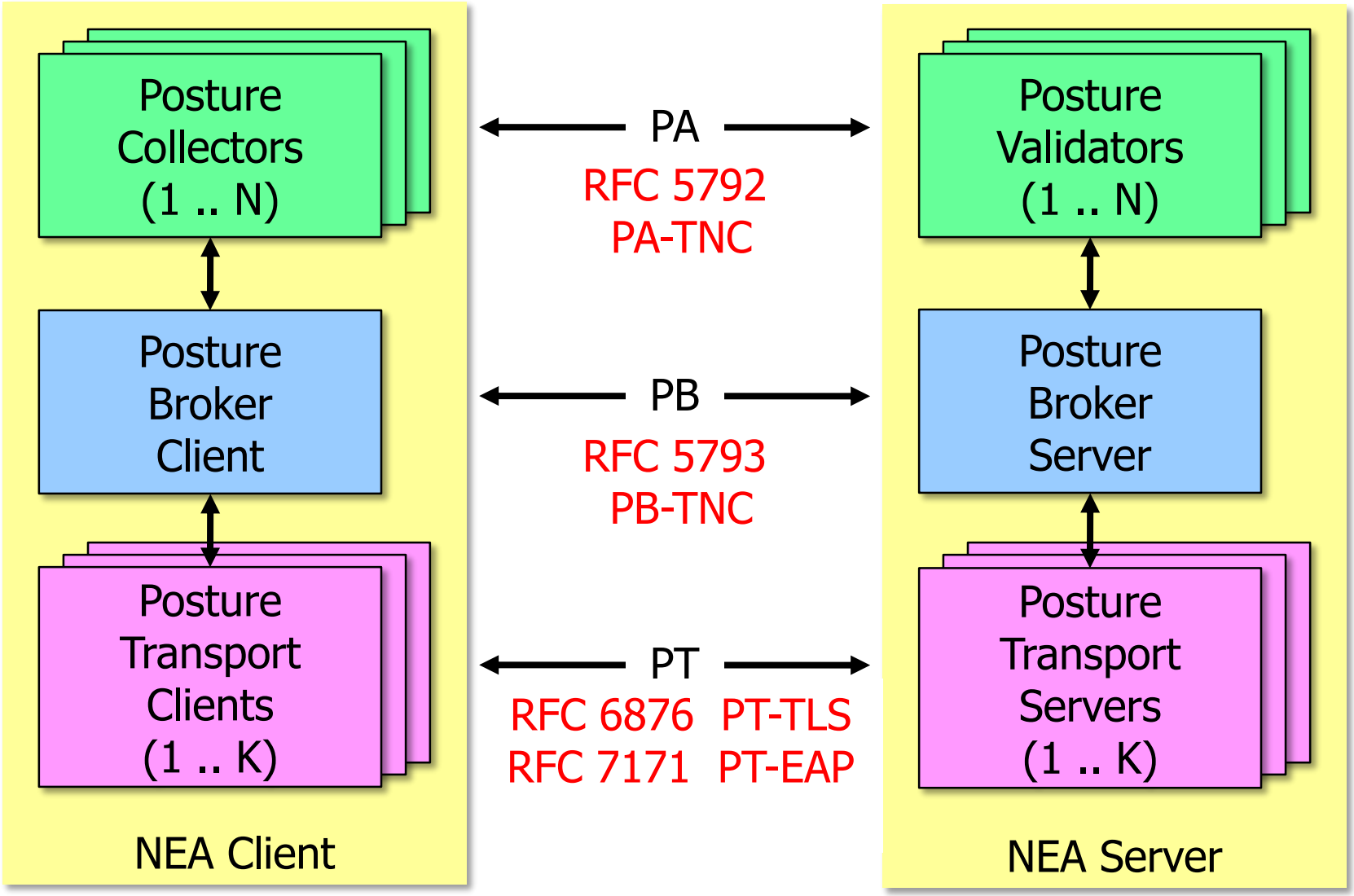
# Trusted Network Connect (TNC) Architecture





# Network Endpoint Assessment (RFC 5209)





# Layered TNC Protocol Stack

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- IF-T Transport Protocol — PT-EAP (RFC 7171)

```
[NET] received packet: from 152.96.15.29[50871] to 77.56.144.51[4500] (320 bytes)
[ENC] parsed IKE_AUTH request 8 [ EAP/RES/TTLS ]
[IKE] received tunneled EAP-TTLS AVP [EAP/RES/PT]
```

- IF-TNCCS TNC Client-Server Protocol — PB-TNC (RFC 5793)

```
[TNC] received TNCCS batch (160 bytes) for Connection ID 1
[TNC] PB-TNC state transition from 'Init' to 'Server Working'
[TNC] processing PB-TNC CDATA batch
[TNC] processing PB-Language-Preference message (31 bytes)
[TNC] processing PB-PA message (121 bytes)
[TNC] setting language preference to 'en'
```

- IF-M Measurement Protocol — PA-TNC (RFC 5792)

```
[TNC] handling PB-PA message type 'IETF/Operating System' 0x000000/0x00000001
[IMV] IMV 1 "OS" received message for Connection ID 1 from IMC 1
[TNC] processing PA-TNC message with ID 0xec41ce1d
[TNC] processing PA-TNC attribute type 'IETF/Product Information' 0x000000/0x00000002
[TNC] processing PA-TNC attribute type 'IETF/String Version' 0x000000/0x00000004
[TNC} processing PA-TNC attribute type 'ITA-HSR/Device ID' 0x00902a/0x00000008
```

- TNC Measurement Data

```
[IMV] operating system name is 'Android' from vendor Google
[IMV] operating system version is '4.2.1'
[IMV] device ID is cf5e4cbcc6e6a2db
```

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## strongSwan Android Client with TNC Support

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# strongSwan Android VPN Client

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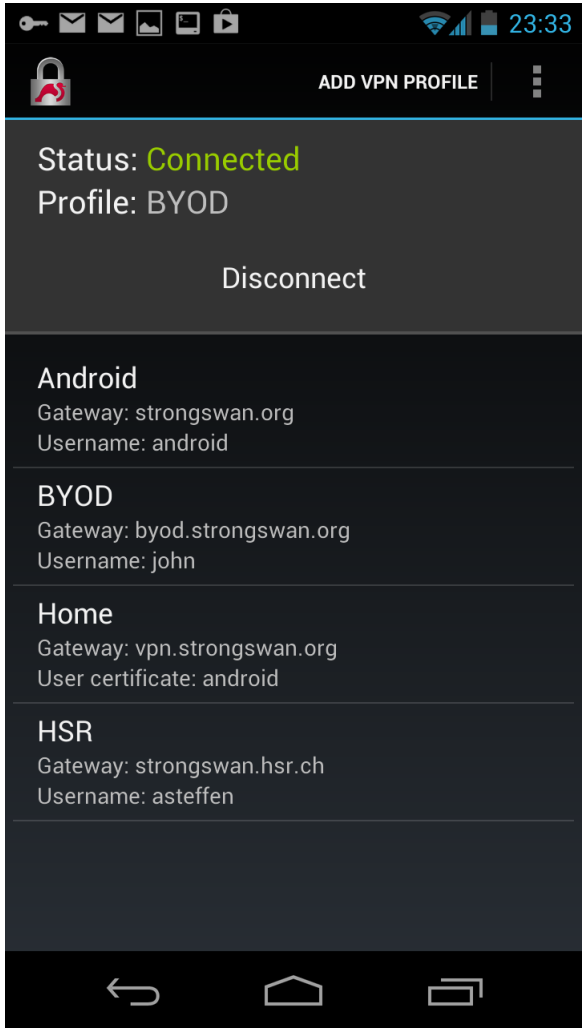


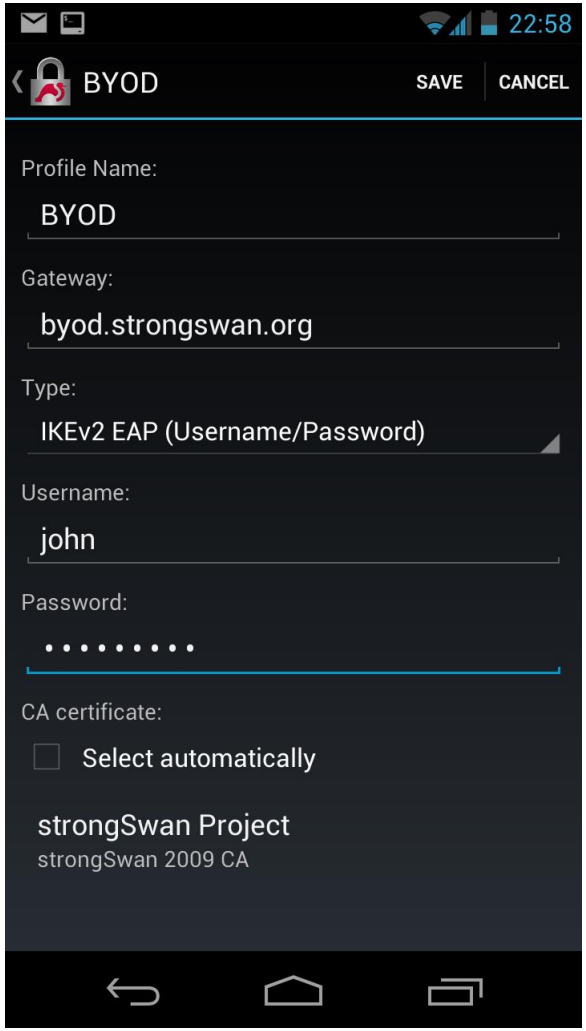

# Allow Download from Unknown Sources

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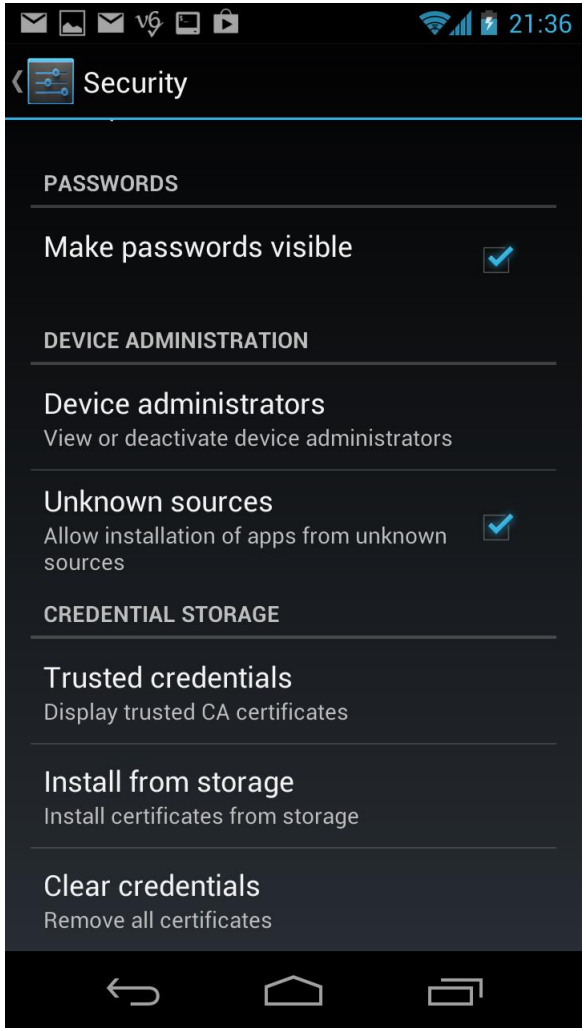


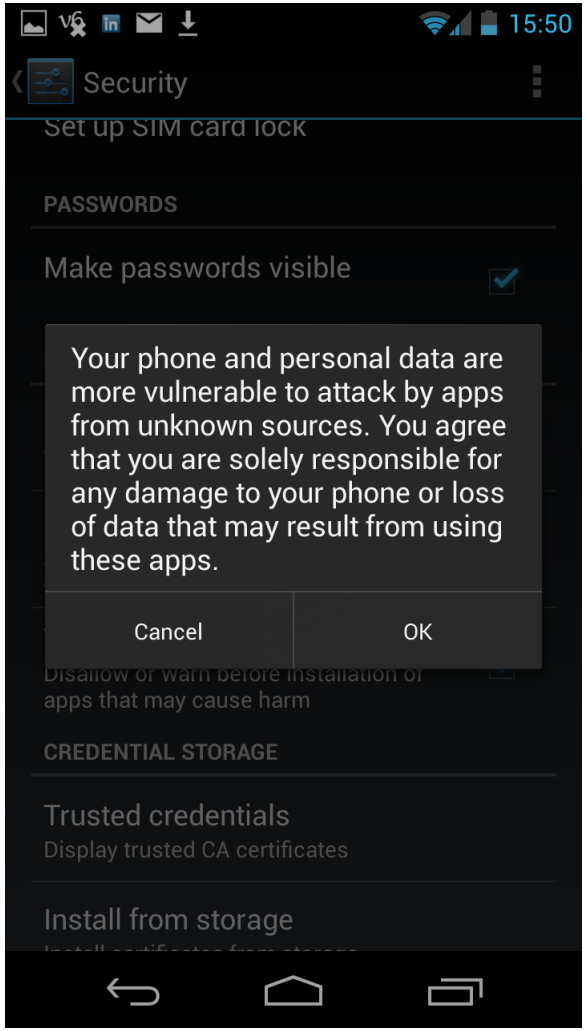

# Install Blacklisted Android Web Server Package

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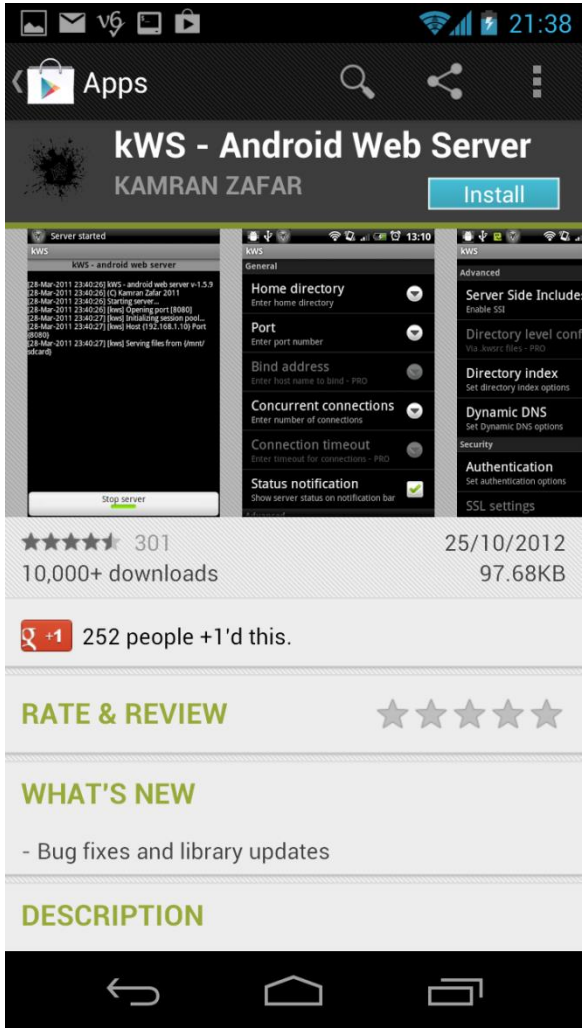

# Minor Non-Compliance: Isolate Client

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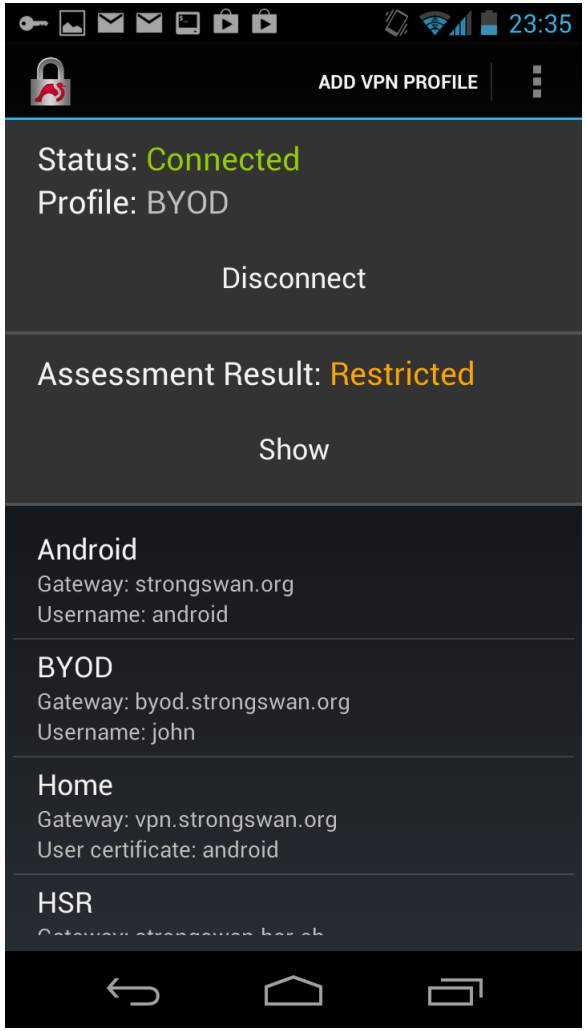


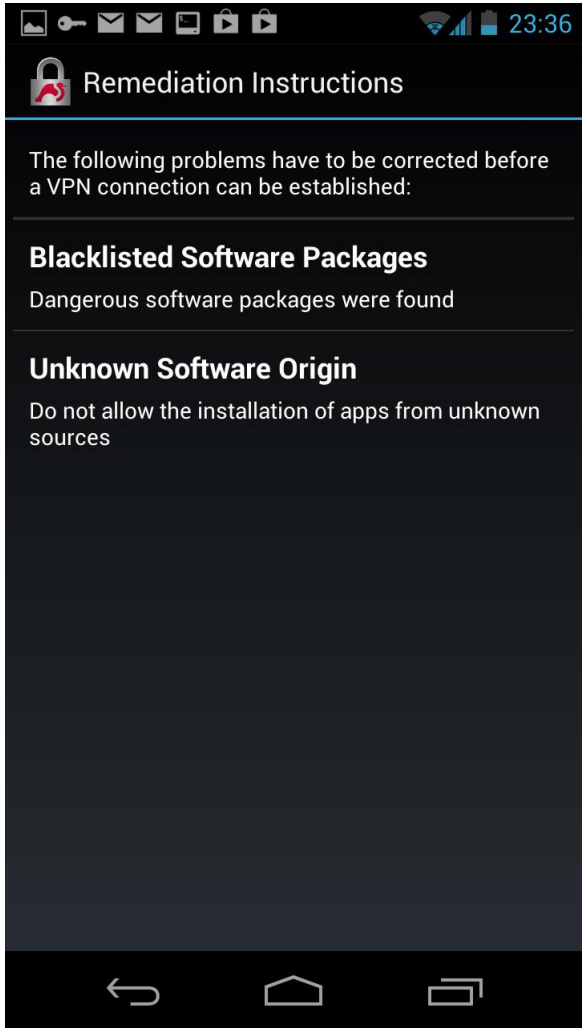


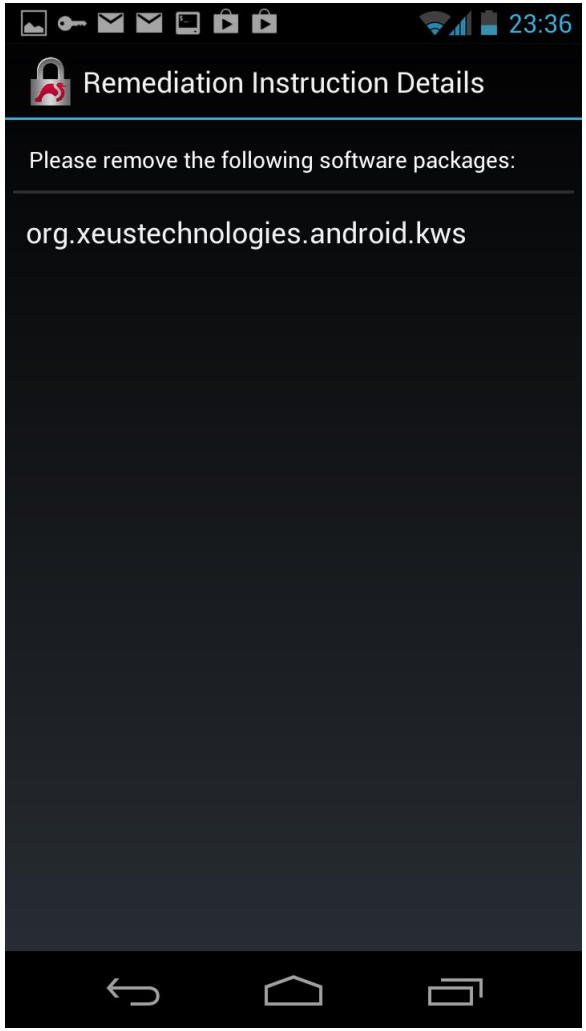

# Start the Android Web Server



# Major Non-Compliance: Block Client

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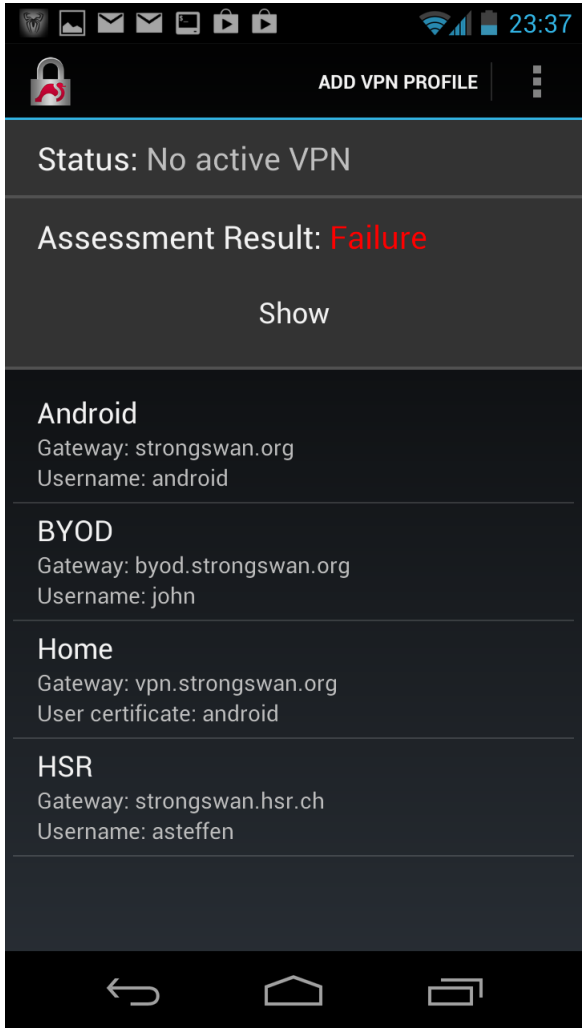


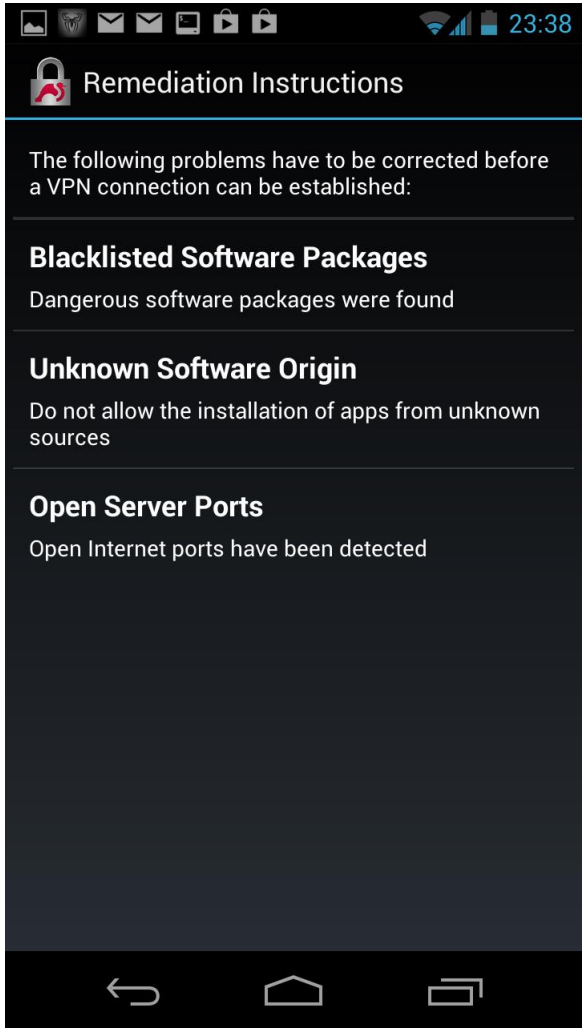


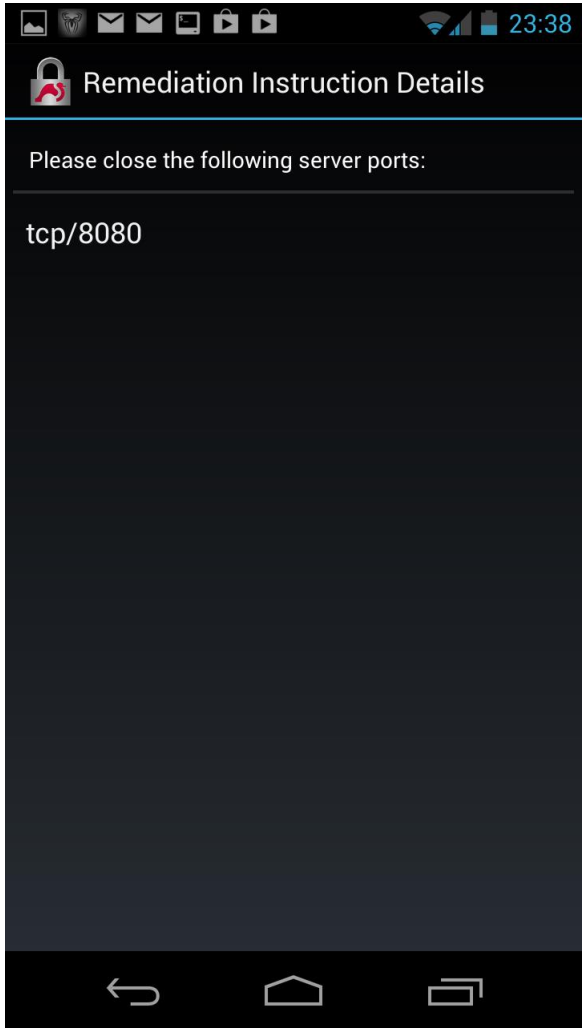

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strongTNC Policy Manager

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# strongTNC Policy Manager



Firefox

strongTNC - Session details

tnc.strongswan.org/sessions/140

strongTNC

- Overview

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- Groups
- Policies
- Enforcements
- Devices

DATA VIEWS

- Packages
- Products
- Directories
- Files
- Statistics

## Session details

### Session Info

| | |
|---|---|
| **ID** | 140 |
| **Device** | Google Nexus Prime (cf5e4cbcc6) |
| **User** | steffen |
| **Time** | Aug 14 14:57:05 2013 |
| **Result** | BLOCK |

### Results

| Policy | Result | IMV Comment |
|---|---|---|
| Unknown Source | ALLOW | unknown sources not enabled |
| Installed Packages | ISOLATE | processed 26 packages: 0 not updated, 1 blacklisted, 0 ok, 25 not found |
| Allowed Open TCP Ports | BLOCK | violating tcp ports: 8008 |
| Allowed Open UDP Ports | ALLOW | no violating udp ports |

https://github.com/strongswan/strongTNC

# Measurement Policies and Enforcements

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Currently supported policy types:

| | | |
|---|---|---|
| • PWDEN | Factory Default Password Enabled | |
| • FWDEN | Forwarding Enabled | |
| • TCPOP | TCP Ports allowed to be Open | Closed Port Default Policy |
| • TCPBL | TCP Ports to be Blocked | Open Port Default Policy |
| • UDPOP | UDP Ports allowed to be Open | Closed Port Default Policy |
| • UDPBL | UDP Ports to be Blocked | Open Port Default Policy |
| • PCKGS | Installed Packages | |
| • UNSRC | Unknown Sources | |
| • SWIDT | Software ID (SWID) Tag Inventory | |
| • FREFM | File Reference Measurement | SHA1/SHA256 Hash |
| • FMEAS | File Measurement | SHA1/SHA256 Hash |
| • FMETA | File Metadata | Create/Modify/Access Times |
| • DREFM | Directory Reference Measurement | SHA1/SHA256 Hashes |
| • DMEAS | Directory Measurement | SHA1/SHA256 Hashes |
| • DMETA | Directory Metadata | Create/Modify/Access Times |
| • TPMRA | TPM-based Remote Attestation | |

# Add/Edit Policies

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strongTNC - Policy Allowed Open UDP ...

tnc.strongswan.org/policies/9

strongTNC

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Overview

CONFIGURATION

Groups
Policies
Enforcements
Devices

DATA VIEWS

Packages
Products
Directories
Files
Statistics

## Policy Allowed Open UDP Ports

### Policy

Filter

Allowed Open TCP Ports
Allowed Open UDP Ports
Default Factory Password Enabled
Get /bin
Get /system/bin
Get /system/lib
IP Forwarding Enabled
Installed Packages
Measure /lib/x86_64-linux-gnu/libcrypto.so.1.0.0

### Policy Info

Name: Allowed Open UDP Ports

Type: Open UDP Listening Ports

All ports closed except: 500 4500

Fail-Action: BLOCK

Noresult-Action: BLOCK

Save Delete

# Define Enforcements

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strongTNC - Enforcement Installed Pack...
tnc.strongswan.org/enforcements/25

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Overview
CONFIGURATION
Groups
Policies
Enforcements
Devices
DATA VIEWS
Packages
Products
Directories
Files
Statistics

## Enforcement Installed Packages on Default

### Enforcement

Filter

Installed Packages on Default
Unknown Source on Android
IP Forwarding Enabled on Linux
Measure /lib/x86_64-linux-gnu/libcrypto.so.1.0.0 on Ubuntu x86_64
Measure /lib/x86_64-linux-gnu/libssl.so.1.0.0 on Ubuntu x86_64
Measure /usr/bin

### Enforcement Info

| | |
|---|---|
| Policy | Installed Packages |
| Group | Default |
| Max. age in seconds | 86400 |
| Fail Action | Inherit from policy |
| Noresult Action | Inherit from policy |

Save
Delete

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## Linux Integrity Measurement Architecture (IMA)

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# Linux Integrity Measurement Architecture



- Linux Security Summit 2012 Paper
  - Presented in September 2012 at LinuxCon in San Diego
  - Remote attestation based on IMA is feasible:

    The transfer and database lookup of 1200 file measurements amounting to about 120 kB of IMA measurements and certified by a Quote2 TPM signature takes about 20 seconds.
  - http://www.strongswan.org/lss2012.pdf
  - Update:

    strongSwan 5.2.0 can handle the IMA-NG SHA-1 and SHA-256 hash formats introduced with the Linux 3.13 kernel in order to support TPM 2.0 devices.

# Linux IMA - BIOS Measurements

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- BIOS is measured during the boot process
  - Many Linux distributions enable BIOS measurement by default when a TPM hardware device is detected.
  - BIOS measurement report with typically 15..30 entries is written to /sys/kernel/security/tpm0/ascii_bios_measurements
  - BIOS measurements are extended into PCRs #0..7

```
PCR  SHA-1 Measurement Hash                          Comment
  0 4d894eef0ae7cb124740df4f6c5c35aa0fe7dae8 08 [S-CRTM Version]
  0 f2c846e7f335f7b9e9dd0a44f48c48e1986750c7 01 [POST CODE]
    ...
  7 9069ca78e7450a285173431b3e52c5c25299e473 04 []
  4 c1e25c3f6b0dc78d57296aa2870ca6f782ccf80f 05 [Calling INT 19h]
  4 67a0a98bc4d6321142895a4d938b342f6959c1a9 05 [Booting BCV Device 80h, - Hitachi HTS723216L9A360]
  4 06d60b3a0dee9bb9beb2f0b04aff2e75bd1d2860 0d [IPL]
  5 1b87003b6c7d90483713c90100cca3e62392b9bc 0e [IPL Partition Data]
```

# Linux IMA - Runtime Measurements

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- Executable files, dynamic libraries and kernel modules are measured when loaded during runtime.
  - With some Linux distributions (e.g. Ubuntu 14.04) IMA can be activated via the ima_tcb boot parameter but usually the kernel must first be manually compiled with CONFIG_IMA enabled
  - The IMA runtime measurement report with about 1200 entries is written to /sys/kernel/security/ima/ascii_runtime_measurements
  - IMA runtime measurements are extended into TPM PCR #10

```
PCR  SHA-1 Measurement Hash                    SHA-1 File Data Hash                        Filename
 10 d0bb59e83c371ba6f3adad491619524786124f9a ima 365a7adf8fa89608d381d9775ec2f29563c2d0b8 boot_aggregate
 10 76188748450a5c456124c908c36bf9e398c08d11 ima f39e77957b909f3f81f891c478333160ef3ac2ca /bin/sleep
 10 df27e645963911df0d5b43400ad71cc28f7f898e ima 78a85b50138c481679fe4100ef2b3a0e6e53ba50 ld-2.15.so
                        ...                                          ...
 10 30fa7707af01a670fc353386fcc95440e011b08b ima 72ebd589aa9555910ff3764c27dbdda4296575fe parport.ko
                        ...                                          ...
```

# strongTNC - Remote Attestation Results

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strongTNC - Session details

tnc.strongswan.org/sessions/1746

strongTNC

Search

- Overview

CONFIGURATION

- Groups
- Policies
- Enforcements
- Devices

DATA VIEWS

- Packages
- Products
- Directories
- Files
- Regids
- SWID tags
- Statistics

## Session details

### Session Info

| | |
|---|---|
| ID | 1746 |
| Device | Lenovo Twist Ubuntu 14.04a (97b685002b) |
| User | steffen |
| Time | Jun 15 11:27:36 2014 |
| Result | Block |

### Results

| Policy | Result | IMV Comment |
|---|---|---|
| TPM BIOS/IMA Measurements | Allow | processed 1186 IMA file evidence measurements: 1122 ok, 64 unknown, 0 differ, 0 failed; 18 BIOS evidence measurements are ok |
| IP Forwarding Enabled | Block | forwarding enabled |
| Allowed Open Linux UDP Ports | Block | violating udp ports: 67 631 |
| Metadata of /etc/tnc_config | Allow | file metadata requested |
| SWID Tag ID Inventory | Allow | received inventory of 2174 SWID tag IDs and 0 SWID tags |
| Allowed Open Linux TCP Ports | Block | violating tcp ports: 8834 |
| Installed Packages | Allow | processed 2173 packages: 0 not updated, 0 blacklisted, 82 ok, 2091 unknown |

# strongTNC - Reference Values for File Hashes

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strongTNC - File sh

tnc.strongswan.org/files/68#page=2

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Search

- Overview

CONFIGURATION

- Groups
- Policies
- Enforcements
- Devices

DATA VIEWS

- Packages
- Products
- Directories
- Files
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- SWID tags
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## File sh

### File

Filter

3/4536

/bin/ntfsls
/bin/ntfsmftalloc
/bin/ntfsmove
/bin/ntfstruncate
/bin/ntfswipe
/bin/open
/bin/openvt
/bin/pidof
/bin/ping
/bin/ping6

### File info: /bin/sh

### File Hashes

| OS | Algo | Hash |
|---|---|---|
| Debian 7.1 armv6l | SHA1 | b3e398defaae41435109d6da56a21878aacd0704 |
| Debian 7.2 armv6l | SHA1 | b3e398defaae41435109d6da56a21878aacd0704 |
| Debian 7.2 armv6l | SHA256 | 9b81f477ace3c7690c2429480938cbae958f8... |
| Debian 7.5 armv6l | SHA1 | b3e398defaae41435109d6da56a21878aacd0704 |
| Debian 7.5 armv6l | SHA256 | 9b81f477ace3c7690c2429480938cbae958f8... |
| Ubuntu 13.04 x86_64 | SHA1 | 8f15a2e3ab1a04c0c6f56d10f8cff2b6a7796311 |
| Ubuntu 13.10 x86_64 | SHA1 | 8f15a2e3ab1a04c0c6f56d10f8cff2b6a7796311 |
| Ubuntu 14.04 x86_64 | SHA1 | 647437c3d7543c7c8d381903834c9ef42eb4cf69 |
| Ubuntu 14.04 x86_64 | SHA1 | dc3e621c72cde19593c42a7703e143fd3dad5320 |
| Ubuntu 14.04 x86_64 | SHA256 | 2934648ffdb7b77f507a6dbd3b2b3fbffdbf5... |

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## TNC Endpoint Compliance Profile

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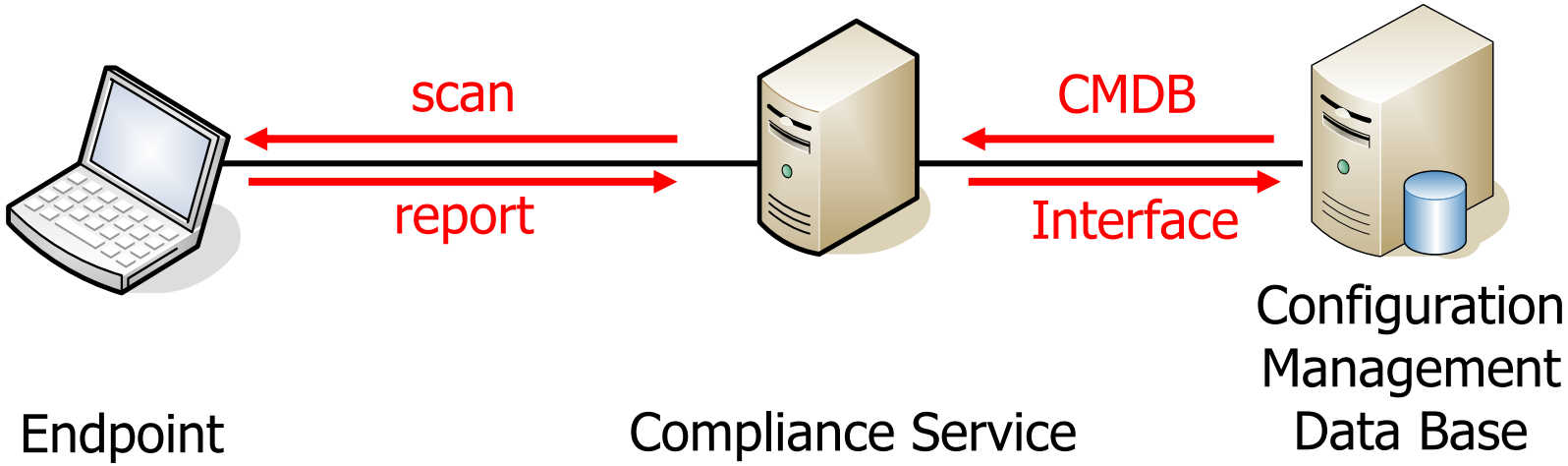
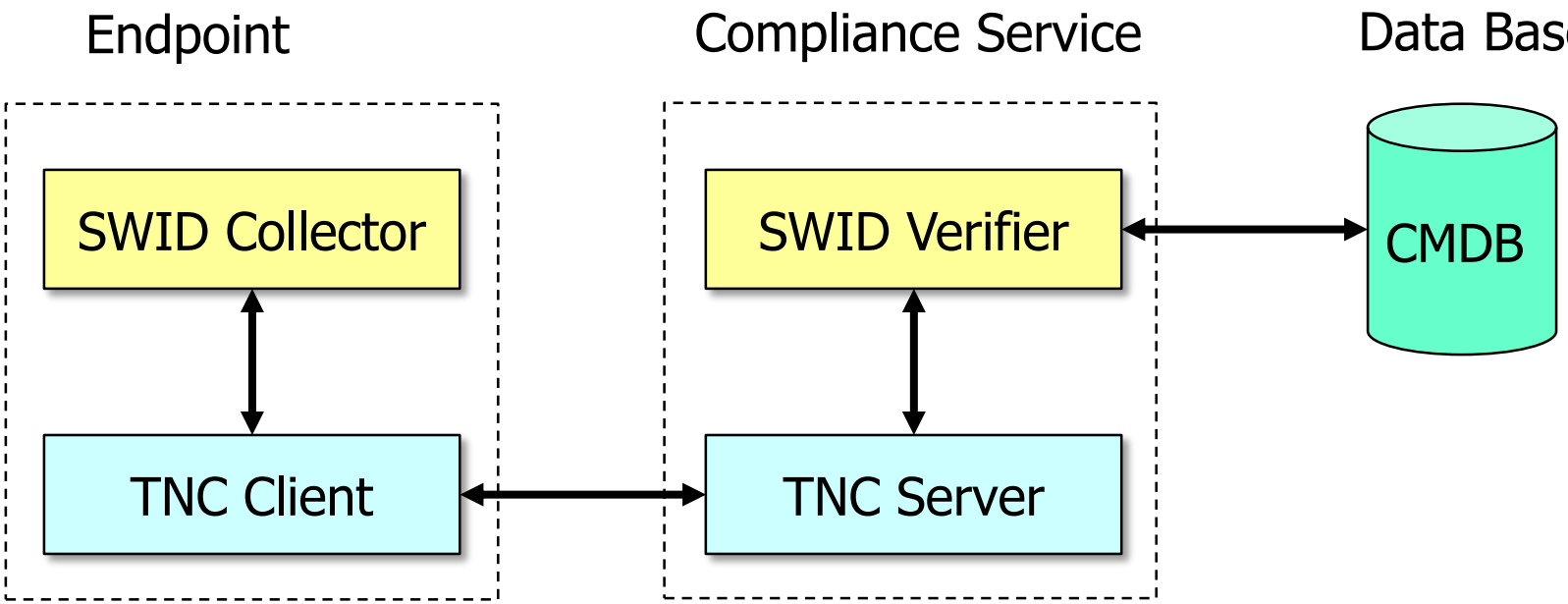
# Endpoint Compliance





# Endpoint Compliance



- Endpoints initially report a complete Software Inventory to the Compliance Service which stores the inventory in a Configuration Management Data Base (CMDB) covering all hosts within an organization or network.
- Changes in the software inventory are continuously reported.
- The tracking of the installed software is based on standardized Software Identification (SWID) Tags.
- Due to the huge bandwidth requirements (2000+ SWID tags, some of them > 1 MB), the preferred TNC transport protocol for endpoint compliance reporting is IF-T for TLS (RFC 6876 PT-TLS).
- With the CMDB it becomes possible to establish at any time which software (including the exact version) was installed on what endpoints during which time interval.

# Software Identification (SWID) Tags

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- Standardized by ISO/IEC 19770-2:2014

```xml
<?xml version='1.0' encoding='UTF-8'?>
<SoftwareIdentity
     xmlns="http://standards.iso.org/iso/19770/-2/2014/schema.xsd"
     name="strongSwan" uniqueId="strongSwan-5-2-0rc1"
     version="5.2.0rc1" versionScheme="alphanumeric">
  <Entity
     name="strongSwan Project" regid="regid.2004-03.org.strongswan"
     role="publisher licensor tagcreator"/>
  <Payload>
    <File location="/usr/sbin" name="ipsec"/>
    <File location="/usr/libexec/ipsec" name="charon"/>
    <File location="/usr/lib/ipsec" name="libcharon.so.0"/>
    <File location="/usr/lib/ipsec" name="libstrongswan.so.0"/>
  </Payload>
</SoftwareIdentity>
```

# swidGenerator - an Open Source Tool

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- The swid_generator tool allows to generate a complete inventory of the software packages installed on a Linux endpoint consisting either of ISO/IEC 19770-2 SWID Tags or concise unique Software IDs.
- Supported Linux package managers:

| | |
|---|---|
| dpkg | Debian, Ubuntu, etc. |
| rpm | RedHat, Fedora, SuSE, etc. |
| pacman | Arch Linux |

- Use:

```
swid_generator software-id
swid_generator swid [--pretty] [--full]  \
                    [--software-id <id>] \
                    [--package <name>]
```

- Download: https://github.com/strongswan/swidGenerator

# SWID Log for a given Endpoint I

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strongTNC - SWID log for Lenovo ...

tnc.strongswan.org/swid-log/26/#page=0

yitang zhang paper

strongTNC

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Overview

CONFIGURATION

Groups
Policies
Enforcements
Devices

DATA VIEWS

Packages
Products
Directories
Files
Regids
SWID tags
Statistics

## SWID log for Lenovo Twist Ubuntu 14.04a

View SWID inventory

### Set date range

From Jun 10. 2014 To Jun 17. 2014 Reset

Predefined range: Last Week

### Changes summary

| | |
|---|---|
| **Added SWID tags** | 59 |
| **Removed SWID tags** | 61 |
| **Sessions in range** | 4 |
| **First session in range** | Jun 10 11:56:01 2014 |
| **Last session in range** | Jun 17 11:44:33 2014 |

### Change log

1/3

| Session | Action | Unique ID | Package name | Version |
|---|---|---|---|---|

# SWID Log for a given Endpoint II

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FHO Fachhochschule Ostschweiz

strongTNC - SWID log for Lenovo ...

tnc.strongswan.org/swid-log/26/#page=0

strongTNC

Search

| Session | Action | Unique ID | Package name | Version |
|---|---|---|---|---|
| Jun 17 11:44:33 2014 | ADDED | Ubuntu_14.04-x86_64-evince-3.10.3-0ubuntu10.1 | evince | 3.10.3-0ubuntu10.1 |
| | ADDED | Ubuntu_14.04-x86_64-evince-common-3.10.3-0ubuntu10.1 | evince-common | 3.10.3-0ubuntu10.1 |
| | ADDED | Ubuntu_14.04-x86_64-libevdocument3-4-3.10.3-0ubuntu10.1 | libevdocument3-4 | 3.10.3-0ubuntu10.1 |
| | ADDED | Ubuntu_14.04-x86_64-libevview3-3-3.10.3-0ubuntu10.1 | libevview3-3 | 3.10.3-0ubuntu10.1 |
| | ADDED | Ubuntu_14.04-x86_64-tzdata-2014e-0ubuntu0.14.04 | tzdata | 2014e-0ubuntu0.14.04 |
| | ADDED | Ubuntu_14.04-x86_64-usb-creator-common-0.2.56.1 | usb-creator-common | 0.2.56.1 |
| | ADDED | Ubuntu_14.04-x86_64-usb-creator-gtk-0.2.56.1 | usb-creator-gtk | 0.2.56.1 |
| | ADDED | strongSwan-5-2-0rc1 | strongSwan | 5.2.0rc1 |
| | REMOVED | Ubuntu_14.04-x86_64-evince-3.10.3-0ubuntu10 | evince | 3.10.3-0ubuntu10 |
| | REMOVED | Ubuntu_14.04-x86_64-evince-common-3.10.3-0ubuntu10 | evince-common | 3.10.3-0ubuntu10 |
| | REMOVED | Ubuntu_14.04-x86_64-libevdocument3-4-3.10.3-0ubuntu10 | libevdocument3-4 | 3.10.3-0ubuntu10 |
| | REMOVED | Ubuntu_14.04-x86_64-libevview3-3-3.10.3-0ubuntu10 | libevview3-3 | 3.10.3-0ubuntu10 |
| | REMOVED | Ubuntu_14.04-x86_64-tzdata-2014c-0ubuntu0.14.04 | tzdata | 2014c-0ubuntu0.14.04 |
| | REMOVED | Ubuntu_14.04-x86_64-usb-creator-common-0.2.56 | usb-creator-common | 0.2.56 |
| | REMOVED | Ubuntu_14.04-x86_64-usb-creator-gtk-0.2.56 | usb-creator-gtk | 0.2.56 |
| Jun 15 11:22:50 2014 | ADDED | Ubuntu_14.04-x86_64-gir1.2-gtk-3.0-3.10.8-0ubuntu1.1 | gir1.2-gtk-3.0 | 3.10.8-0ubuntu1.1 |
| | ADDED | Ubuntu_14.04-x86_64-indicator-printers-0.1.7+14.04.20140527-0ubuntu1 | indicator-printers | 0.1.7+14.04.20140527-0ubuntu1 |
| | ADDED | Ubuntu_14.04-x86_64-initramfs-tools-0.103ubuntu4.2 | initramfs-tools | 0.103ubuntu4.2 |
| | ADDED | Ubuntu_14.04-x86_64-initramfs-tools-bin-0.103ubuntu4.2 | initramfs-tools-bin | 0.103ubuntu4.2 |
| | ADDED | Ubuntu_14.04-x86_64-libgail-3-0-3.10.8-0ubuntu1.1 | libgail-3-0 | 3.10.8-0ubuntu1.1 |
| | ADDED | Ubuntu_14.04-x86_64-libgtk-3-0-3.10.8-0ubuntu1.1 | libgtk-3-0 | 3.10.8-0ubuntu1.1 |
| | ADDED | Ubuntu_14.04-x86_64-libgtk-3-bin-3.10.8-0ubuntu1.1 | libgtk-3-bin | 3.10.8-0ubuntu1.1 |
| | ADDED | Ubuntu_14.04-x86_64-libgtk-3-common-3.10.8-0ubuntu1.1 | libgtk-3-common | 3.10.8-0ubuntu1.1 |

tnc.strongswan.org/swid-tags/3820/

# List of Endpoints for a given SWID Tag

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strongTNC - strongSwan-5-2-0dr4

tnc.strongswan.org/swid-tags/2165/#page=0&filter=strongswan&page2=0&page1=0

yitang zhang paper

strongTNC

Search

- Overview

CONFIGURATION

- Groups
- Policies
- Enforcements
- Devices

DATA VIEWS

- Packages
- Products
- Directories
- Files
- Regids
- SWID tags
- Statistics

## strongSwan-5-2-0dr4

### Tag

strongswan

- strongSwan-5-2-0dr4
- strongSwan-5-2-0dr5
- strongSwan-5-2-0dr6
- strongSwan-5-2-0rc1

### Tag Info

| | |
|---|---|
| **Name** | strongSwan |
| **Version** | 5.2.0dr4 |
| **Unique ID** | strongSwan-5-2-0dr4 |
| **Entities** | strongSwan Project (Tag Creator,Publisher,Licensor) |
| **Software ID** | regid.2004-03.org.strongswan_strongSwan-5-2-0dr4 |

View raw SWID tag

### Reported by Devices

| Description | First reported |
|---|---|
| Lenovo Twist Ubuntu 14.04 (aed15f4a32) | May 27 12:10:38 2014 |
| Lenovo Twist Ubuntu 14.04a (97b685002b) | May 24 10:31:07 2014 |
| Raspberry Pi 1 Debian 7.2a (1083f03988) | May 25 08:46:29 2014 |
| Raspberry Pi 1 Debian 7.5a (1083f03988) | May 25 13:08:08 2014 |
| Raspberry Pi 2 Debian 7.2 (34069147ac) | May 25 18:29:30 2014 |
| Raspberry Pi 2 Debian 7.5 (34069147ac) | May 25 18:59:08 2014 |

# Thank you for your attention!

# Questions?

www.strongswan.org/tnc/