Device and network topology map

High level introduction to gMap
Quick SoftAtHome introduction: leading software vendor for Broadband, Video and Data Analytics

- 300 talents
- owned by a club of operators
- 22M+ homes
- in 35 countries
- 40+ service providers
- 5M mobile agents

Logos of various companies are also displayed at the bottom.
Network topology and device identification map

FXS

DECT

USB

HGW

Ethernet

WLAN

Security Score

Private LAN

Private WLAN

Guest WLAN

USB

Ethernet

Wi-Fi
Why do we need topology discovery and device identification?

- Provide a more precise information to the end user
  - A more comprehensive Home Map with exact devices naming can help the user to solve himself connectivity problems.
  - Will generate less calls to the hotline
- Improve the LAN and so provide a better customer experience
  - Identifying which devices are causing problems, and plan remediation solutions: by the hotline or by new features in the Home Gateway.
- Adapt steering algorithms to provide better Wi-Fi Quality of Experience
- Provide operators with more detailed information about each device in the LAN
  - Better hotline problem solving. “Your iPad air needs an update” for example
  - Provide more detailed statistics and thus better reporting
    - Most used home devices
    - Devices causing the most problems
    - Most performant devices
- Tailored security and QoS rules
  - Provide dedicated QoS and security rules for each device type
gMap framework

- Device and network information gathering system
- Provides real-time information on home networks and device topologies.
- Modular and extensible: add extra protocols, interfaces, device types.
- Unified High Layer API

gMap models both:
- the gateway and extender’s interfaces:
  - physical, e.g. Ethernet, DECT, FXS, USB
  - virtual, e.g. WLAN VAP’s, SIP extensions
- the connected devices
  - physical, e.g. USB device, network-attached devices (PLC, Wi-Fi extenders, Printer, …)
  - virtual, e.g. USB storage device, partitions, UPnP DMS/DMR, SIP phones
Technology Overview

/ Topology detection
/ USB ports, hubs
/ PLC / Wi-Fi extenders & repeaters (MME, HomePlug AV, IEEE 1905.1A, SSWi)
/ LTLD
/ Bluetooth

/ Home Automation
/ DECT ULE
/ Z-Wave
/ Bluetooth Low Energy
/ Wireless MBUS
/ KNX
/ Zigbee
/ Philips HUE
/ IP Camera

/ Virtual device detection
/ UPnP devices, exposing DMS/DMR functions
/ USB interfaces, disk partitions
/ SIP phone presence (registration status)
/ IoT Cloud to Cloud devices (Nest, Netatmo …)
Main network topology discovery methods

- Bridge forwarding table
- Wi-Fi association list
- IEEE 1905.1A
- Homeplug AV
- SS Wi
- LLTD
Example: Wi-Fi Association list

```
/wctl -i wl0 assoclist
assoclist 50:C7:BF:01:E0:85
assoclist 18:B4:30:86:0D:FF
assoclist 00:07:F5:3A:50:62
assoclist 90:A2:DA:F0:0F:C1
```
Example: Bridge forwarding table

ETH0 -> Netdev name eth1.0
ETH2 -> Netdev name eth3.0

/usr/lib/gmap/mibs # bridge fdb show br bridge brport eth1.0
d8:fb:5e:5d:69:a0 master bridge permanent
80:e6:50:e2:95:d7 master bridge (Apple TV2)
...

/usr/lib/gmap/mibs # bridge fdb show br bridge brport eth3.0
00:11:32:30:e6:72 master bridge (SynologyNAS)
...
Device Identification

**Home Gateway**

- User Agent HTTP Fingerprints
- UPnP Fingerprints
- HTTPS Fingerprints

**SoftAtHome DIL Cloud**

- GMAP
  - Gmap probe
- DIL
- Third party algos

**SoftAtHome DB**

- 3rd party cloud database
- Orange mobile devices database

**Eyes’ON**

- Existing

**DIL Cloud**

- DHCP Fingerprints
- DNS-SD Fingerprints
- mDNS Hostname
- MAC Address
- TLS Fingerprints
- SYN SYN/ACK Fingerprints
Example: DHCP fingerprints (MacBook Pro)
gMap High Level Architecture

- gMap is a **framework** that provides a **unified** real-time **view** of devices attached to the gateway and the SoftAtHome Smart Wi-Fi (SSW) devices.
  - gMap client microsystems are used to enrich the base data model (MIBs).

![Diagram of gMap High Level Architecture](image-url)
gMap modules

- Self
- ETH
- Device type
- DNS
- UPnP
- WAN
- HNID
- USB
- mDNS / DNS-SD
- Events
- PLC HomePlug AV2
- PLC Devolo
- IEEE-1905.1A

- Wi-Fi Associated device list
- Device DB
- Owner
- Virtual device
- SSW
- LLTD
- Name-selector
- Camera
- HUE
- Z-Wave
- DECT-ULE
- DECT repeater
- ...

Confidential and SoftAtHome proprietary
Please wait while gMap is gathering all the data!
Data Synology NAS

```
Devices.Device.00:11:32:30:E6:72.Name=SynologyNAS
Devices.Device.00:11:32:30:E6:72.DeviceType=storage
Devices.Device.00:11:32:30:E6:72.Active=1
Devices.Device.00:11:32:30:E6:72.Tags=lan edev mac physical eth ipv4 ipv6 dhcp mdns upnp
Devices.Device.00:11:32:30:E6:72.Master=
Devices.Device.00:11:32:30:E6:72.Location=
Devices.Device.00:11:32:30:E6:72.Layer2Interface=eth3.0
Devices.Device.00:11:32:30:E6:72.InterfaceName=ETH2
Devices.Device.00:11:32:30:E6:72.MACVendor=
Devices.Device.00:11:32:30:E6:72.Owner=
Devices.Device.00:11:32:30:E6:72.VendorClassID=
Devices.Device.00:11:32:30:E6:72.UserClassID=
Devices.Device.00:11:32:30:E6:72.SerialNumber=
Devices.Device.00:11:32:30:E6:72.ProductClass=
Devices.Device.00:11:32:30:E6:72.OUI=
Devices.Device.00:11:32:30:E6:72.IPAddress=192.168.0.149
Devices.Device.00:11:32:30:E6:72.IPAddressSource=DHCP
```

Data Synology NAS

Devices.Device.00:11:32:30:E6:72.DeviceTypes
Devices.Device.00:11:32:30:E6:72.DeviceTypes.default
Devices.Device.00:11:32:30:E6:72.DeviceTypes.default.Type=Computer
Devices.Device.00:11:32:30:E6:72.DeviceTypes.mdns
Devices.Device.00:11:32:30:E6:72.DeviceTypes.mdns.Type=Printer
Devices.Device.00:11:32:30:E6:72.DeviceTypes.webui
Devices.Device.00:11:32:30:E6:72.DeviceTypes.webui.Type=storage
Devices.Device.00:11:32:30:E6:72.UDevice
Devices.Device.00:11:32:30:E6:72.UDevice.ETH2
Devices.Device.00:11:32:30:E6:72.UDevice.ETH2.Type=ethernet
Devices.Device.00:11:32:30:E6:72.LDevice
Devices.Device.00:11:32:30:E6:72.LDevice.uuid=00113230-e672-0011-72e6-72e630321100
Devices.Device.00:11:32:30:E6:72.LDevice.uuid=00113230-e672-0011-72e6-72e630321100.Type=default
Devices.Device.00:11:32:30:E6:72.Locations
Devices.Device.00:11:32:30:E6:72.IPv4Address
Devices.Device.00:11:32:30:E6:72.IPv4Address.192.168.0.149
Devices.Device.00:11:32:30:E6:72.IPv4Address.192.168.0.149.Address=192.168.0.149
Devices.Device.00:11:32:30:E6:72.IPv4Address.192.168.0.149.Scope=global
Devices.Device.00:11:32:30:E6:72.IPv4Address.192.168.0.149.AddressSource=DHCP
Devices.Device.00:11:32:30:E6:72.IPv4Address.192.168.0.149.AddressSource=DHCP
Devices.Device.00:11:32:30:E6:72.IPv6Address

Confidential and SoftAtHome proprietary
Other use cases
Network Topology
Presence detection

Media-agnostic way to do presence detection

/ Wi-Fi
/ Bluetooth
/ ...

Devices.Device.A0:56:F3:2D:76:8D.DiscoverySource=import
Devices.Device.A0:56:F3:2D:76:8D.Name=Mirceas-iPhone
Devices.Device.A0:56:F3:2D:76:8D.DeviceType=iPhone
Devices.Device.A0:56:F3:2D:76:8D.Active=1
Parental control

/ Assignment of user to a device.
/ Assignment of location to a device
/ Internet user based access rights
  / Permanent
  / Blocked
  / Scheduled
Security profiles

Thanks to the extra security information the UI knows which device is a malicious and a non malicious device.
Thanks to gMap, the backhaul selection algorithm knows the topology and the speed between each individual network node!
Device prioritisation aka QoS for Gamers

Quality of Service managers has an active query open on gMap. And knows in real-time which devices need to be assigned to the "QoS for Gamers" QoS profile.

<table>
<thead>
<tr>
<th>Device name</th>
<th>Prioritised</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple TV2</td>
<td>Off</td>
</tr>
<tr>
<td>H5110(EU)</td>
<td>Off</td>
</tr>
<tr>
<td>Logitech-UE-Air-Speaker-3AS062</td>
<td>Off</td>
</tr>
<tr>
<td>AquariumControlCenter</td>
<td>Off</td>
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</tbody>
</table>
gMap offers an agnostic way, for the UI, to control any IoT device regardless of the technology it is using!
<table>
<thead>
<tr>
<th>For more information about SoftAtHome</th>
<th>Corporate Headquarter</th>
<th>United Arab Emirates office</th>
<th>North America office</th>
<th>Belgium office</th>
<th>And also</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 rue du Débarcadère</td>
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Extension API

/ * gMap offers an API to add extensions: *
/   * To present a logical hierarchy of devices and their functionalities
/   * To label devices with:
/     - tags → device type, security risk, network type, events, ...
/     - names → friendly presentation to user
/     - device type → device type can come from multiple sources, e.g. grules, webui, dil, finger printing services, ...
/ * To expose an API to devices: *
/   * parameters, e.g. MAC address, WLAN signal strength, ...
/   * functions, e.g. play/pause, unpair, get statistics, switch on, ...
/   * events, e.g. IP address change, smoke detected, bandwidth statistics, ...
/   * Dynamic loading / unloading of new functionality depending on the tags.
gMap Client API

// Unified API
// Same API for web services and SI-API as for native applications

// Get topology
// From any point in the hierarchy, e.g.
//  • the whole gateway
//  • a particular network interface of the gateway
//  • a device, downwards to its subdevices
//  • a device, upwards, the path to the gateway

// Search Devices
// Find & get functions, by type / parameter / discovery mechanism, ..
// Uses logical expressions as filter
gMap Client API

- Device Tagging, Labeling
  - Add, remove tags: addTag, clearTag functions
  - Tag verification: hasTag function
- Adding, changing and removing name(s)
  - setName, addName, removeName, ... functions
- Setting and removing alternative device
  - setAlternative, removeAlternative
- Get IP address
  - getAddress
- Get and Set individual parameters
  - Get / Set
- Assigning and removing Location
  - setLocation, clearLocation
- Assign a user to a device
  - setOwner
- Subscribe to event notifications
  - e.g. device changed, device added/disappeared, topology changed
- Queries
  - Provide logical expression
  - Get real-time update of devices matching (or no longer matching) expression
  - Get custom notifications, specific to device type (e.g. periodic power consumption event, alarm)
Use cases

// Unified High Level API for device information
//     Queries, statistics, events, meta-data, finger prints, ...
// Unified database
// Device and Topology map
//     LAN and IoT devices
// Device Detection
//     STB, Game Console, Toolkit, 4G Modem, ...
// Device profiles (QoS, Security, ...) 
// Backhaul computation and selection for Smart Wi-Fi
// Presence detection
// Parental control
//     User to device association
//     Location to device association
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