Manufacturer Usage Descriptions

Automated device classification and policy discovery

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Today's latest threat: **printers**

Study cites multi-function printers as some of the most dangerous members of the IoT family

Bitdefender.com, 28 February 2019

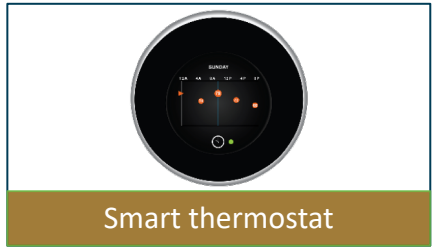
What Sort of Access Do These Printers Require?

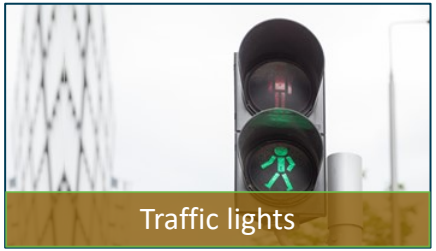
From	To	Protocol	Source Port	Destination Port(s)
Printer	xmpp009.hpeprint.com	TCP		80, 443, 5222,5223
Printer	DNS Server	UDP		53
Printer	chat.hpeprint.com	TCP		80,443
Printer	224.0.0.251/32	UDP		5353
Printer	220.0.0.252/32	UDP		5355
Printer	h10141.www1.hp.com	TCP		80
Printer	Local Networks	UDP	5353	
Printer	Local Networks	TCP	80	

Source: University of New South Wales, using mudgee

(not shown: L2 packets)

The possibilities are endless





Assumptions and Assertions

Assumptions	Assertions
A Thing has a single use or a small number of uses.	Because a Thing has a single or a small number of intended uses, all other uses must be unintended.
Things are tightly constrained. Very little CPU, memory, and battery.	Any intended use can be clearly identified.
Network administrators are the ultimate arbiters of how their networks will be used	Manufacturers are in a generally good position to provide guidance to administrators.
Even those Things that can protect themselves today may not be able to do so tomorrow	A mechanism is needed to protect devices that may have vulnerabilities.

Translating intent into config

Any intended use can be clearly identified by the manufacturer

access-list 10 permit host controller.mfg.example.com

All other uses can be warned against in a statement by the manufacturer

access-list 10 deny any any

Introducing Manufacturer Usage Descriptions (MUD)

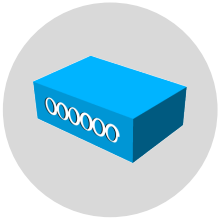
A URL:

https://manufacturer.example.com/mydevice.json

A MUD File:

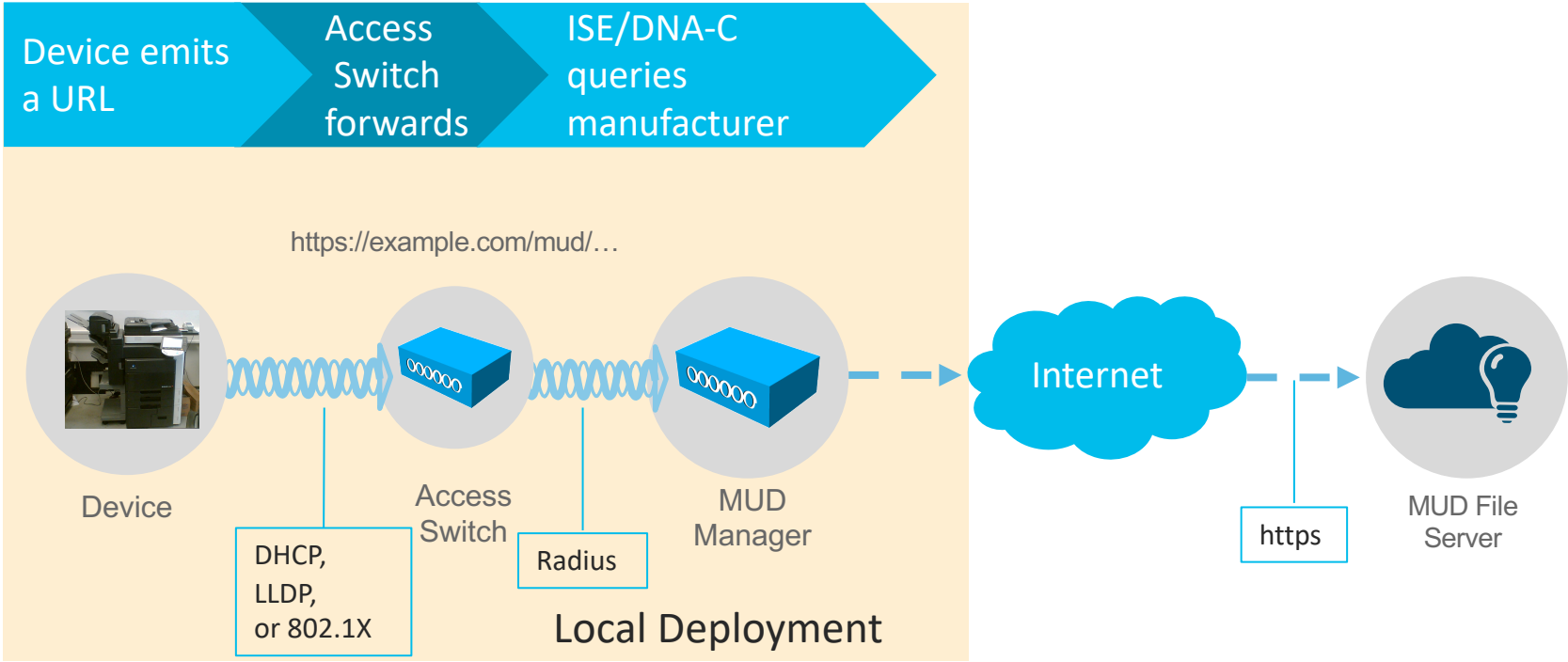
```
...
"ace": [   {
          "name": "cl0-todev",
          "matches": {
            "ietf-mud:mud": {
              "my-controller": [
                null
              ]
            } },
          "actions": {
            "forwarding": "accept"
          } }  ]
...
```

The MUD Manager:



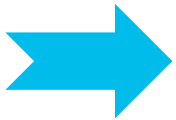
The MUD File Server:

Expressing Manufacturer Usage Descriptions



Getting from the MUD file to deployment config

```
... "acl": [
    {
     "name": "mud-76228-v4to",
     "type": "ipv4-acl-type",
     "aces": {
      "ace": [
       {
        "name": "myctl0-todev",
        "matches": {
         "ietf-mud:mud": {
          "my-controller": [
           null
          ]
         }
        },
        "actions": {
         "forwarding": "accept"
        } …
```

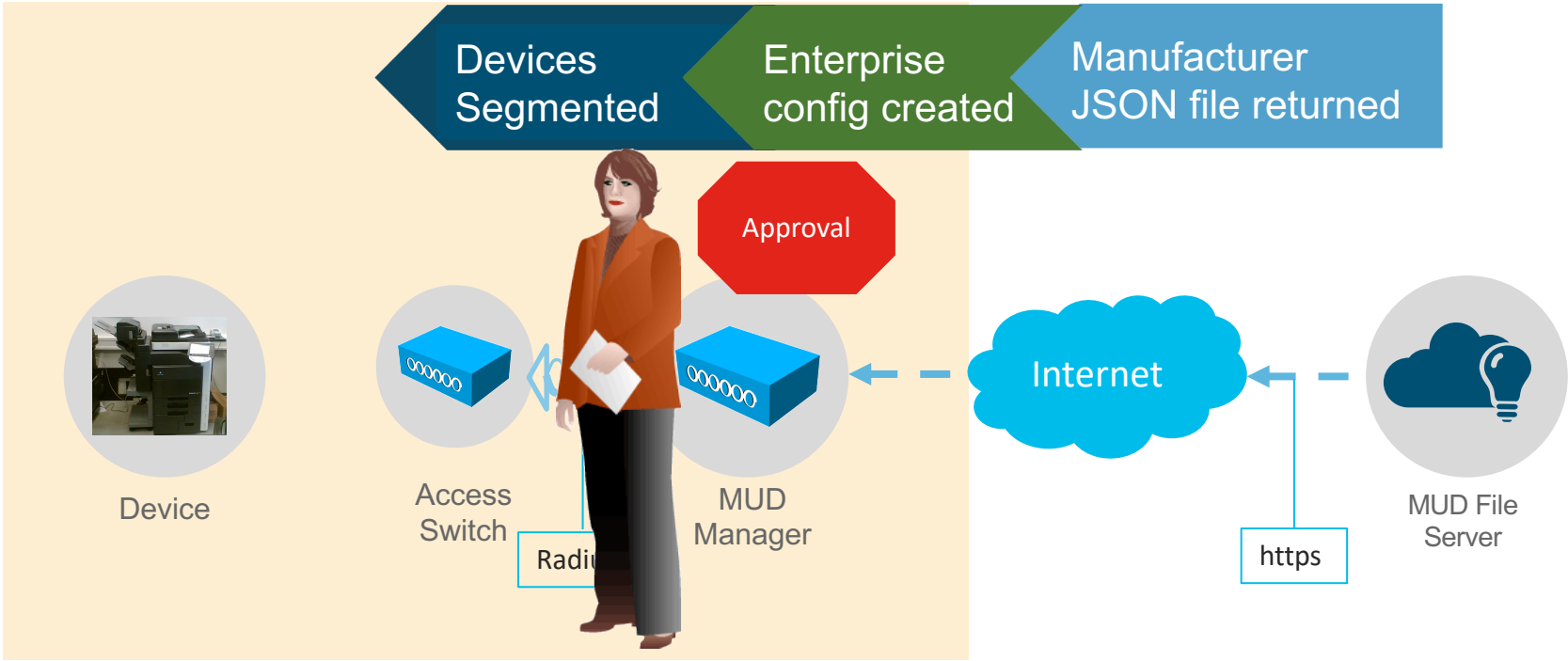


Whatever is appropriate in the local deployment.

10.1.2.3
10.4.5.6

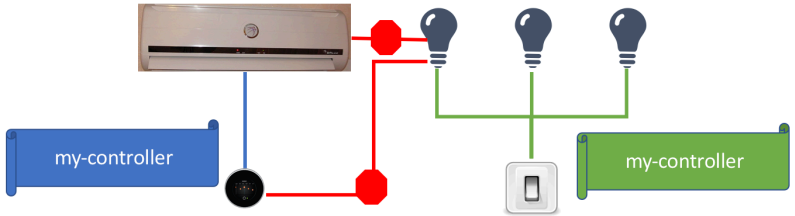
https://mudmaker.org

Expressing Manufacturer Usage Descriptions

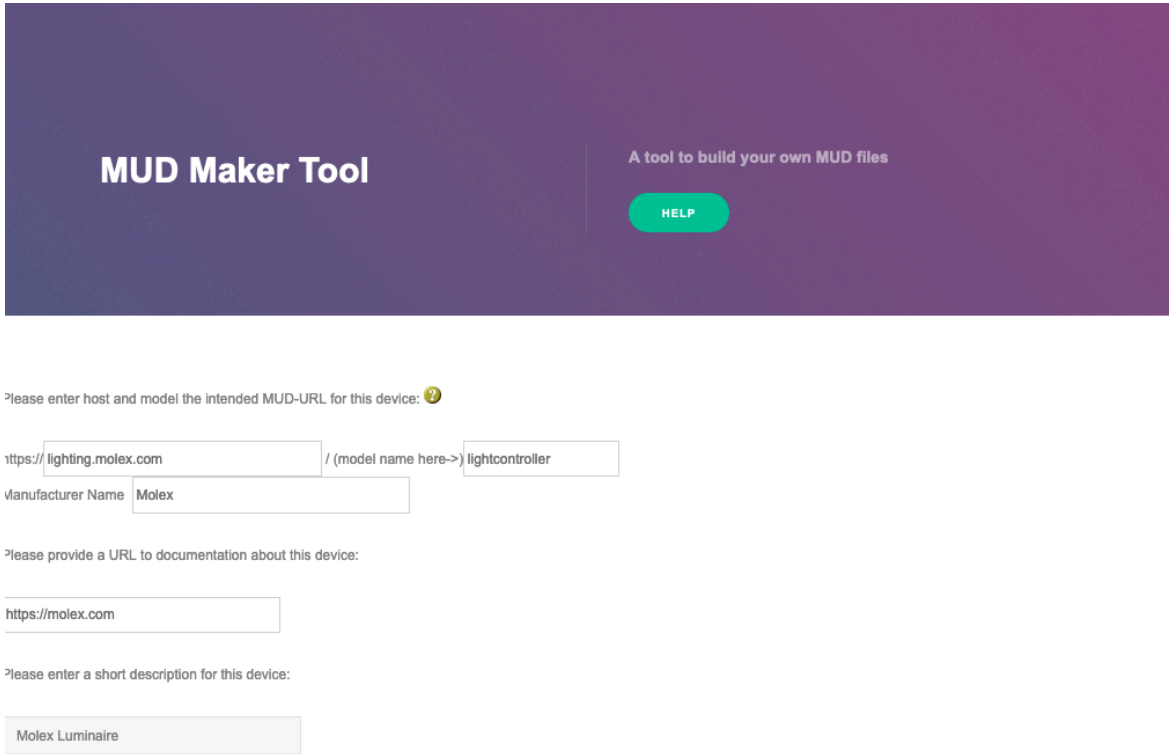


Results

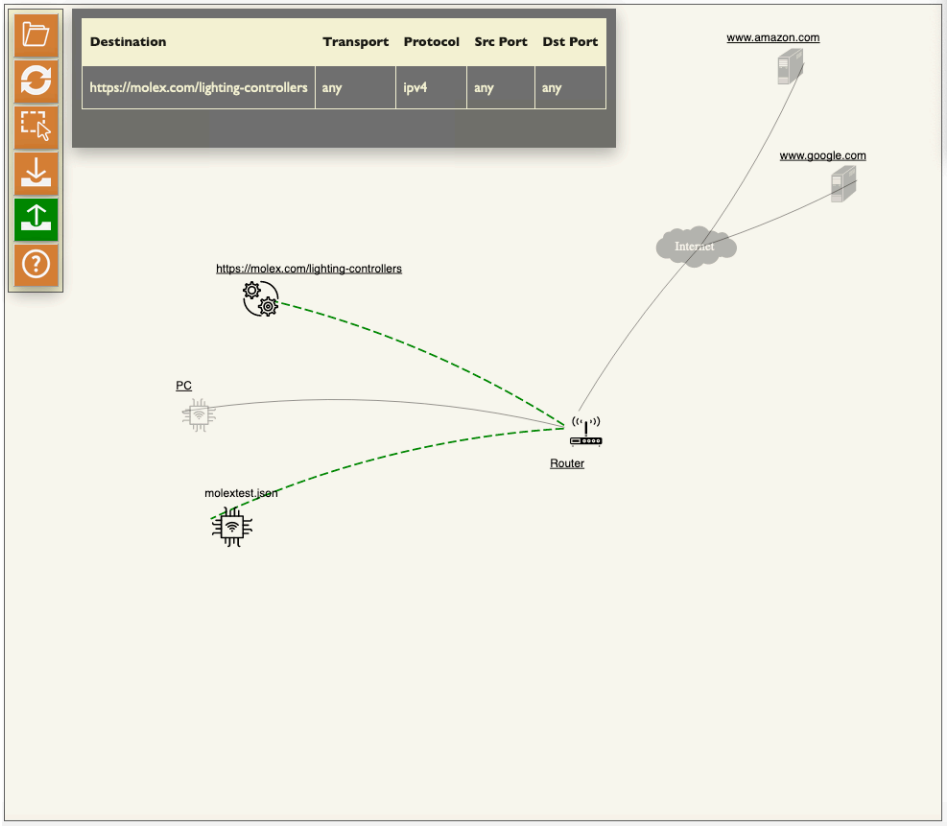
- Devices are automatically segmented based on what sort of access they were designed to have
- Administrator didn‘t play guessing games



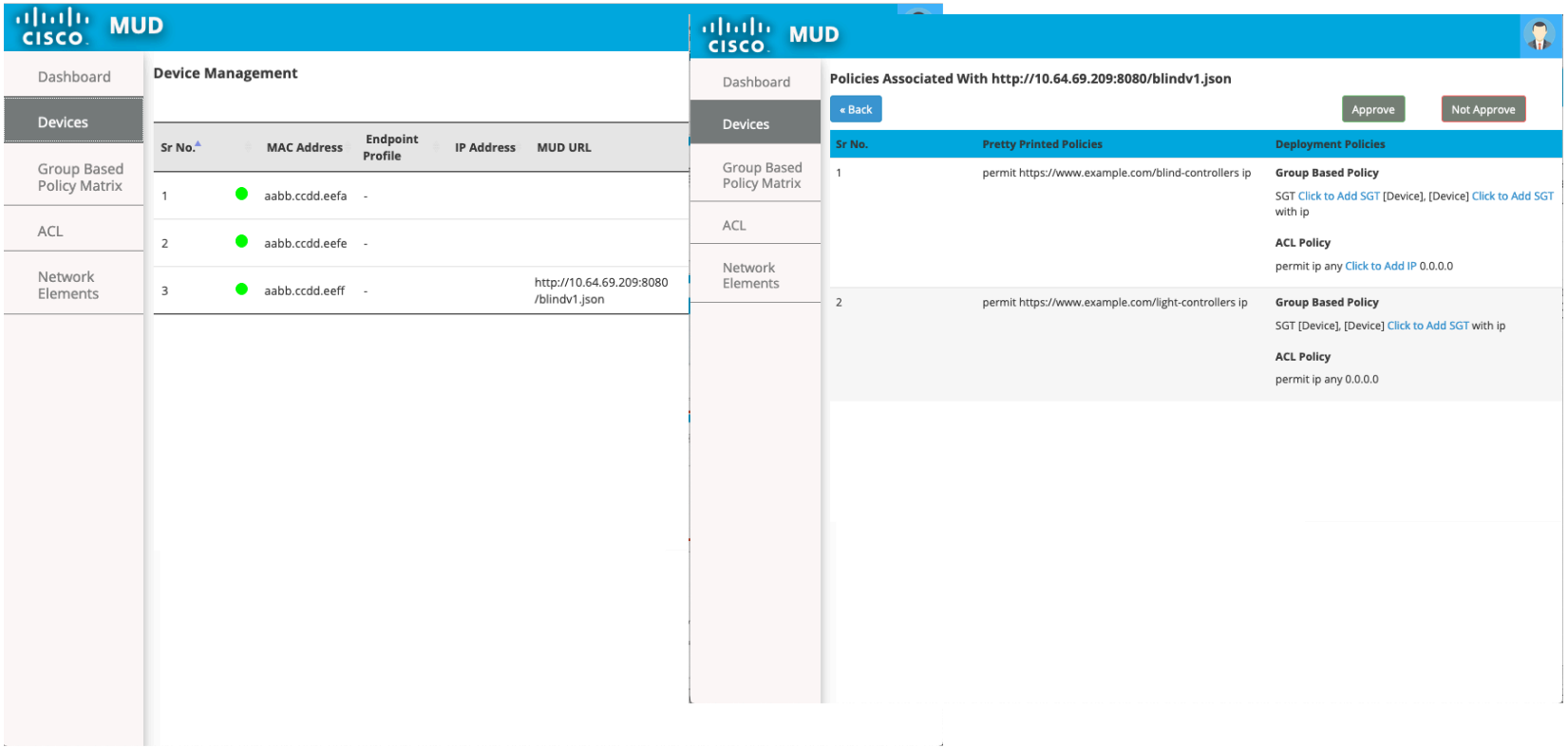
For Device Developers: Authoring Tooling



For Device Developers: Policy Visualization



For Admins: Simple GUI for Approval



Some MUD characteristics

- MUD configures **the network, and not devices**.
  - Devices require no semantic understanding of MUD or MUD files
  - Almost no additional processing by devices required (just output a MUD URL)
  - MUD makes no promises to device as to what network resources it will be granted access to
- It is a component architecture
  - Use what you want, discard the rest
  - If you only want to classify, take MUD URL, maybe additional “header” information
  - If device doesn’t output MUD URL, it can be associated in other ways
    - Label scan
    - BOM import
    - Imported SBOM component
  - MUD can provide no more than whatever underlying network capabilities exist. It is merely a management function.

Next steps

- Focus has primarily been on L3 Access
  - Work needed to automate controller selection
  - SP/CPE gear integration would help
  - Reporting tooling
- Today MUD can function well on 802.3, 802.11 networks
- MUD can also provide lower level network characteristics in extensions:
  - Expected b/w / frequency profile to test against (important for 3G/5G)
  - DETNET / TSN characteristics

References

- RFC 8520 – Manufacturer Usage Descriptions
- MUD file authoring tool and visualizer
  https://mudmaker.org
- DACL-based MUD manager
  https://github.com/CiscoDevNet/MUD-Manager
- Openflow-based MUD Manager
  https://github.com/usnistgov/nist-mud
- More coming