A Fox in the Hen House

UPnP IGD

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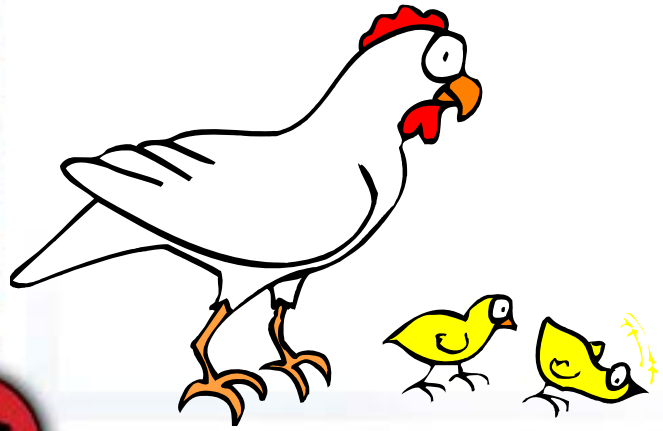


Agenda

- Always popular disclaimer
- Intro to UPnP
- UPnP IGD profile
- Demos
- Why this works
- Future research

Important Disclaimer

(Pay Attention)

- This project is my own personal research and is not sponsored by anyone but me.
- If you break something you get to keep the pieces.
- No routers were harmed in the creation of this presentation.

Introduction to UPnP

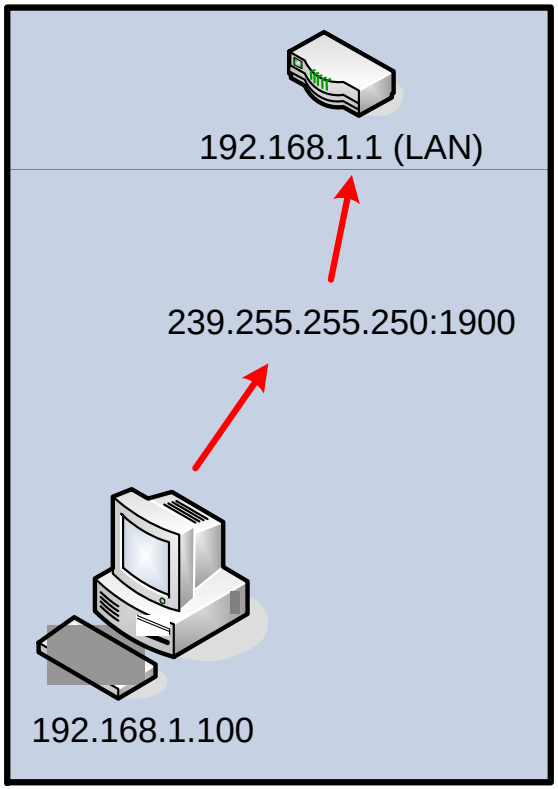
- Goal of UPnP + SSDP
  - Allow devices to easily self organize and configure on a home network
  - DHCP or Reserved Space (169.254.0.0)
- Based on common standards
  - TCP, UDP, Multicast, XML,SOAP, HTTP

Finding Targets (SSDP)

- 239.255.255.250:1900
- M-SEARCH
  - Control point initiated search
  - Responses come back via UDP Unicast
  - Responses contain Location URL
- NOTIFY
  - Periodically sent by UPnP devices

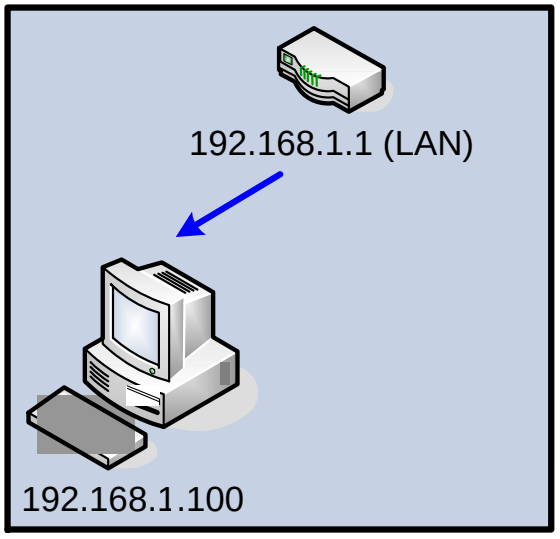
M-SEARCH

M-SEARCH * HTTP/1.1
ST: ssdp:all
MX: 5
MAN: ssdp:discover
HOST: 239.255.255.250:1900



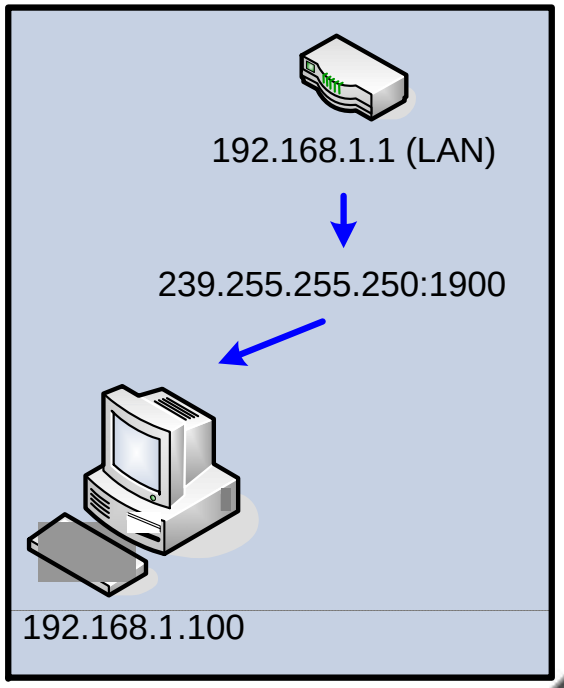
M-Search Response

HTTP/1.1 200 OK
ST: upnp:rootdevice
USN: uuid:13529010-1ad7-10c2-9abc-001cc33fa2ca::upnp:rootdevice
EXT:
SERVER: VxWorks/5.4.2 UPnP/1.0 iGateway/1.1
LOCATION: http://192.168.1.1:2869/IGatewayDeviceDescDoc
CACHE-CONTROL: max-age = 126
Content-Length: 0



NOTIFY

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
LOCATION: http://192.168.1.1:2869/IGatewayDeviceDescDoc
USN: uuid:13529010-1ad7-10c2-9abc-001cc33fa2ca::upnp:rootdevice
SERVER: VxWorks/5.4.2 UPnP/1.0 iGateway/1.1
NT: upnp:rootdevice
NTS: ssdp:alive
CACHE-CONTROL: max-age = 126



What now?

- Pull description XML file from Location
- Description file contains “Services”
  - <serviceType></serviceType>
  - <serviceId></serviceId>
  - <controlURL></controlURL>
  - <eventSubURL></eventSubURL>
  - <SCPDURL></SCPDURL>

What now?

- For each service
  - Pull SCPDURL via HTTP
  - Parse description for actions
  - Send SOAP messages to Control URL
  - Have Fun.

What is UPnP IGD

- Internet Gateway Device profile
- Attempts to simplify network connectivity and configuration for client systems.
- Allows client systems to request firewall rule modifications so services such as chat and gaming work

Can I log into your router?

- NO!
- *Ok, I’m assuming you changed the default username and password.

That's OK, I'll do it myself

- WANIPConnection:1
- WANPPPConnection:1
  - AddPortMapping(NewRemoteHost,
    NewExternalPort,NewProtocol,NewInternalPort,
    NewInternalClient,NewEnabled,
    NewPortMappingDescription,NewLeaseDuration)

Demonstration 1

Adding a forward rule to the router

So… what happened?

- Found an IGD via SSDP M-Search
  - n.discover("urn:schemas-upnp-org:device:InternetGatewayDevice:1")
- Found service description for:
  - WANIPConnection:1
- Sent a SOAP message to add a forward
  - s.AddPortMapping("",1234,"TCP",1234,"192.168.1.123",1,"UPnPwn",0)
- Success

And this is bad?

- Ummm… Yeah.
- No authentication
- No user notification
- Any internal host can request a forward "on behalf of" any other inside host

Some more fun with AddPortMapping

- Forward to any internal host (LAN side)
- Forward to any host (on WAN side)
  - Some firmware is so broken they define "NewInternalHost" as ANY.
- Forward to the admin interface from the outside
- DoS (fill forwards table)

Demonstration 2

What does the router owner see?

Is this bad?

- Forwarding rules that aren't listed in any obvious place? You tell me.
- Most users don't check their rules anyway, but if they do, they get a false sense of security.
- Does your mom know how to run nmap?

Is this bad? Or worse?

- Some devices save these rules to flash
- Some devices show you the rules, but you can't change them unless you use UPnP

Can we do anything?

- Turn off UPnP
- Don't forward "on behalf of" anybody else
- Modify UPnP Servers to only trust specific hosts
  - This breaks part of the spec, but in practice isn't really a problem
- Implement UPnP Device Security and Security Console Profiles (maybe)
- Simplified key system for updates (token)
  - Would require modified UPnP client and server
  - Should run over SSL
- Stop buying insecure devices

Some other stuff to scare you

- LANHostConfigManagement:1
  - SetDHCPRelay(NewDHCPRelay)
  - SetIPRouter(NewIPRouters)
  - SetDNSServer(NewDNSServers)
- WANPPPConnection:1
  - GetUserName()
  - GetPassword()

Be more afraid

linux-igd hack (Credit to: Armijn Hemel http://www.upnp-hacks.org/)

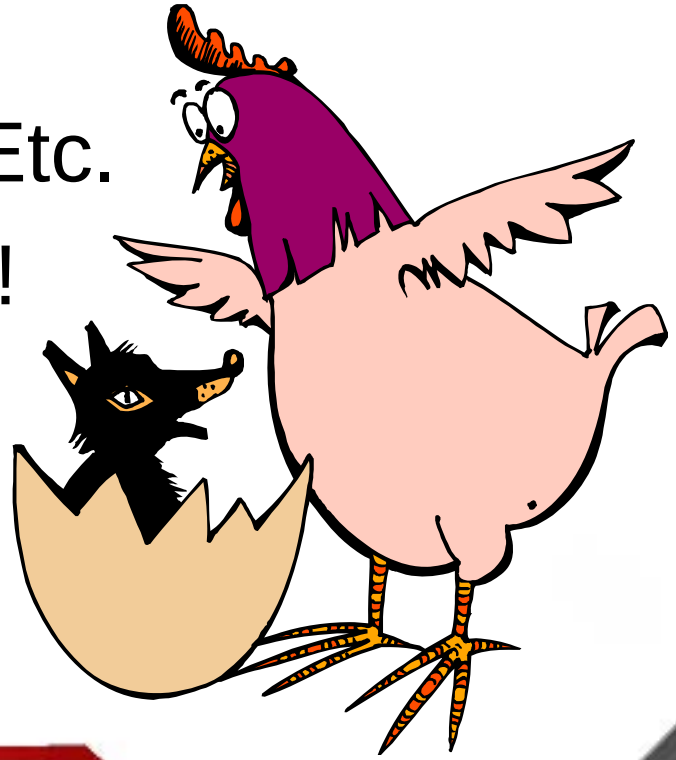
- Many devices are based on and old version of Linux IGD project code that has this vulnerability:

```
int pmlist_AddPortMapping (
char *protocol, char *externalPort, char *internalClient,char *internalPort) {
char command[500];
sprintf(command, "%s -t nat -A %s -i %s -p %s -m mport
                        --dport %s -j DNAT --to %s:%s", g_iptables,
                        g_preroutingChainName, g_extInterfaceName,
                        protocol, externalPort, internalClient, internalPort);
system (command);
...
}
```

- So, what do you think happens if NewInternalClient="‘/sbin/reboot‘"

Oh, and it's not always local

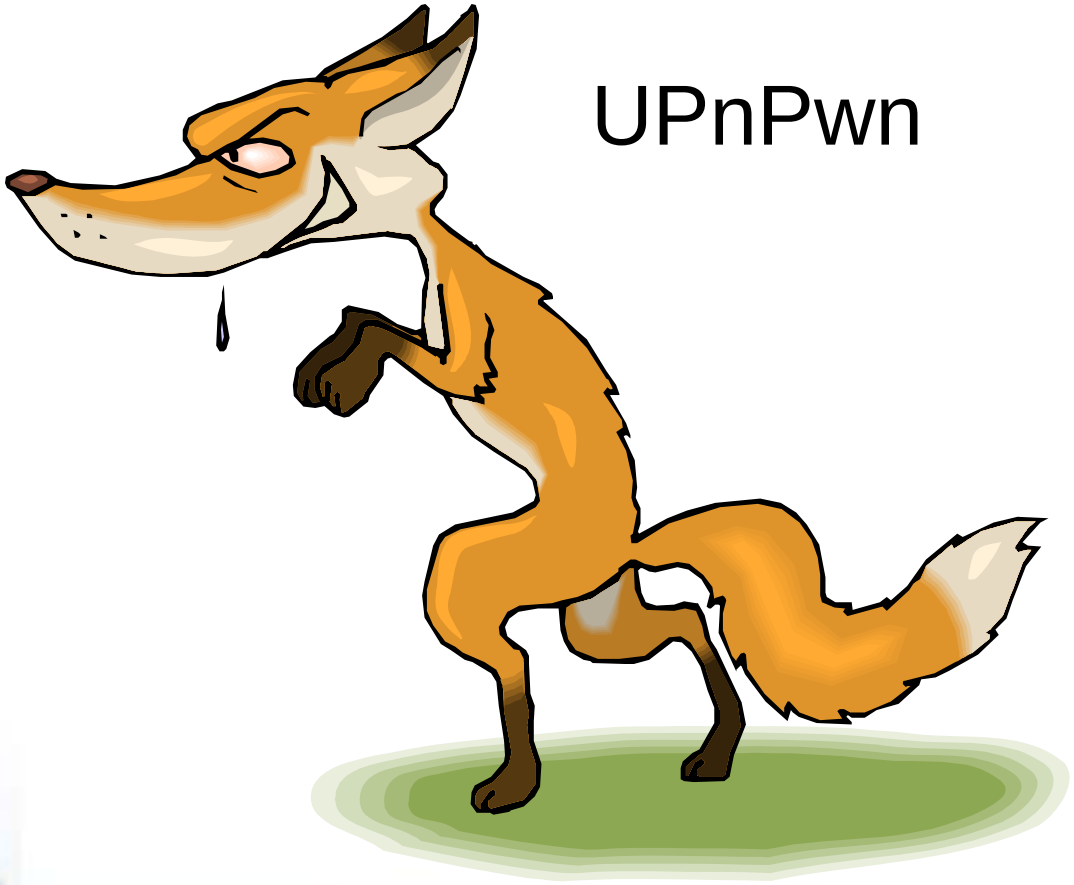
- GNU Citizen Flash UPnP Attack
- XSS
- Worms, Virus, Trojans, Etc.
- UPnP on WAN interface!



Future Research

- UPnP Stack Fingerprinting
- UPnP Fuzzer
- Code Execution / Buffer Overflows
- Windows Connect Now (WFADevice:1)
- UPnP A/V Profiles
- UPnP HVAC (anybody have one?)
- Other Dynamic configuration protocols

Demonstration 3



UPnPwn

Questions?

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References

- UPnPwn updates and other research
  - http://www.bigbrainlabs.com/
- UPnP-hacks (Linux IGD attack)
  - http://www.upnp-hacks.org/igd.html
- GNUCitizen Flash UPnP Attack
  - http://www.gnucitizen.org/blog/hacking-the-interwebs/
- Crazy Toaster
  - http://www.drorshalev.com/dev/upnp/toaster/DC-15-Shalev-004.ppt
- RFCs
  - http://tools.ietf.org/html/draft-cai-ssdp-v1-03
  - http://tools.ietf.org/html/draft-cohen-gena-client-00
  - http://tools.ietf.org/html/draft-goland-http-udp-01
- UPnP Forum
  - http://www.upnp.org/standardizeddcps/igd.asp