WWW.IARIA.ORG

PANEL SECURWARE/DEPEND

Security and Trust in IoT-based Complex Systems

Today's Panelists

- **Moderator:**
  Petre Dini, Concordia University, Canada || China Space Agency Center, China
- **Panelists:**
  Giray Kömürcü, Tubitak-Bilgem, Turkey

  Possible cheap security solutions on Internet of Things based on Physical Unclonable Functions
- **Vito Santarcangelo, Centro Studi S.r.l., Italia**

  ISO 27001: 2013 for the development of security policies in IoT"; "IoT Security: The Shodan case
- **Curtis Busby-Earle, The University of the West Indies at Mona, Jamaica**
- **security concerns related to the emergent behaviours that would result from the unification the many and varied "components" of an IoT**
- **Vladimir Muliukha, Peter the Great St.Petersburg Polytechnic University, Russia**

  vision of security issues of distributed systems; on the difference between "Confidentiality" and "Security"

Thanks!

Qs & As

WWW.IARIA.ORG

Securware 2015

Security and Trust in IoT-based Complex Systems

Curtis Busby-Earle, PhD

Internet of Things?

- Ubiquitous Computing
  - “...to unify the multiple interfaces to disparate resources loosely connected on a variety of networking mediums”
- Networking
  - protocols, devices, apps, cost
  - opened up the possibility of computer technology receding into the environment

PNoTs

Curtis Busby-Earle, PhD

Emergent Behaviour

- When combined, how do/will these “systems” behave?
- Must consider
  - security and usability
  - security and performance
  - security and interoperability/interference
  - security and privacy
  - security and social interactions (e.g. networks of PNoTs)
  - …

Port existing solutions?

- Firewall on every device?
- IDS on every device?
- Anti-malware on every device?
- Challenge response protocol implemented on every device?
- Encrypt/decrypt communication on every device?
- ...

Maybe, not so practical!

New approaches

- Must develop new approaches
  - more dynamic - must be able to deal with unknown, emergent behaviour
    - very difficult!

- Must truly build security *into* “things”

What’s next?

Your thoughts and ideas!

PANEL

IoT Security : The Shodan case

Vito Santarcangelo

Applied Research Engineer

Centro Studi S.r.l.

Centro Studi

Process Development & Applied Research

gruppo orizzonti holding

Venice, 26 August 2015

IARIA

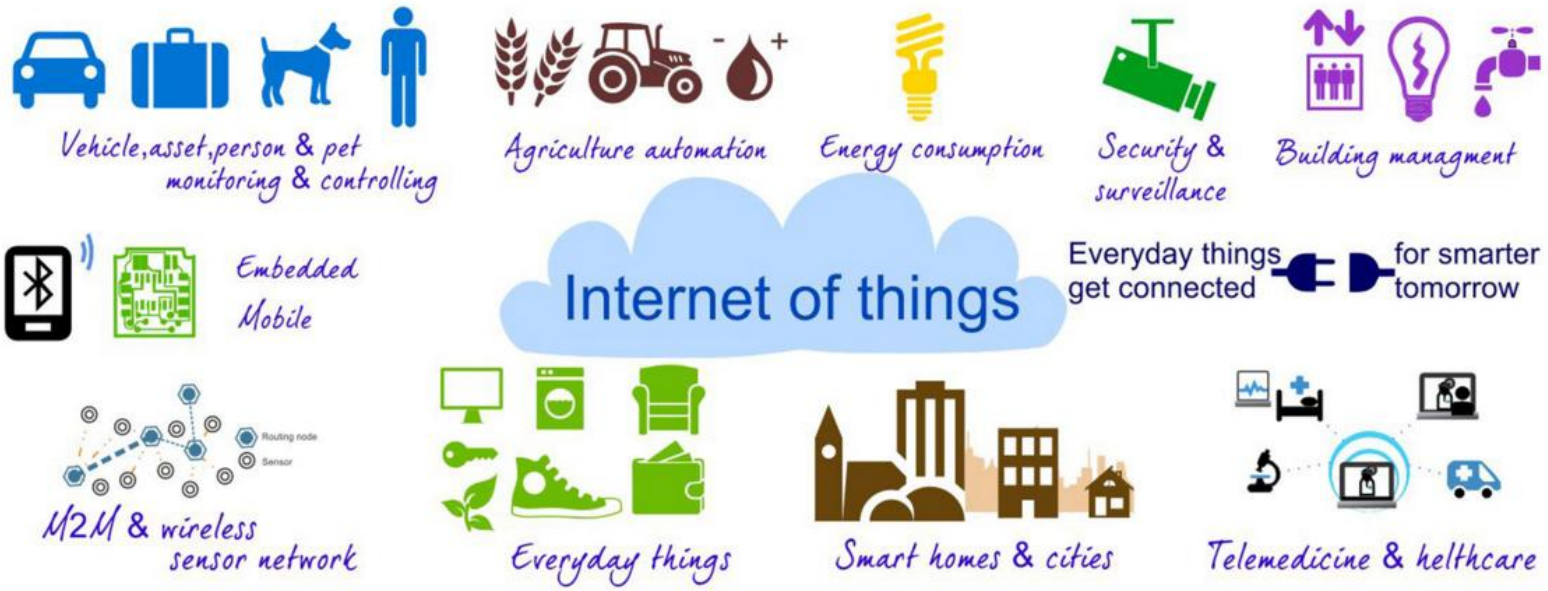
NETWARE2015

The IoT Scenario

- IoT is the network of physical objects or "things" embedded with electronics, software, sensors, and connectivity to enable objects to exchange data with other connected devices

- Examples of applications : Media, Surveillance, Building and home automation, Environmental monitoring, Infrastructure management, Energy management, Medical and healthcare systems

IoT



https://datasciencebe.files.wordpress.com/2014/11/internet-of-things.jpg

Common Problems

A common network… common Problems!

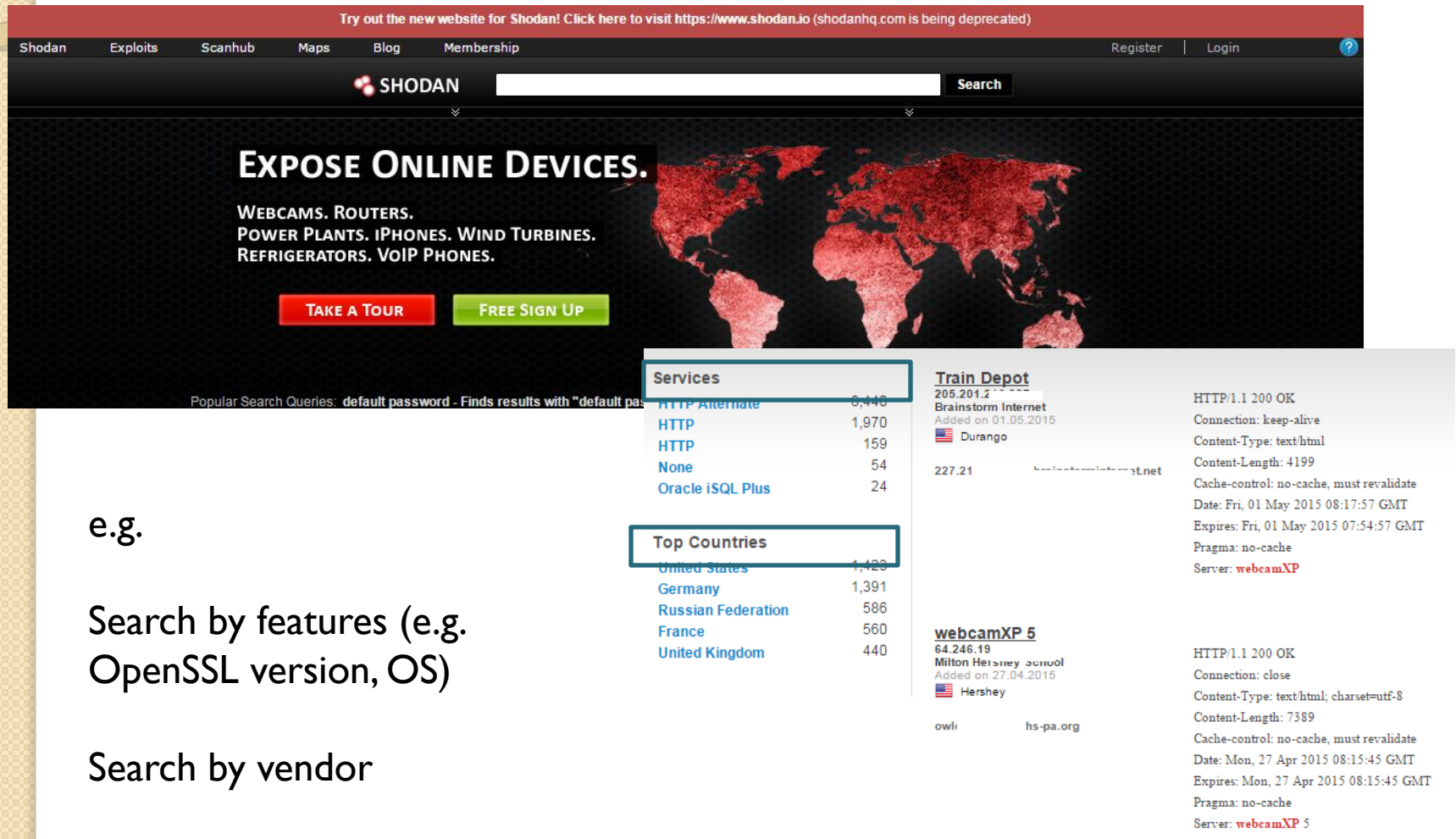
Examples of security problems for IoT devices:

- USE OF DIRECT DEVICE PORTFORWARDING INSTEAD OF VPN ACCESS
- DIRECT REMOTE ACCESS (eg. Synology QuickConnect) INSTEAD OF VPN ACCESS
- USE OF DEFAULT USER AND PASSWORD CREDENTIALS
- FIRMWARE's BUGS (VERSION OUTDATED)

THE SHODAN CASE

SEARCH ENGINE

- **Google finds web sites - Shodan finds devices**



e.g.

Search by features (e.g. OpenSSL version, OS)

Search by vendor

SHODAN

www.shodan.io

Explore the Internet of Things
Use Shodan to discover which of your devices are connected to the Internet, where they are located and who is using them.

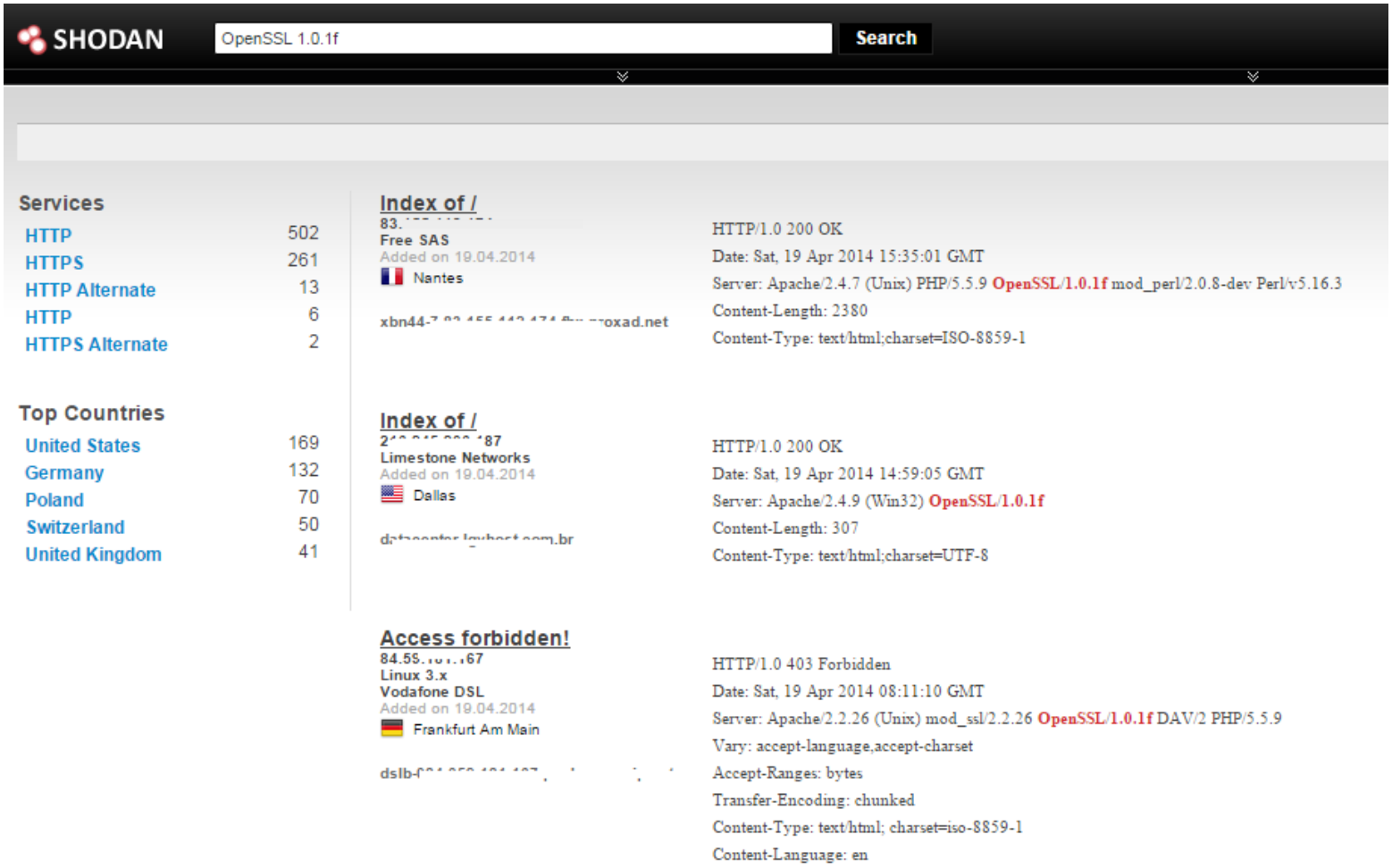
See the Big Picture
Websites are just one part of the Internet. There are power plants, Smart TVs, refrigerators and much more that can be found with Shodan!

Monitor Network Security
Keep track of all the computers on your network that are directly accessible from the Internet. Shodan lets you understand your digital footprint.

Get a Competitive Advantage
Who is using your product? Where are they located? Use Shodan to perform empirical market intelligence.

EXAMPLE OF SEARCH

by features



Heartbleed is a bug present in
OpenSSL versions 1.0.1 through 1.0.1f.

EXAMPLE OF SEARCH

by vendor

189.[redacted]
Cablemas Telecomunicaciones SA de CV
Added on 27.02.2015
Acapulco
189.[redacted].cable.dyn.cableonline.com.mx

220 AXIS 207 Network Camera 4.40 (Aug 28 2006) ready.
530 Login incorrect.
214-The following commands are implemented.
USER QUIT PASS SYST HELP PORT PASV LIST
NLST RETR STOR TYPE MKD RMD DELE PWD
CWD SITE CDUP RNFR RNTO NOOP EPRT EPSVr
214 End of list.
503 Bad sequence of commands.

173.[redacted]
Comcast Business Communications
Added on 27.02.2015
Southborough
[redacted]-77-189-[redacted]NewEngland[redacted]ness.net

220 AXIS 214 PTZ Network Camera 4.49 (Oct 05 2009) ready.
530 Login incorrect.
214-The following commands are implemented.
USER QUIT PASS SYST HELP PORT PASV LIST
NLST RETR STOR TYPE MKD RMD DELE PWD
CWD SITE CDUP RNFR RNTO NOOP EPRT EPSVr
214 End of list.
503 Bad sequence of commands.

189.[redacted]
Uninet S.A. de C.V.
Added on 27.02.2015
[redacted]dyn.prod-infinitum.com.mx

220 AXIS 207W Network Camera 4.44.2 (Dec 14 2009) ready.
530 Login incorrect.
214-The following commands are implemented.
USER QUIT PASS SYST HELP PORT PASV LIST
NLST RETR STOR TYPE MKD RMD DELE PWD
CWD SITE CDUP RNFR RNTO NOOP EPRT EPSVr
214 End of list.
503 Bad sequence of commands.

217.14[redacted]
Linux 2.4-2.6
Telecom Italia
Added on 27.02.2015

220 AXIS P3344 Fixed Dome Network Camera 5.07 (Oct 02 2009) ready.
530 Login incorrect.
214-The following commands are implemented.
USER QUIT PASS SYST HELP PORT PASV LIST
NLST RETR STOR TYPE MKD RMD DELE PWD
CWD SITE CDUP RNFR RNTO NOOP EPRT EPSVr

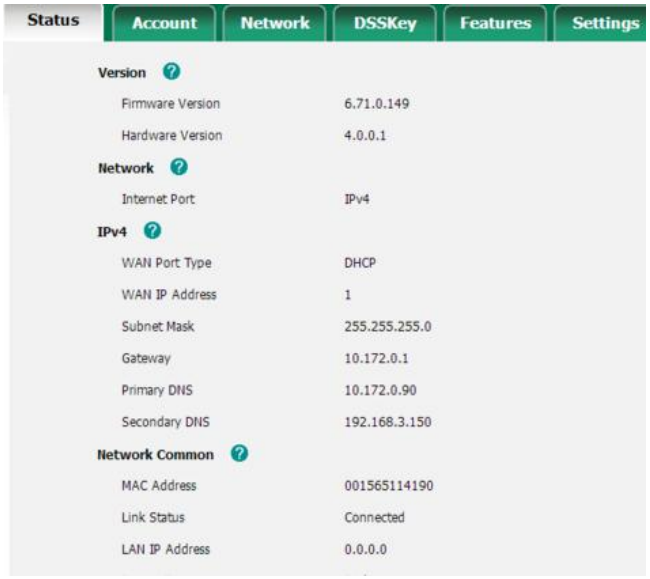
SHODAN MAP

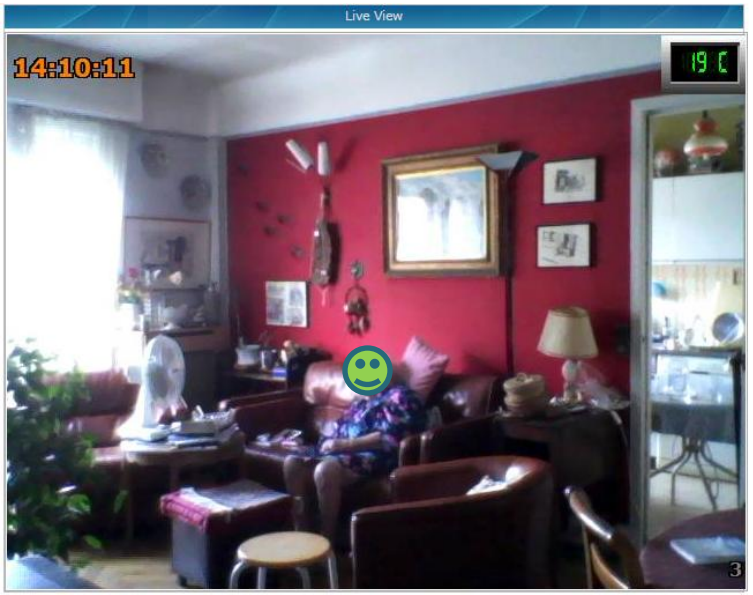

apache
Search
Total Results: 36,716,191
Top Services
HTTP 25,329,934
HTTPS 8,934,720
HTTP (8080) 1,610,741
HTTP (81) 399,656
HTTPS (8443) 264,588
Top Countries
US 13,612,190
DE 3,236,243
JP 2,070,628
CN 1,899,375
GB 1,297,671
Top Organizations
Amazon.com 846,163
Ecommerce Corporat... 792,959
Verio Web Hosting 769,196
Unified Layer 625,117
GoDaddy.com, LLC 573,559
United States
México
Cuba

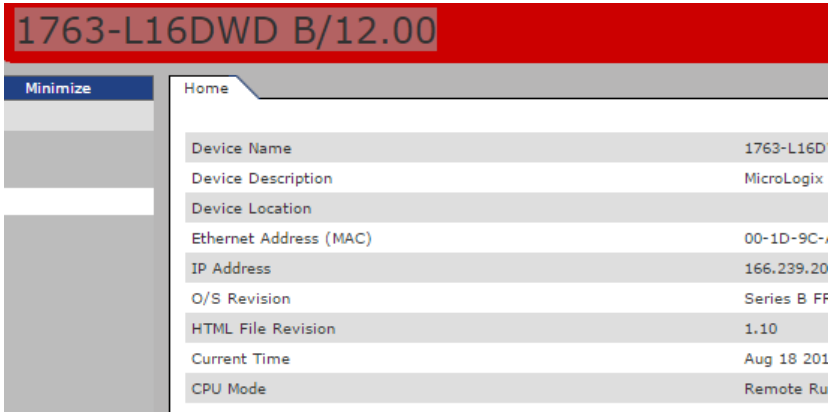
POPULAR SHODAN RESEARCH QUERIES

- default password - Finds results with "default password" in the banner; the named defaults might work!
- Router w/ Default Info - Routers that give their default username/password as admin/1234 in their banner.
- webcamxp - one of the best dorks for ip cameras/webcams
- D-Link Internet Camera - D-Link Internet Camera DCS-5300 series, without authentication.
- IPads - IPads. Think different. Think no security.
- cisco-ios last-modified - Finds Cisco-IOS results that do not require any authentication ;-)
- Snom VOIP phones with no authentication - A list of Snom phone management interface without authentication
- Anonymous access granted - title says it all, mostly FTP servers would be visible
- iOmega NAS Devices (no passwords) - A bunch of external hard drives without passwords attached to the interbuttz

EXAMPLES


Status
Account
Network
DSSKey
Features
Settings
Version
Firmware Version 6.71.0.149
Hardware Version 4.0.0.1
Network
Internet Port IPv4
IPv4
WAN Port Type DHCP
WAN IP Address 1
Subnet Mask 255.255.255.0
Gateway 10.172.0.1
Primary DNS 10.172.0.90
Secondary DNS 192.168.3.150
Network Common
MAC Address 001565114190
Link Status Connected
LAN IP Address 0.0.0.0


Live View
14:10:11
19 C


1763-L16DWD B/12.00
Minimize
Home
Device Name 1763-L16D
Device Description MicroLogix
Device Location
Ethernet Address (MAC) 00-1D-9C-
IP Address 166.239.20
O/S Revision Series B FF
HTML File Revision 1.10
Current Time Aug 18 201
CPU Mode Remote Ru


Aficio MP 2851 Web Image Monitor
Home
Status
Device Info
Counter
Inquiry
Device Name : 121 CR212
Location :
Comment :
Host Name : RNP14
Status
Printer Warming Up...
Copier Energy Saver Mode
Fax Energy Saver Mode
Scanner Energy Saver Mode
Printer:
Energy Saver Mode
Warming Up...

SOLUTIONS

- Robust authentication credentials
- Firmware upgrade
- Use of OTP (One Time Password) Auth Method
- Security devices as Firewall, IDS and IPS
- VPN Networks

REFERENCES

For more information and dataset visit

http://www.researchgate.net/profile/Vito_Santarcangelo

Thanks for the attention!

PANEL

ISO 27001:2013 for the development of security policies in IoT

Vito Santarcangelo

Applied Research Engineer

Centro Studi S.r.l.

Centro Studi

Process Development & Applied Research

gruppo orizzonti holding

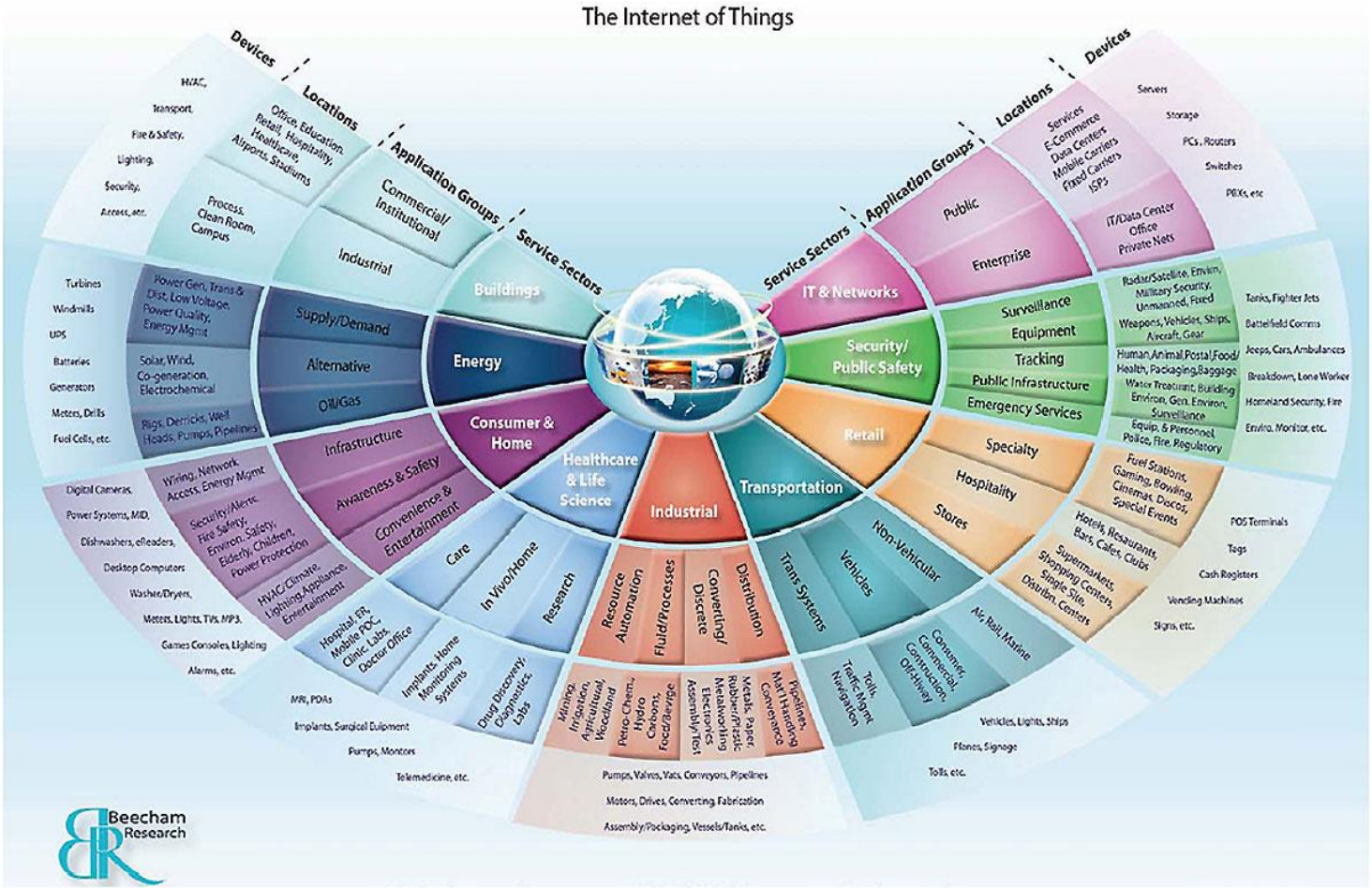
Venice, 26 August 2015

IARIA

NETWARE2015

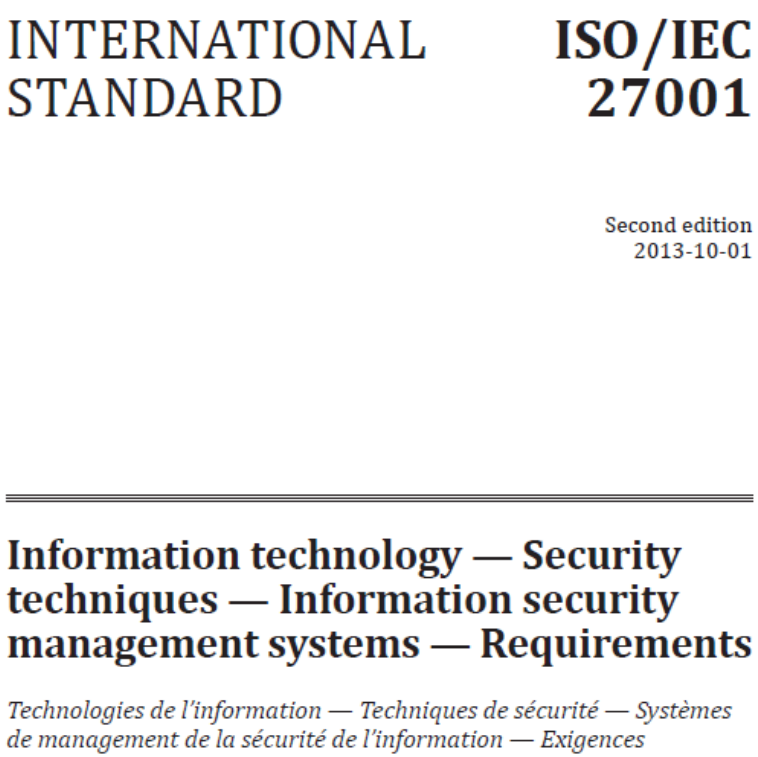
A common network… common Problems!

IoT Scenario



IoT is the network of physical objects or "things" embedded with electronics, software, sensors, and connectivity to enable objects to exchange data with other connected devices

ISO 27001:2013 AND ANNEX A


INTERNATIONAL STANDARD

ISO/IEC 27001

Second edition
2013-10-01

Information technology — Security techniques — Information security management systems — Requirements

Technologies de l'information — Techniques de sécurité — Systèmes de management de la sécurité de l'information — Exigences

ISO 27000 : Fundamentals and vocabulary

ISO 27001 : ISMS Requirements (normative)

ISO 27002 : ISMS Code of practice (guide)

ISO 27001's Annex A

list of 114 controls /best practices (35 control objectives, 14 key points from A.5 to A.18)

POLICIES FOR IoT

A.6 Organization of information security

A.6.2 Mobile devices and teleworking ***(to enable connection from mobile devices through teleworking infrastructure)***

A.9 Access control

A.9.1 Business requirements of access control ***(to establish an access control policy to limit access to information)***

A.9.2 User access management ***(to prevent unauthorized access to systems and services)***

A.9.3 User responsibilities ***(user must safeguard their authentication information)***

A.9.4 System and application access control ***(secure log-on procedures)***

A.10 Cryptography

A.10.1 Cryptographic controls ***(to ensure proper and effective use of cryptography to protect the confidentiality, authenticity and/or integrity of information)***

POSSIBLE IMPLEMENTATION

1) **Robust authentication and periodically change of the credential**
2) **Use of OTP Authentication**
3) **Access based on IP Filtering**
4) **Record the generality of connected users and IP**
5) **Use of VPN Network**

POLICIES FOR IoT

A.12 Operation security

A.12.2 Protection from malware *(controls against malware)*

A.13 Communication security

A.13.1 Network security management *(network controls, security of network services, segregation in networks)*

A.13.2 Information transfer *(information transfer policies and procedures)*

POSSIBLE IMPLEMENTATION

1) **Use VLANs**
2) **Install Firewall, Antivirus Gateway**
3) **Install IDS and IPS (intrusion prevention system)**

REFERENCES

For more information and dataset visit

http://www.researchgate.net/profile/Vito_Santarcangelo

Thanks for the attention!

Static and Dynamic Aspects of Distributed Cloud Security Systems

Vladimir Muliukha

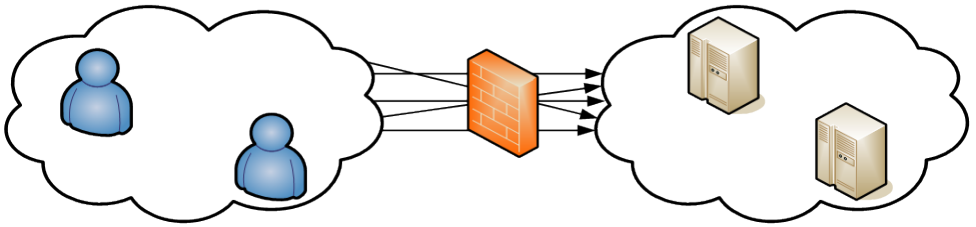
Institute of Applied Mathematics and Mechanics,
Telematics Department

SECURWARE 2015, August, 26 2015 – Venice, Italy

Access Services in Real World: Subject-Object Model

“subject” buy a ticket and access to “object” , but constantly watched by an “object curator”

Access Control in Cloud Environment



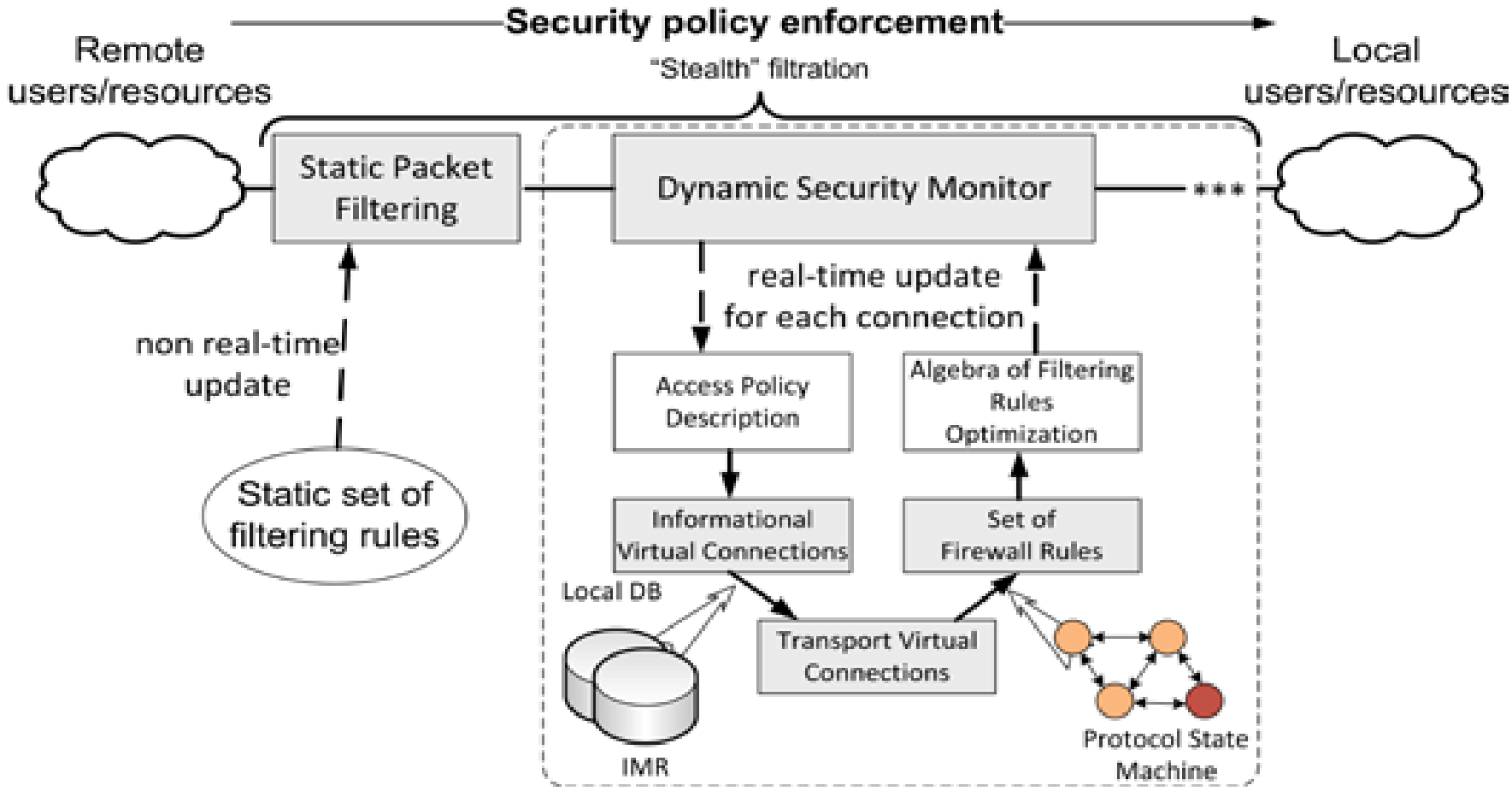
Access relationship and resources merges together by access **policy semantics**: user (or subject) may try to have access to resource and policy "curator" control "behavior" of the subject and feedback replay from the object.

Access control policy can be divided into **static** and **dynamic** parts:

- **Static** part (known as mandatory) set by administrator;
- **Dynamic** one is **content (semantic, behavior, data) dependent**.

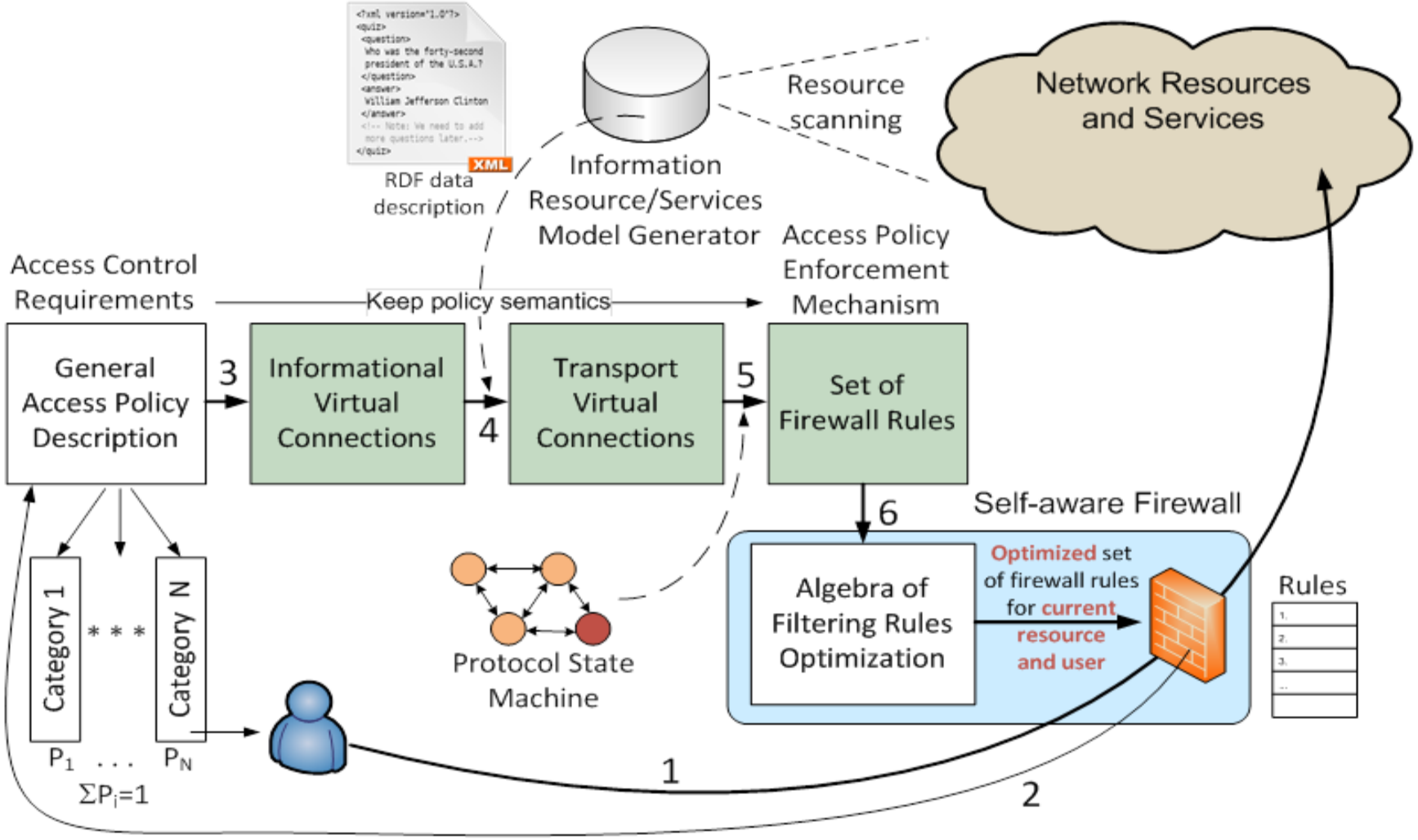
to merge static and dynamic aspects of access policy firewall in cloud environment should have **self-aware** feature and provide security **as a new kind of cloud service.**

Proposed Security Conveyor Architecture

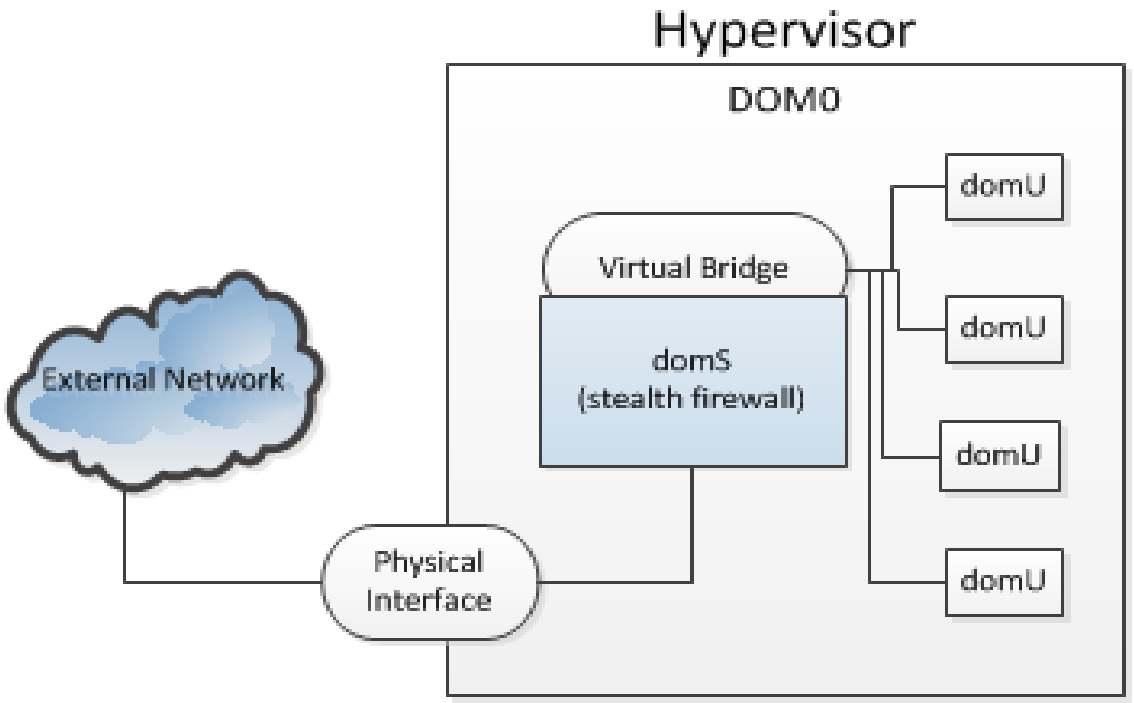


Dynamic Security Monitor

Security policy **semantics form invariant essence** of access rules **transformations** (3,4,5,6).



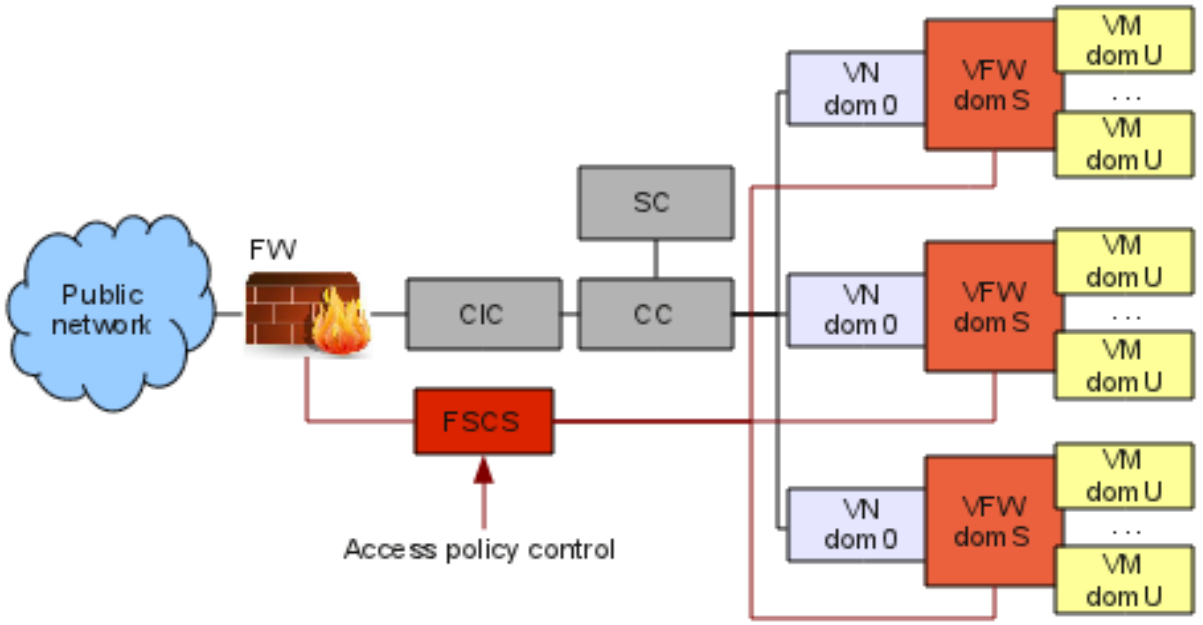
Implementation: Hypervisor with Stealth Firewall



- domS is a firewall virtual machine
- Firewall is “stealth” for object (interfaces have no IP or MAC addresses)
- Firewall controls VC traffic (between VMs and from external resources)
- domS is using Hypervisors resources – cores/memory
- domS doesn’t require to change cloud or VM configuration. The only change is hypervisor network subsystem.

Advances: firewall **configuration** (hardware and software) **is scaled** according to current cloud state.

Architecture of a Secure Cloud Computing Environment



FW – hardware firewall;

VFW – virtual firewall;

FSCS – Cloud Firewall security control system

VM – virtual machine

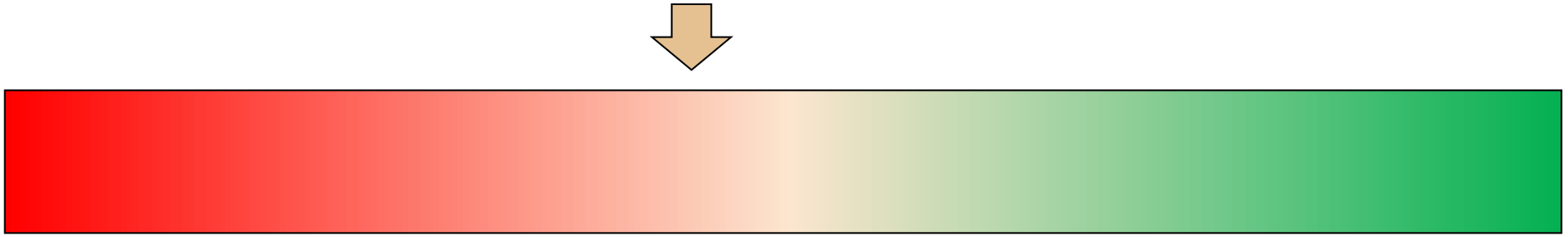
CIC – cloud controller

CC – cluster controller

SC – storage controller

- Hypervisor provides VFW services
- Private cloud protected by FW
- **Dynamic access policy forms by FSCS** and replicated to all firewalls

Security Service: Trade-off between Confidentiality and Availability



Confidentiality ***Availability***

NASA

ROSCOSMOS

BAYER

intel

PTK

twitter

THE TIMES

RUSSIAN DEFENCE EXPORT ROSOBORONEXPORT

e-gov

Massachusetts Institute of Technology

CNN

Is HIGHER SECURITY In IoT With PHYSICAL UNCLONABLE FUNCTIONS POSSIBLE?

Giray Kömürcü

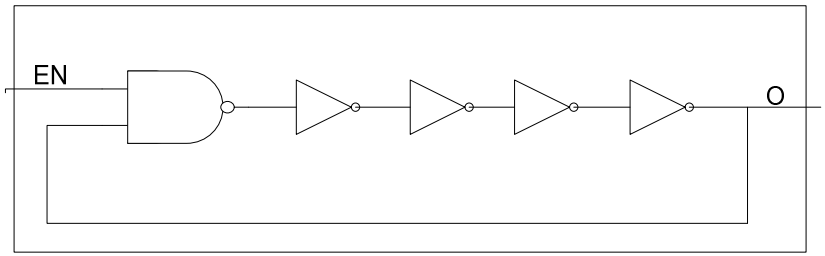
SECUREWARE'15
2015

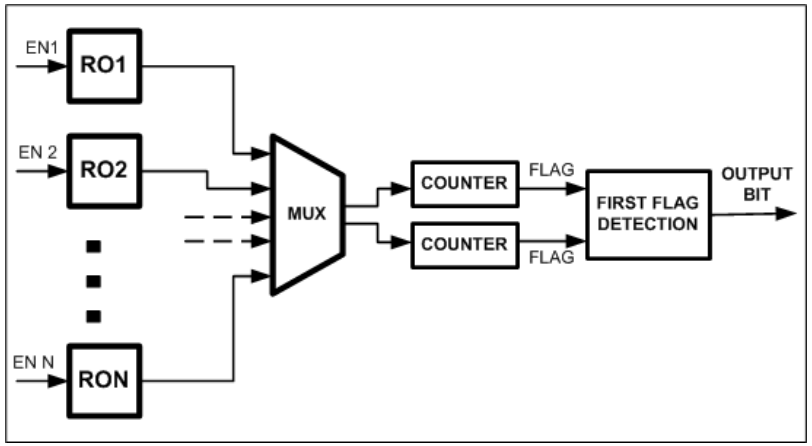
What is PUF?

- Physical Unclonable Function
- Unique capability of generating chip specific signatures
- Uncontrollable components in the manufacture process
  - Gate delays, wire delays, threshold voltages...
- Applicable for both ASIC and FPGA
- Different types of PUFs have been developed
  - Ring Oscillator PUF, Arbiter PUF, SRAM PUF, Glitch PUF etc.
- Uniqueness, Robustness, Unpredictability and Unclonability is the key features
- Low cost solutions

RO-PUF

- Ring Oscillator PUF
  - Depends on the delay differences of identical structures
  - Oscillation frequencies of 2 identical ring oscillators are compared



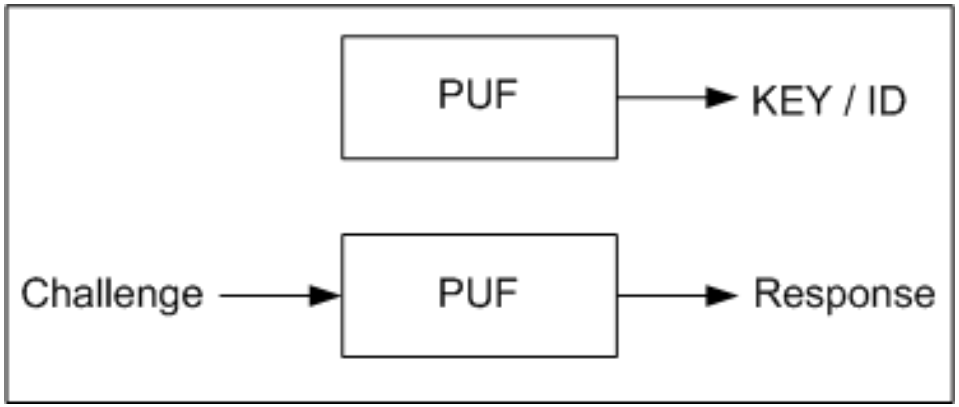


  - ‘1’ is generated if freq(RO1) < freq(RO2)
  - ‘0’ is generated if freq(RO1) > freq(RO2)

Usage Areas

- IP protection
  - Design theft through FPGA bitstream duplication
- Secret Key Generation and Storage
  - Eliminates the problem of Secret Key Sharing and Non-Volatile-Memory requirements
- IC Identification and Authentication
  - ID generation, authentication through Challenge-Response Pairs

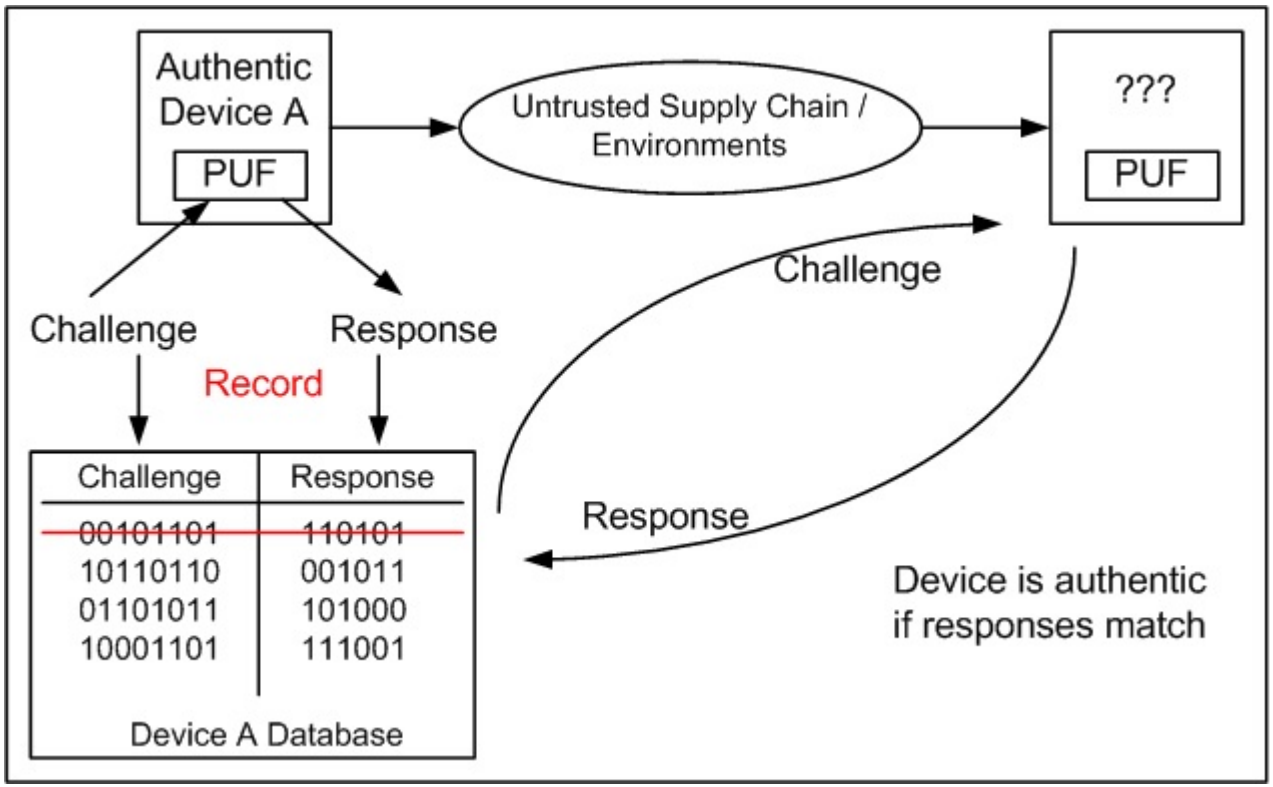
Challenge Response Pair Concept



- Outputs are generated depending on the inputs to the system, as well as device mismatches
- Used in authentication
- Some PUF types support CRP property
- Conventional RO-PUFs support limited number of CRPs

Authentication Using PUFs

- Authenticity of devices is important in IoT



PUFs in IoT

- IoT is vulnerable against attackers since it is an open environment
- Authentic devices may be replaced with replicas
  - Secure authentication is critical
- Secret Key sharing may threaten the system security
  - Especially if periodic key deployment is required
- PUFs can help improving the system security with low additional cost

Conclusion

- PUFs have the unique capability of generating chip specific signatures
- PUFs can be used to supply higher security for low cost in several areas including IoT