Symposium on The Future Networked Car

(Geneva, Switzerland, 3 March 2016)

IoT Security issues related to the future Networked Car

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Contents

1) IoT problems – in relation to the networked car

- Observing current IoT Attacks
- Analyzing IoT Attacks
- Understanding Infected IoT devices

2) Key findings and Conclusion

Scanning observation by nicter-Atlas

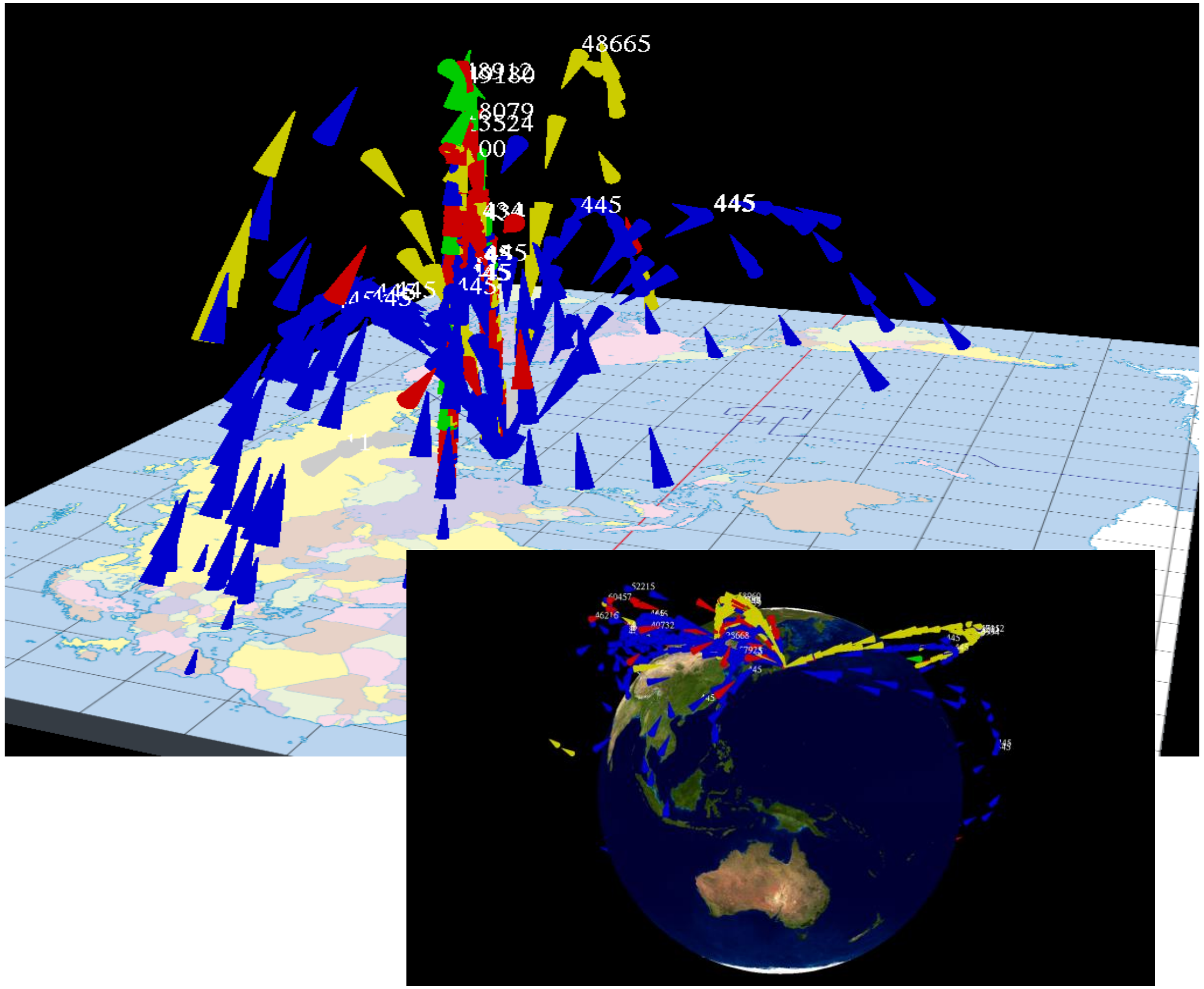
Recently, “scanning to Port 23 (telenet)” is getting larger!!

- Capturing packets through dark-net in real time basis.
- Color indicates the protocol types.

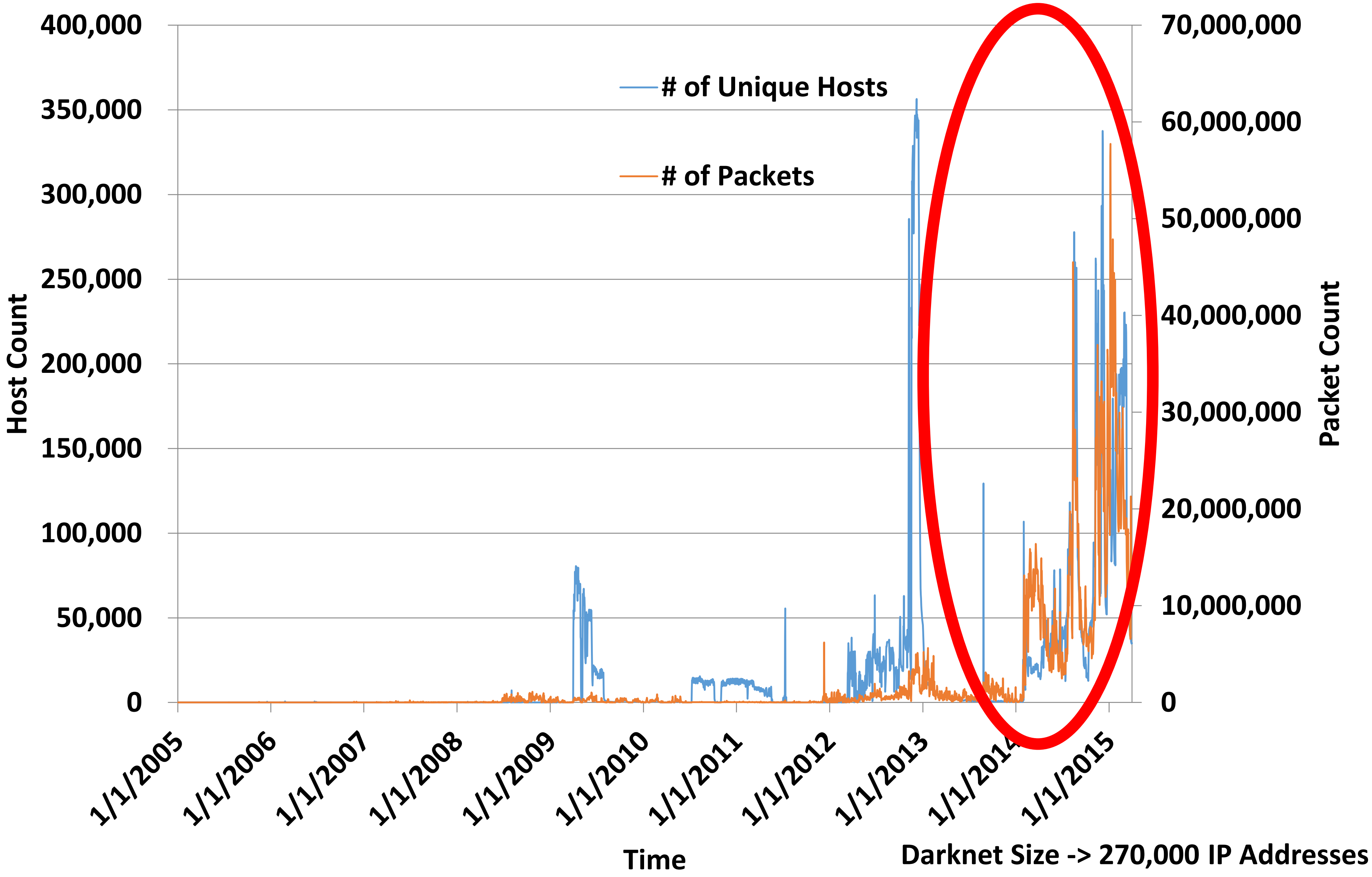
🟥 **UDP**
🟦 **TCP SYN**
🟨 **TCP SYN/ACK**
🟩 **TCP Other**
⬜ **ICMP**

Atlas All view

Atlas 23 view



Telnet (23) attacks on Darknet have rocketed



Darknet Size -> 270,000 IP Addresses
(2015/May)

Attacking hosts are IoT devices

150,000 attacking IPs

361 models observed in 4 months

LED display control system

Solid State Recorder

Data Acquisition Server

Wireless Router

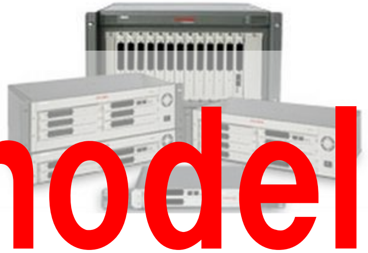
TV Receiver

GSM Router

IP Phone

Parking Management System

VoIP Telephony System



Fire Alarm

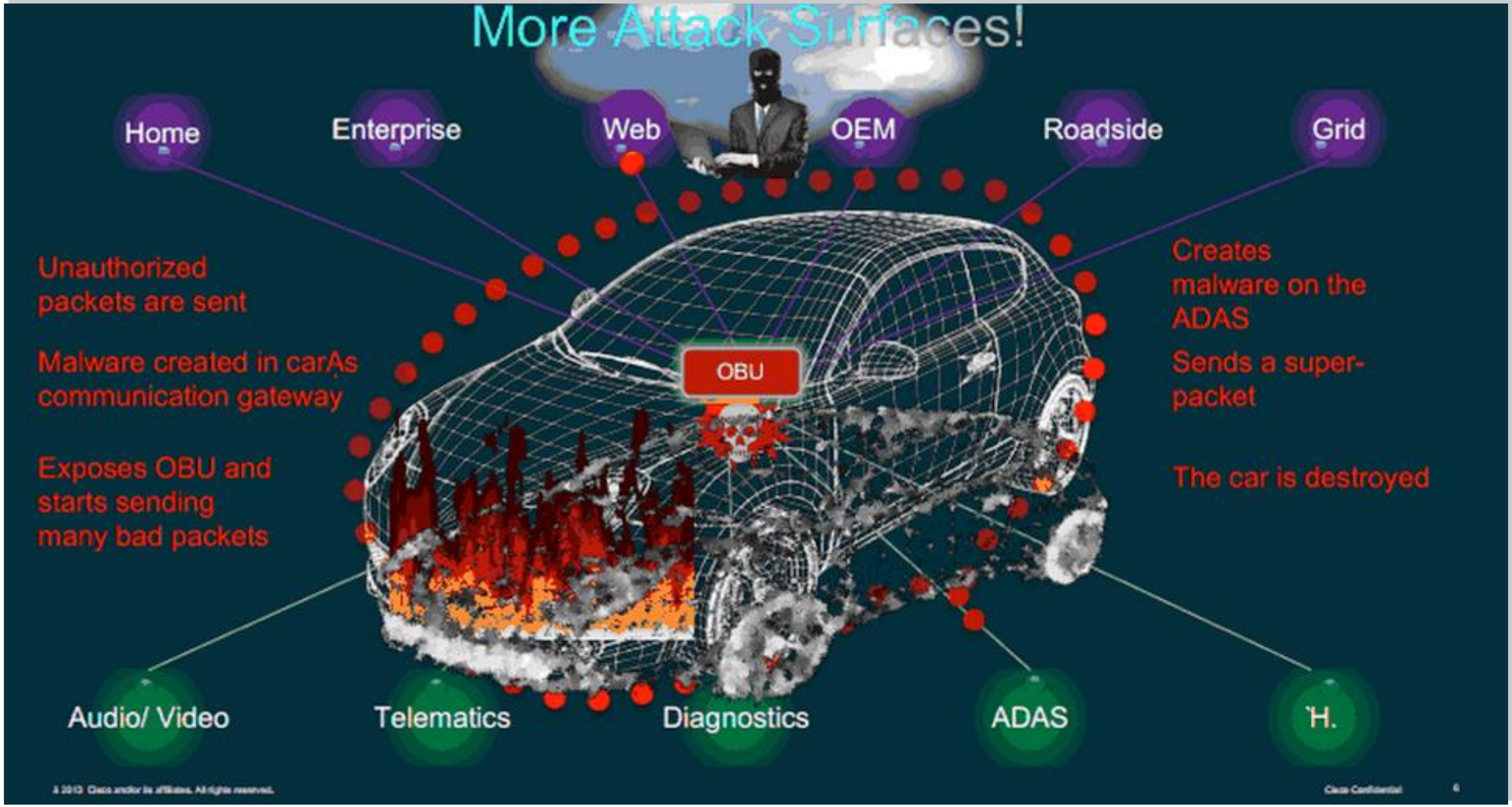
Security Appliance

Internet Communication Module

Video Broadcaster

Devices are inferred from their web interface and telnet banners.

In the case of Connected Car, More Attack Surfaces can be recognized and many IoT devices will be located in the car!



More Attack Surfaces!

Unauthorized packets are sent

Malware created in carAs communication gateway

Exposes OBU and starts sending many bad packets

Creates malware on the ADAS

Sends a super-packet

The car is destroyed

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Cisco Confidential 6

http://gigaom.com/2013/08/06/ciscos-remedy-for-connected-car-security-treat-the-car-like-an-enterprise/

Why IoT devices?

- 24/7 online
- No AV
- Weak/Default login passwords
- with global IP address and open to Internet

We would like to know..

Malware

- What kind of malware?
- How many different kinds?

Targets

- What IoT devices are targeted?

Monetization

- What the attackers do after compromising these devices?

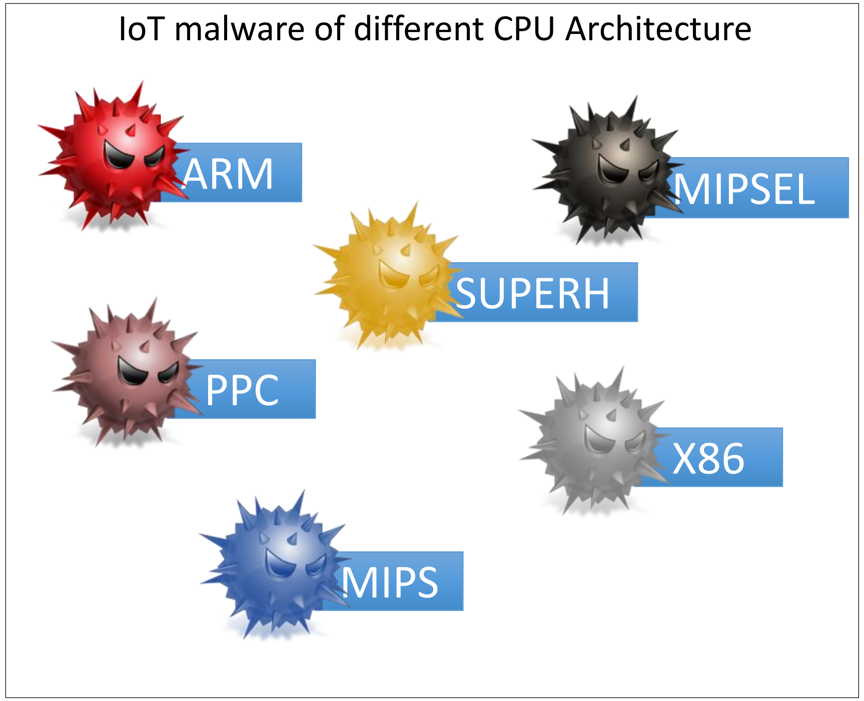
We propose the first honeypot for IoT

Our Challenges

Honeypot

IoT devices listening on Telnet

Sandbox: IoTBOX

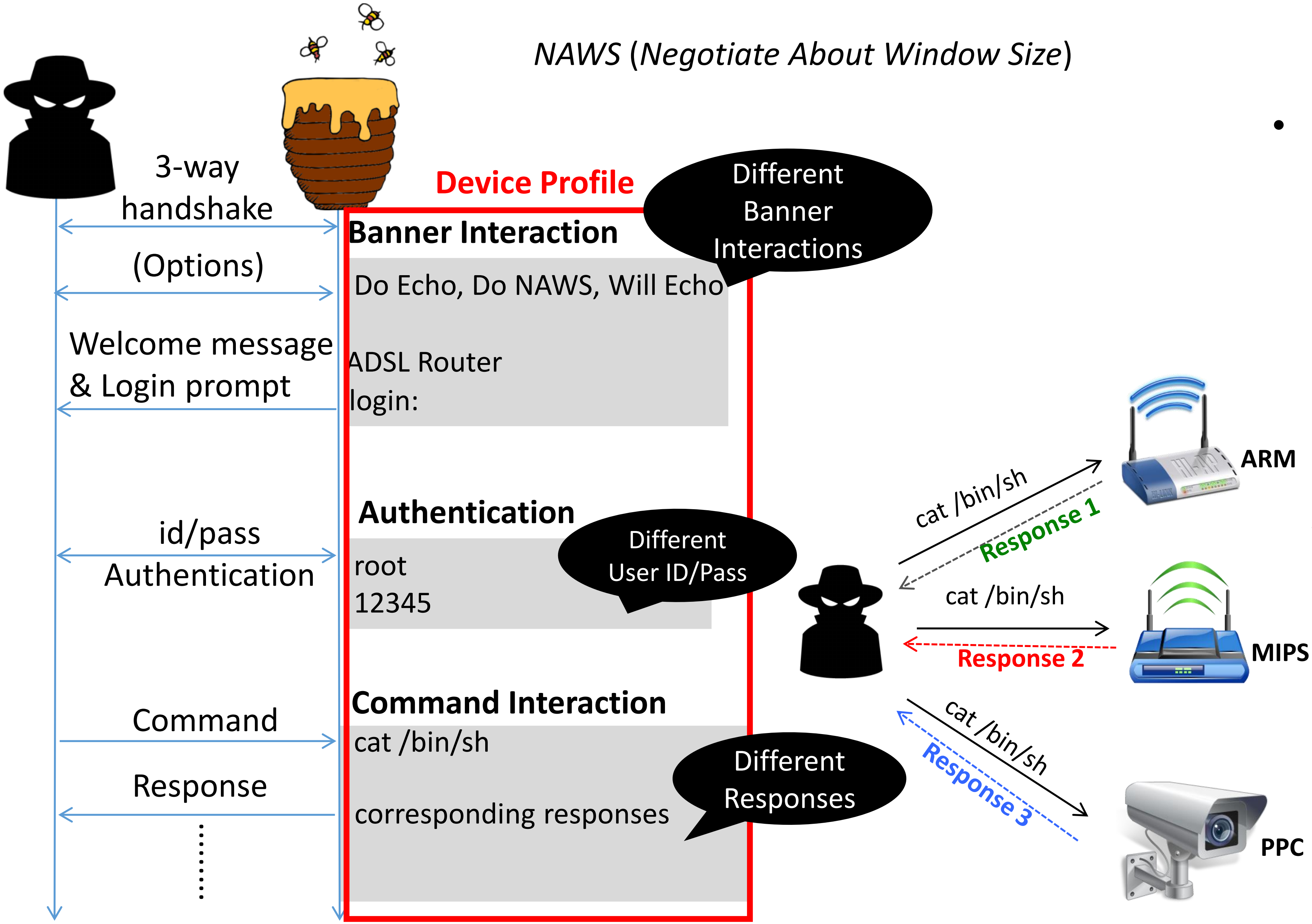


IoT malware of different CPU Architecture

- Emulating diverse IoT devices
- Handling **to capture** malware of different CPU architectures

- Handle **to run** malware of different CPU architectures

Emulating different devices (IoTPOT)



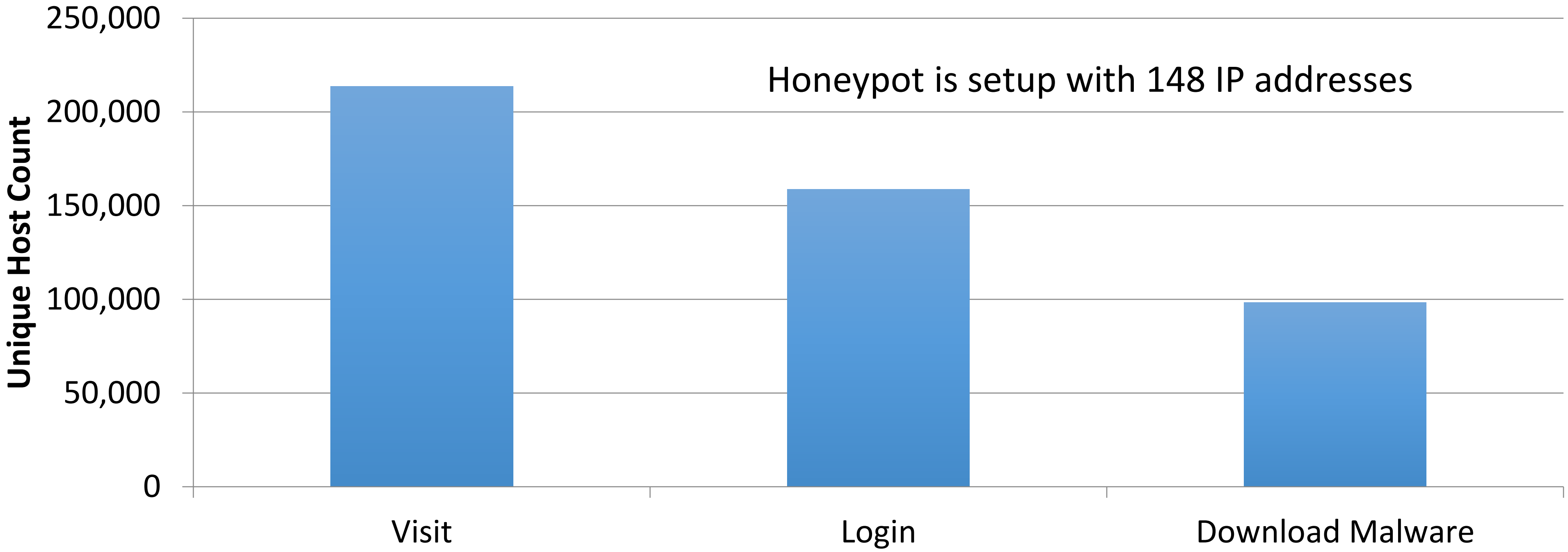
NAWS (Negotiate About Window Size)

- **Different Banner**
  - Scanning Internet on port 23 to get different banners
- **Different User ID/Pass**
  - Obtain weak/default ID/Pass by web search
  - Always accept/reject incoming challenges
  - Accept after several challenges
- **Different Interactions**
  - Learn from actual devices
  - System with general configuration for embedded devices

(E.g., OpenWRT or Debian based embedded OS)

IoTPOT results

- During 122 days of operations [April 01 to July 31 - 2015]



900,394 Malware Download Attempts

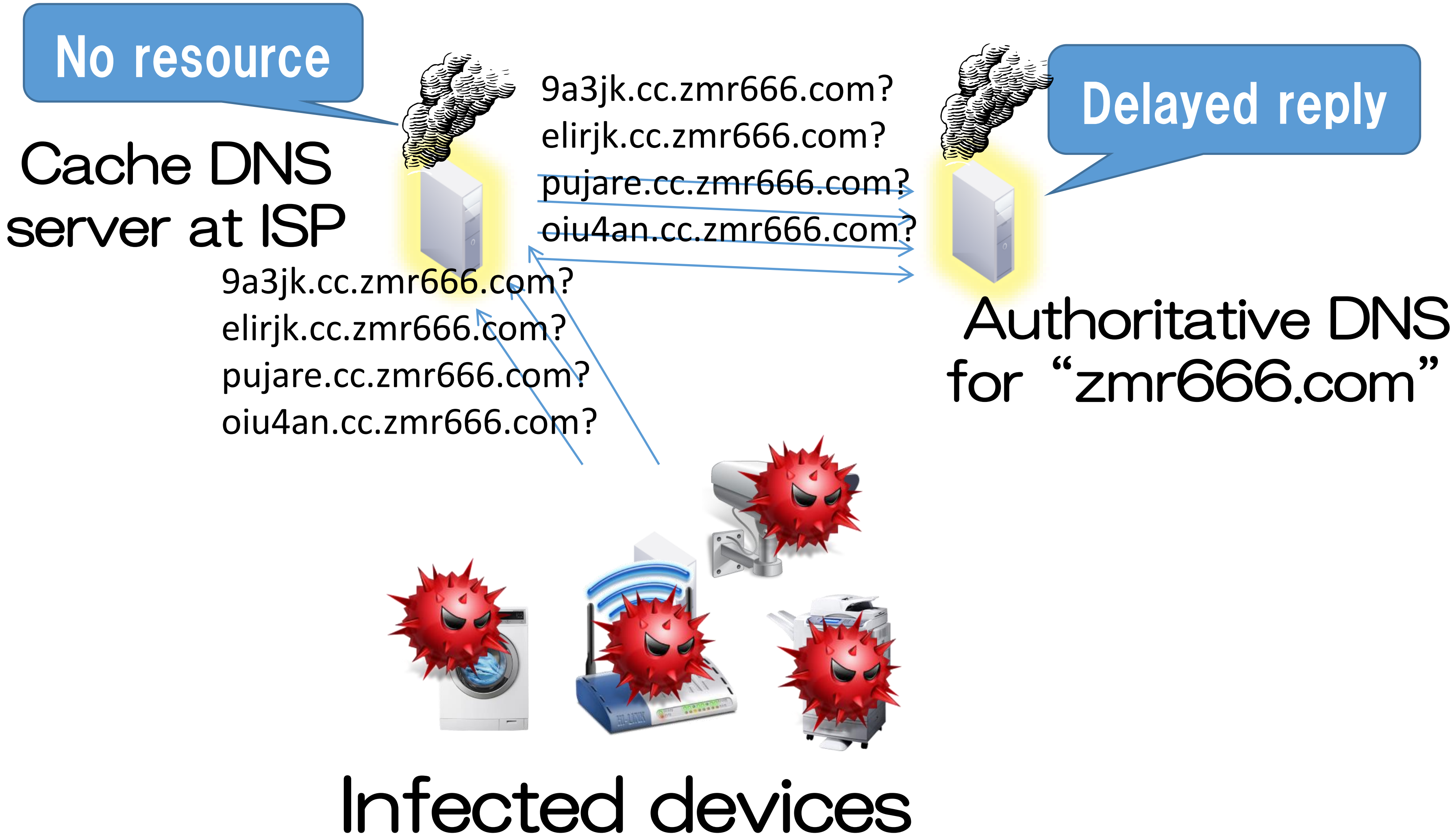
Malware of 11 different CPU architectures

93% of downloaded binaries are new to Virus Total (2015/09)

Analyzing attacks

- **Intrusion**
  - Pattern of User ID/Password challenges
- **Infection**
  - Telnet Command Sequences from Attacker
- **Monetization**
  - Behaviors of second stage malware (i.e. binaries and shell scripts)

Example1: DDoS（DNS Water Torture attacks）



No resource

Cache DNS server at ISP

9a3jk.cc.zmr666.com?
elirjk.cc.zmr666.com?
pujare.cc.zmr666.com?
oiu4an.cc.zmr666.com?

Delayed reply

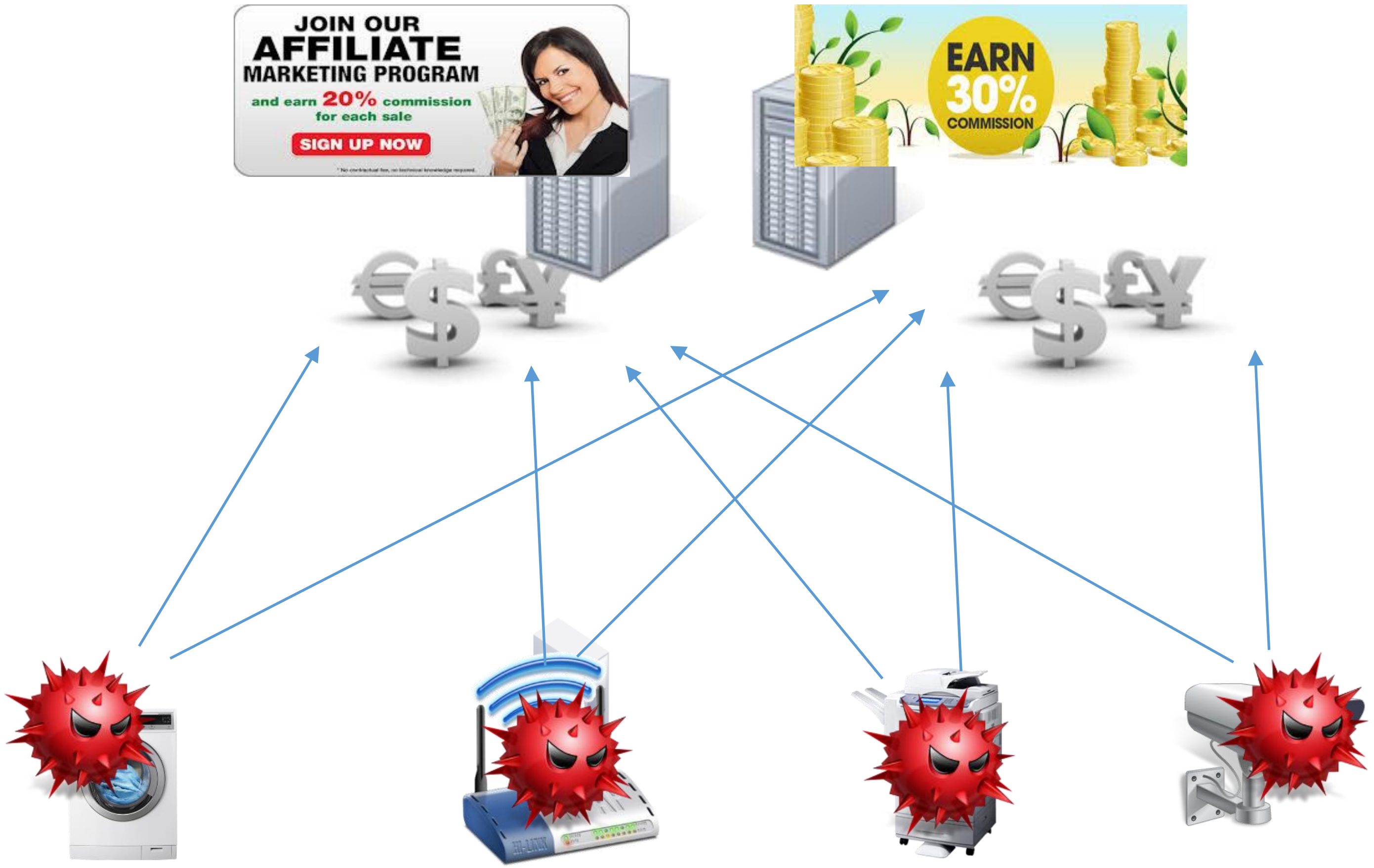
Authoritative DNS for “zmr666.com”

9a3jk.cc.zmr666.com?
elirjk.cc.zmr666.com?
pujare.cc.zmr666.com?
oiu4an.cc.zmr666.com?

Infected devices

Example 2: Click fraud

Infected devices imitates user clicks to advertising web sites



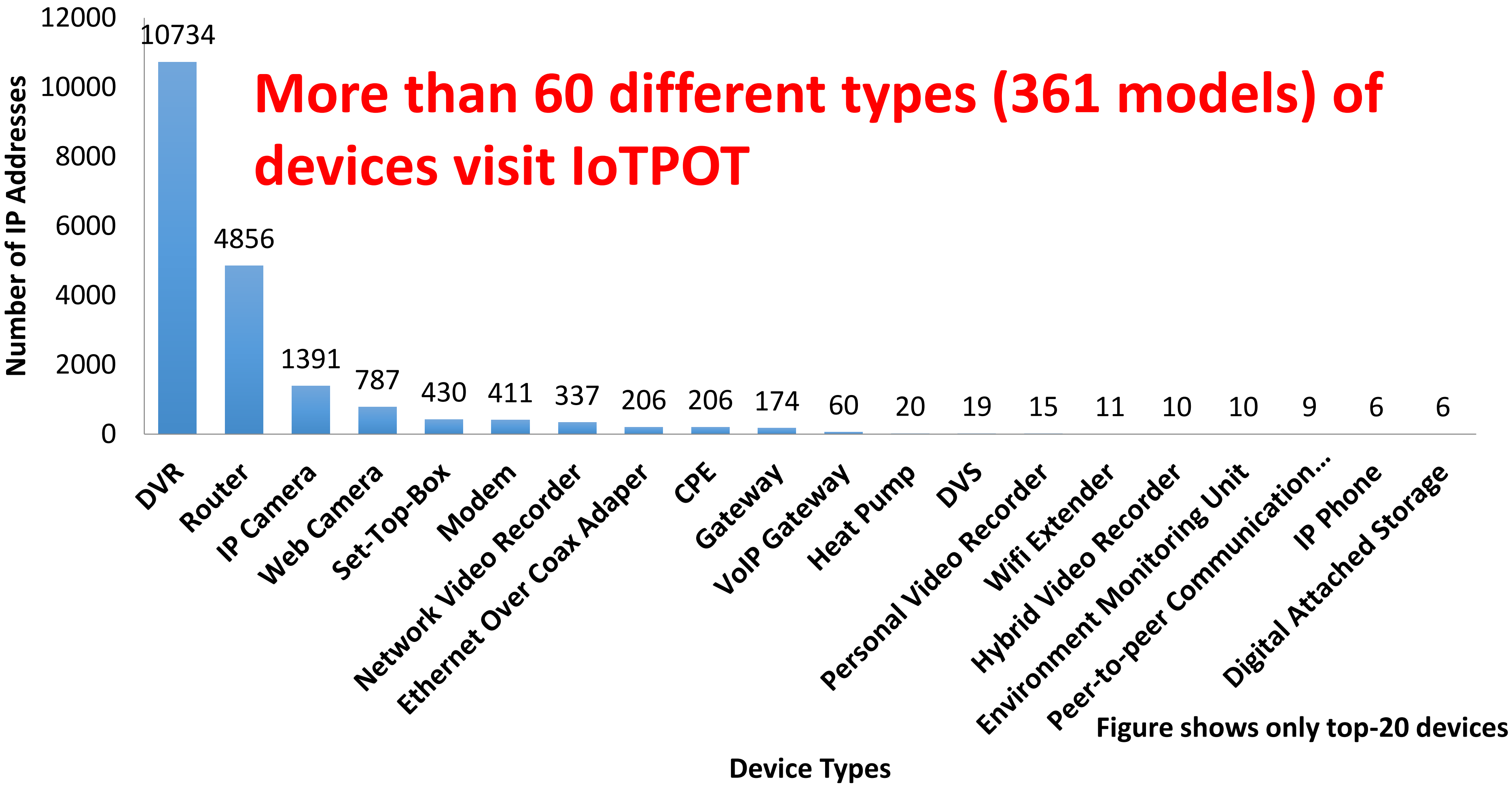
Infected Devices

Example 3: Stealing credential from PPV (Pay Per View)

crede
ntial

Particular set top boxes are being targeted (such as dreambox)

For Understanding Infected IoT devices, looking back on devices visiting IoTPOT

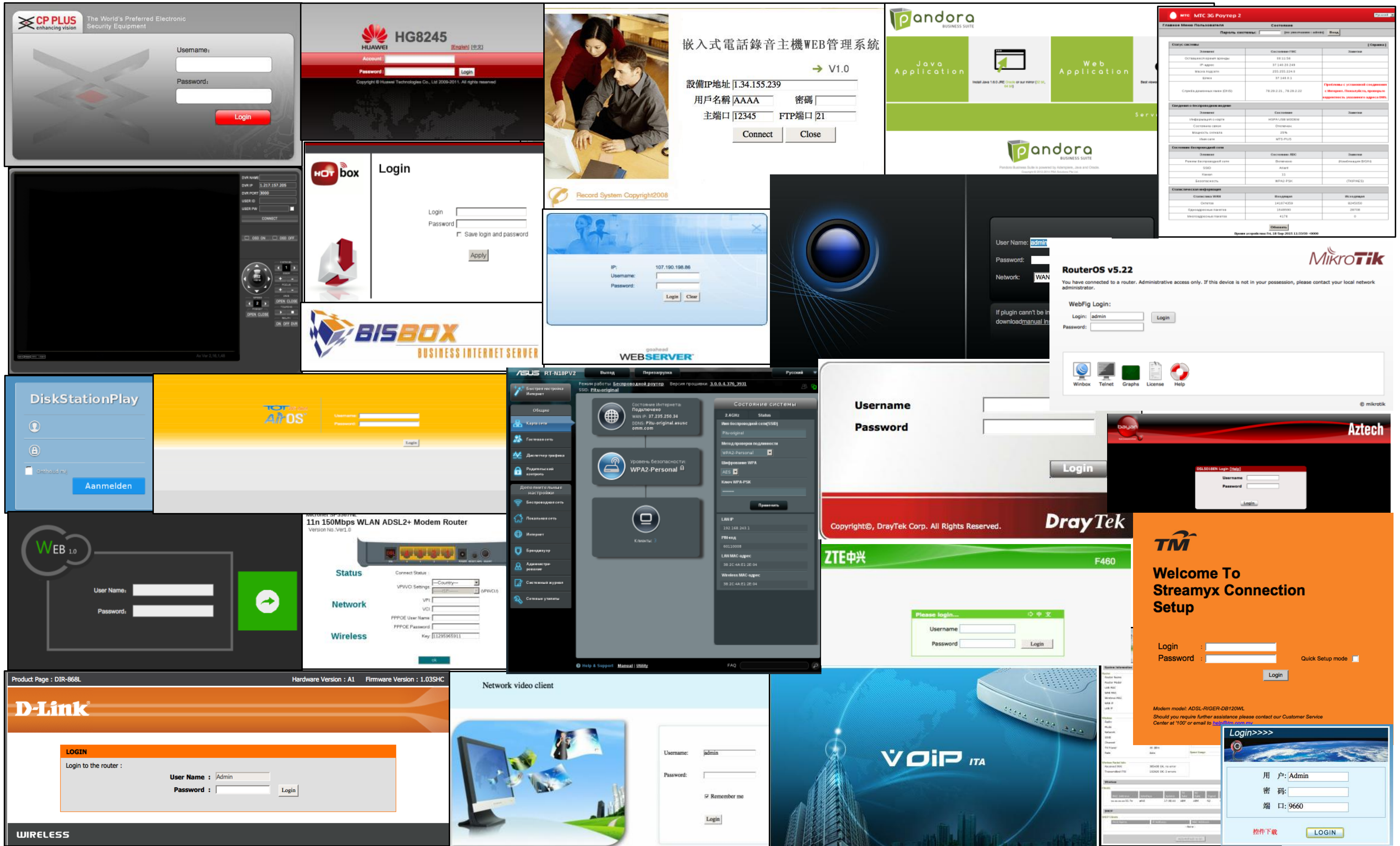


More than 60 different types (361 models) of devices visit IoTPOT

Figure shows only top-20 devices

- We scan back on port 23/TCP and 80/TCP
  - More than 60 type of devices visit us

Web interfaces of devices attacking us



CP PLUS enhancing vision The World's Preferred Electronic Security Equipment
Username:
Password:
Login

HUAWEI HG8245 English | 中文
Account
Password
Login
Copyright © Huawei Technologies Co., Ltd 2009-2011. All rights reserved

嵌入式電話錄音主機WEB管理系統
V1.0
設備IP地址 1.34.155.239
用戶名稱 AAAA 密碼
主端口 12345 FTP端口 21
Connect Close
Record System Copyright2008

pandora BUSINESS SUITE
Java Application
Web Application

МТС 3G Роутер 2

HOT box
Login
Login
Password
Save login and password
Apply

BISBOX BUSINESS INTERNET SERVER

IP: 107.190.198.86
Username:
Password:
Login Clear
WEBSERVER

User Name: admin
Password:
Network: WAN

RouterOS v5.22
MikroTik
You have connected to a router. Administrative access only. If this device is not in your possession, please contact your local network administrator.
WebFig Login:
Login: admin Login
Password:
Winbox Telnet Graphs License Help
© mikrotik

DiskStationPlay
Onthoud mij
Aanmelden

AirOS
Username
Password
Login

ASUS RT-N10PV2
WPA2-Personal

Username
Password
Login
Copyright©, DrayTek Corp. All Rights Reserved.
DrayTek

Aztech
Username
Password
Login

WEB 1.0
User Name:
Password:

11n 150Mbps WLAN ADSL2+ Modem Router
Version No.:Ver1.0
Status
Network
Wireless

ZTE中兴 F460
Please login...
Username
Password
Login

TM
Welcome To Streamyx Connection Setup
Login :
Password :
Quick Setup mode
Login
Modem model: ADSL-RIGER-DB120WL
Should you require further assistance please contact our Customer Service Center at '100' or email to help@tm.com.my

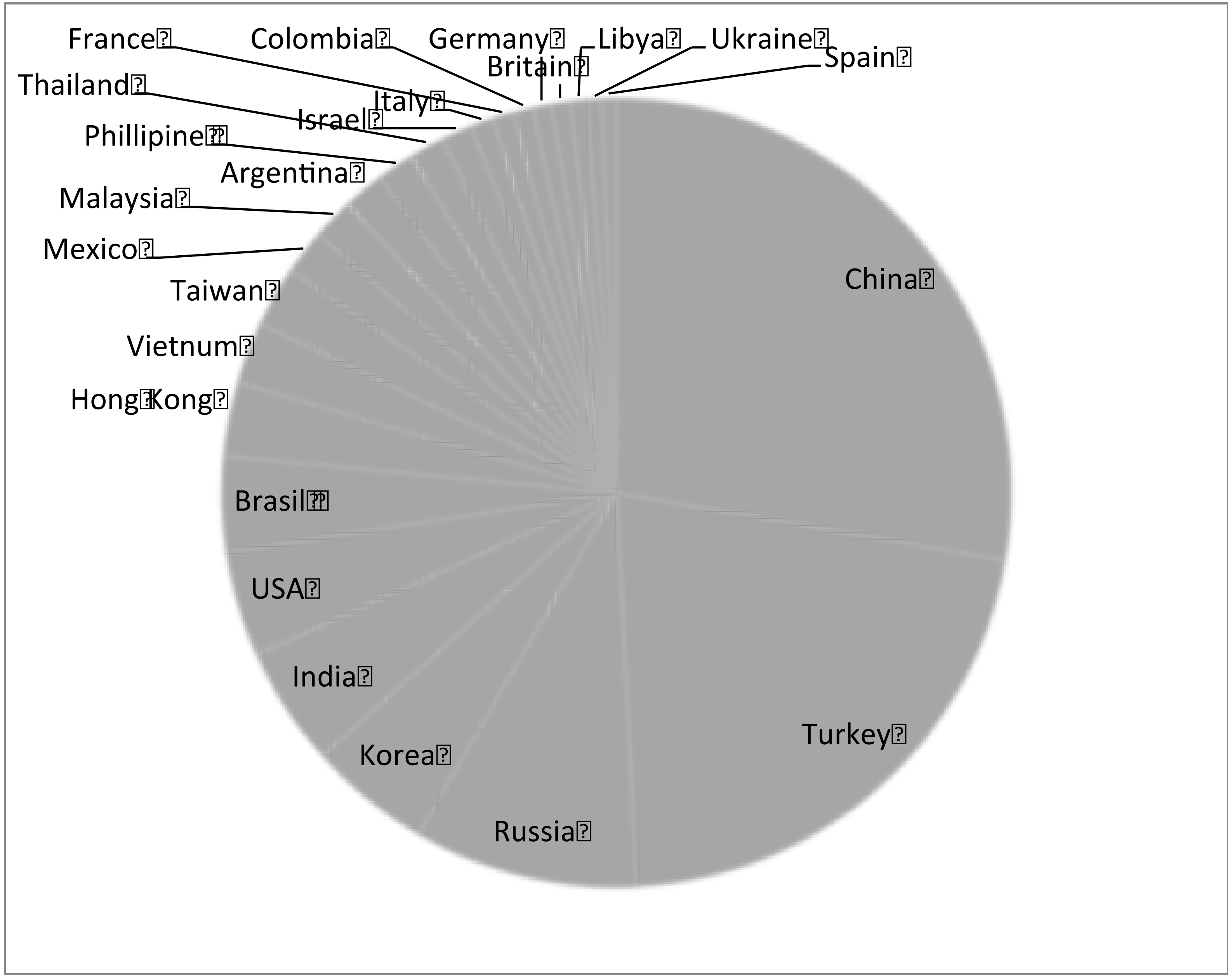
Product Page : DIR-868L Hardware Version : A1 Firmware Version : 1.03SHC
D-Link
LOGIN
Login to the router :
User Name : Admin
Password :
Login
WIRELESS

Network video client
Username: admin
Password:
Remember me
Login

VOIP ITA

Login>>>>
用 户: Admin
密 码:
端 口: 9660
控件下载 LOGIN

AS with more than 1,000 infected Devices



Categorizing device types

- Surveillance Group
  - IP Camera
  - DVR (Digital Video Recorder)
- Networking Related Devices
  - Router
  - Gateway
  - Modem
  - Bridge
  - Security Appliance
- Telephone System
  - VoIP Gateway
  - IP Phone
  - GSM Router
  - Analog Phone Adapter
- Infrastructure
  - Parking Management System
  - LED display control system

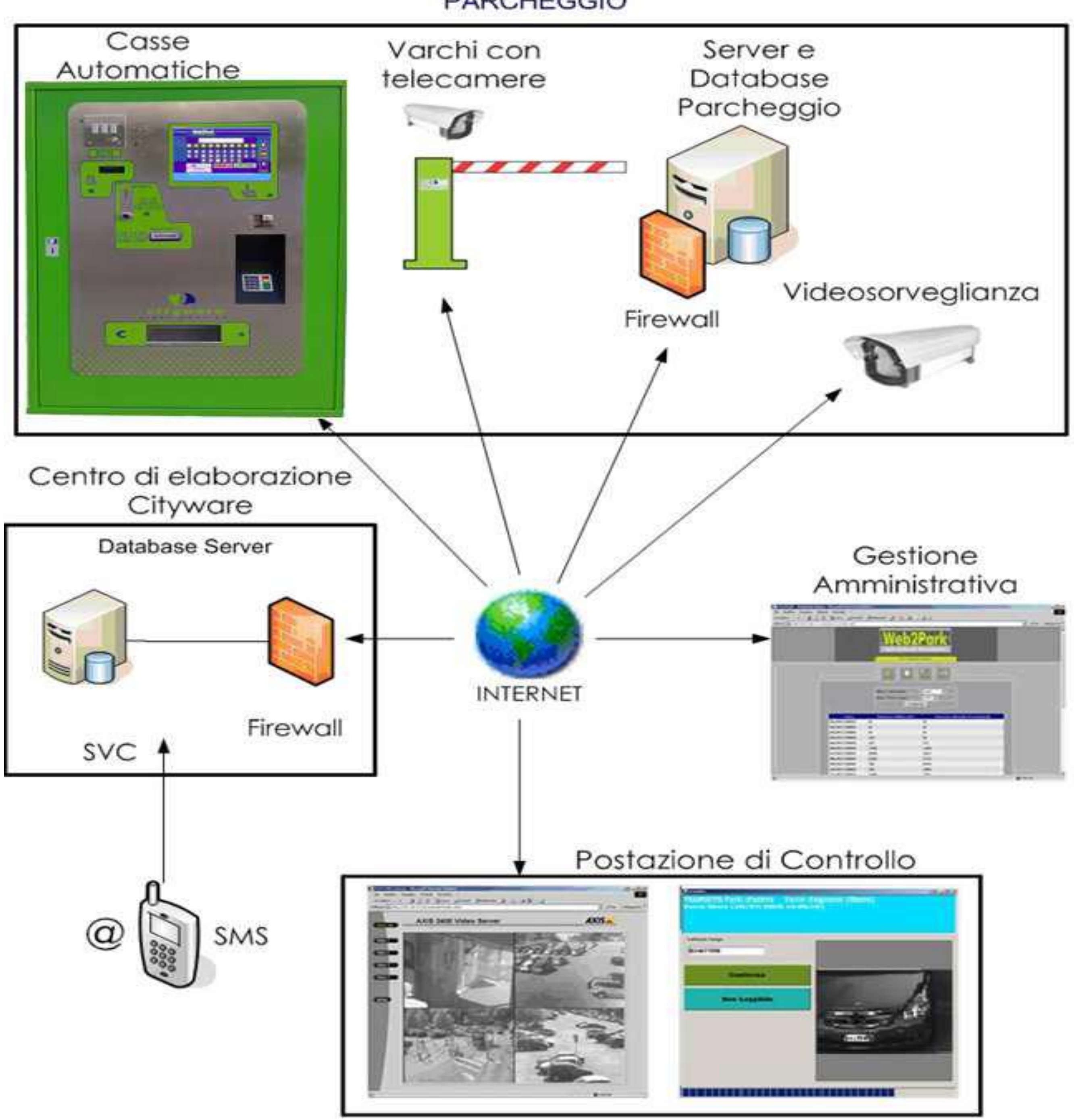
- Industrial Control System
  - Solid State Recorder
  - Internet Communication Module
  - Data Acquisition Server
  - BACnet I/O Module
- Personal
  - Web Camera
  - Personal Video Recorder
  - Home Automation Gateway
- Broadcasting Facility
  - Digital Video Broadcaster
  - Digital Video Scaler
  - Video Encoder/Decoder
  - Set Top Box
- Other
  - Heat Pump
  - Fire Alarm System
  - Disk Recording System
  - Optical Imaging Facility
  - Fingerprint Scanner

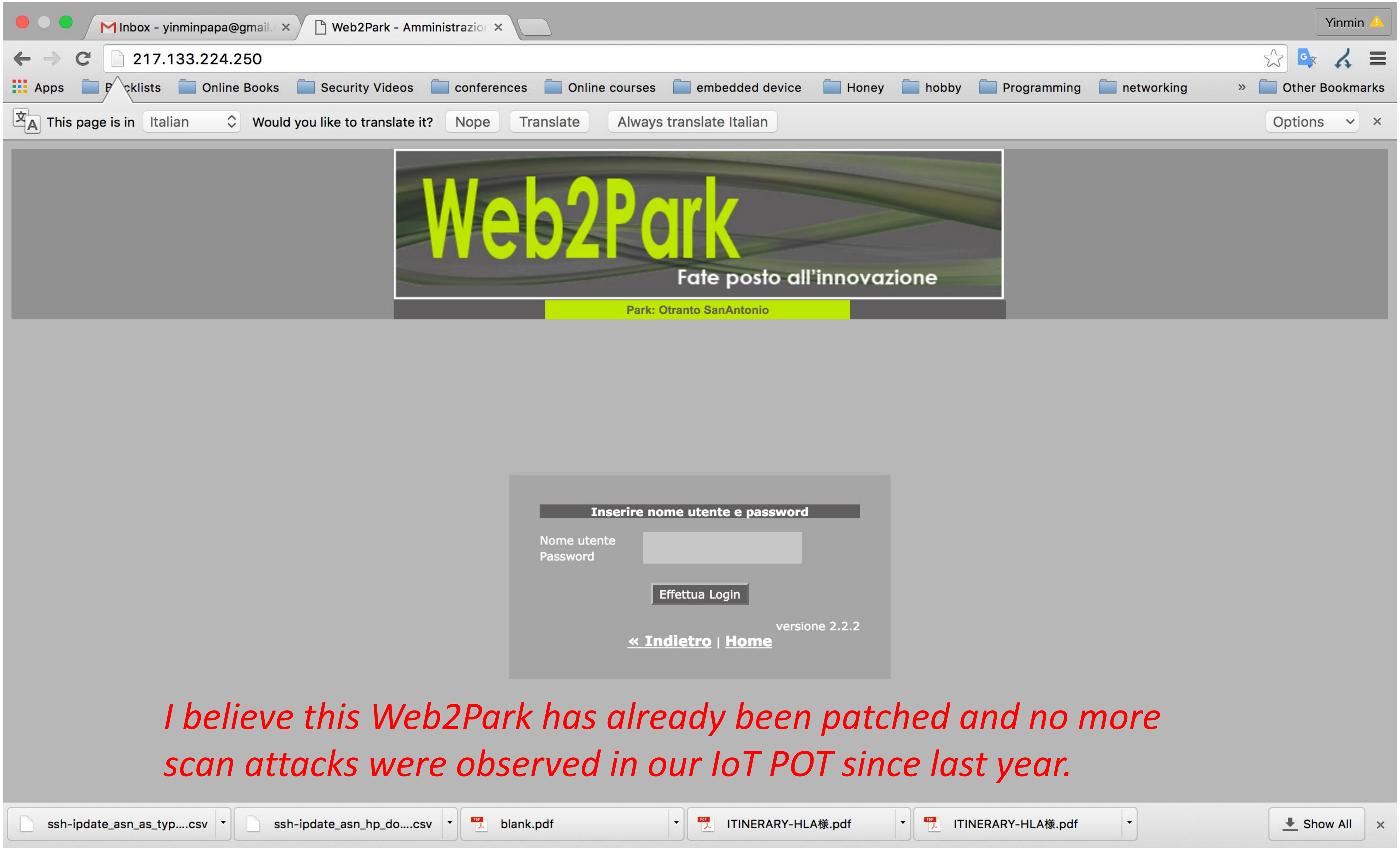
Devices are inferred from their web interface and telnet banners.

Attacks observed in IoTPOT from the following data source last year (2015).

Time Stamp visiting IoTPOT:
2015-03-09 and 2015-03-14
Country (IP) from Italy
HTTP Title :
Web2Park -Amministrazione

Web2Park®





Inserire nome utente e password

Nome utente

Password

versione 2.2.2

I believe this Web2Park has already been patched and no more scan attacks were observed in our IoT POT since last year.

Smart+Connected City Infrastructure Management: IoT Use Cases

Smart+Connected City

Parking

Give citizens live parking availability information to reduce circling and congestion

Smart+Connected City

Traffic

Monitor and manage traffic incidents to reduce congestion and improve livability

Smart+Connected City

Safety & Security

Automatically detect security incidents, shorten response time, and analyze data to reduce crime

Smart+Connected City

Location Services

Provide view of people flow data to aid planning and leverage location data for contextual content and advertising

Smart+Connected City

Lighting

Manage street lighting to reduce energy and maintenance costs

Presentation in ITU-T by Mr. Mikhail Kader

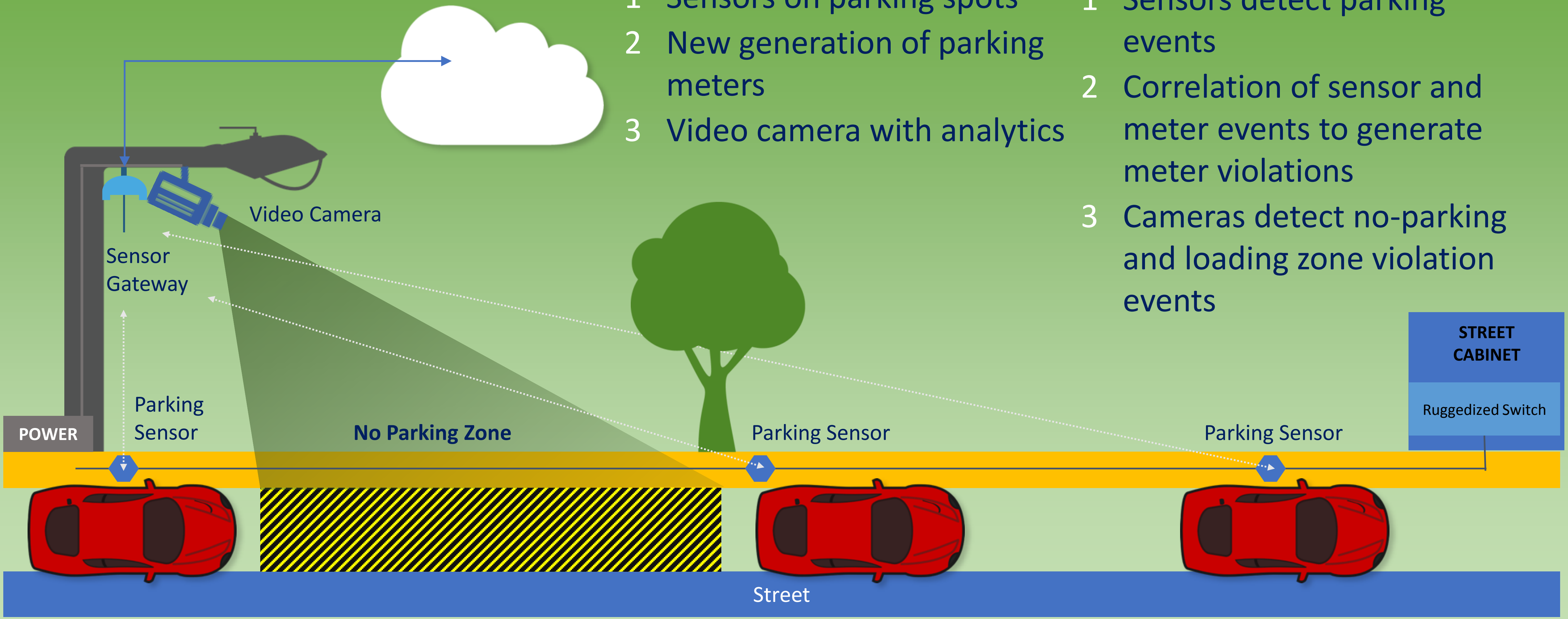
For Example

City Parking

Improve Traffic and Reduce Congestion

Presentation in ITU-T by Mr. Mikhail Kader

Smart+Connected City Parking: How It Works



Solution Components

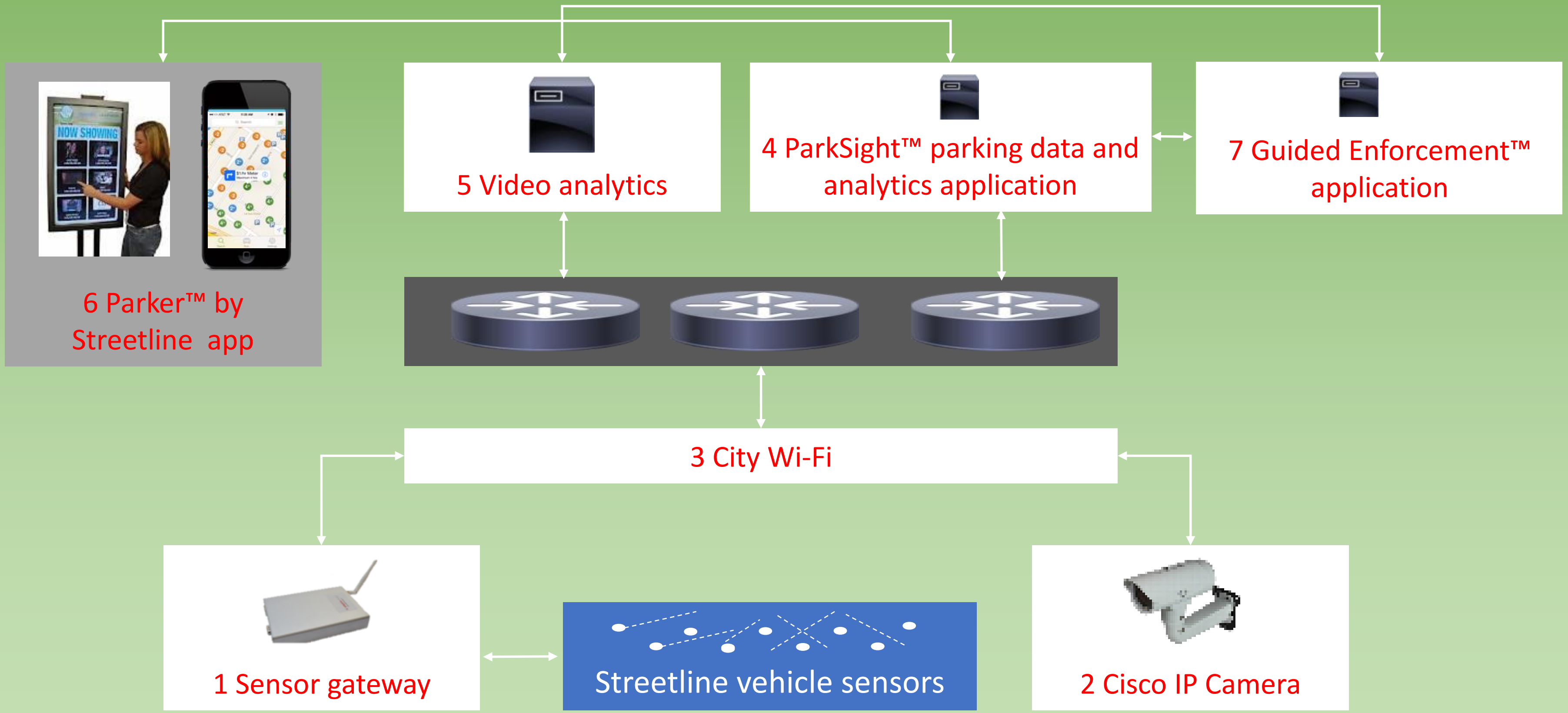
1. Sensors on parking spots
2. New generation of parking meters
3. Video camera with analytics

Data Flow

1. Sensors detect parking events
2. Correlation of sensor and meter events to generate meter violations
3. Cameras detect no-parking and loading zone violation events

Smart+Connected Parking: High-level Architecture

Sensor and video-enabled parking management for cities



6 Parker™ by Streetline app
5 Video analytics
4 ParkSight™ parking data and analytics application
7 Guided Enforcement™ application
3 City Wi-Fi
1 Sensor gateway
Streetline vehicle sensors
2 Cisco IP Camera

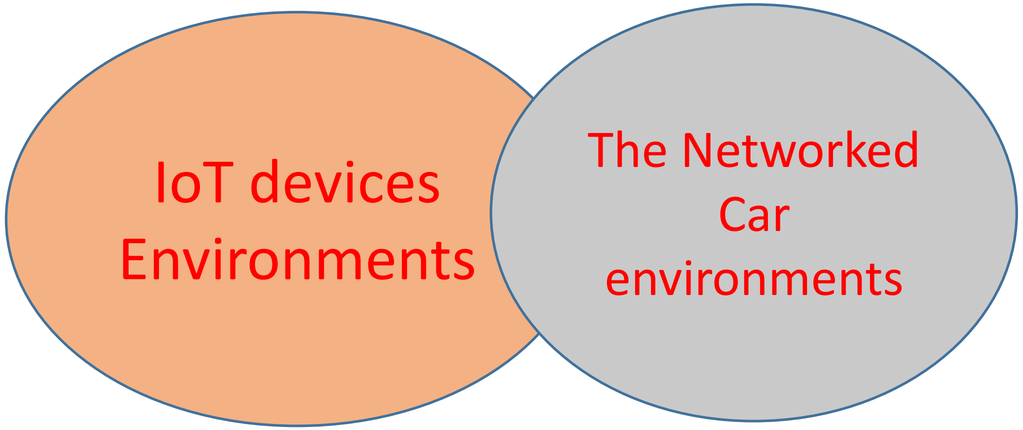
1. Streetline sensor gateway
2. Cisco IP Camera
3. Cisco Wireless Mesh Network for connectivity
4. Streetline parking data and analytics application
5. Video analytics for violation detection
6. Streetline citizen application to find real-time parking availability and payments
7. Streetline enforcement application for parking enforcement officer

Key findings and Conclusion

- **Malware**
  - At least 6 DDoS malware families target IoT devices via Telnet
  - Malware samples of 11 different CPU architectures are captured
  - 93 % of samples are new to Virus Total
  - One family has quickly evolved to target more devices with as many as 9 different CPU architectures
- **Targets**
  - More than 60 types (361 models) of IoT devices are infected
- **Monetization**
  - 11 types of DDoS attacks
  - Scans (TCP/23,80,8080,5916 and UDP/ 123,3143)
  - Fake web hosting
  - Click fraud attacks
  - Stealing credential of PPV

<Key Security Controls>

1. Threat observation and analysis
2. Malware/intrusion detection
3. Software Remote Update (ITU-T)
4. Data Confidentiality
   – Light-weight crypto
5. Appropriate Authentication and Access control
6. Incident handling and Information (threat) sharing



IoT devices Environments

The Networked Car environments

In the connected car environment, *Malware Infection* to the Car Components (IoT devices) should be carefully considered!!

Introduction of draft Rec. X.itssec-1 “Scope”

Functionality of Head Unit

! Status check of ECUs
! Log collection
! In-car diagnosis function

Functionality of Server

! Stored Data Definition
✓ Auth info
✓ Log Audit

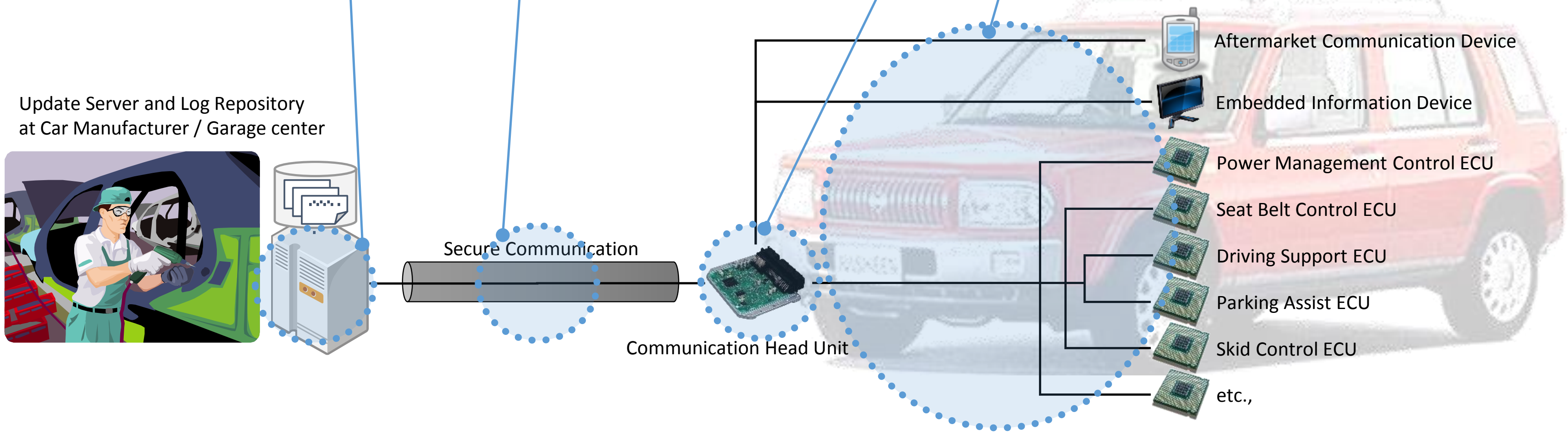
✓ With considerations of privacy concerns

Communication protocol

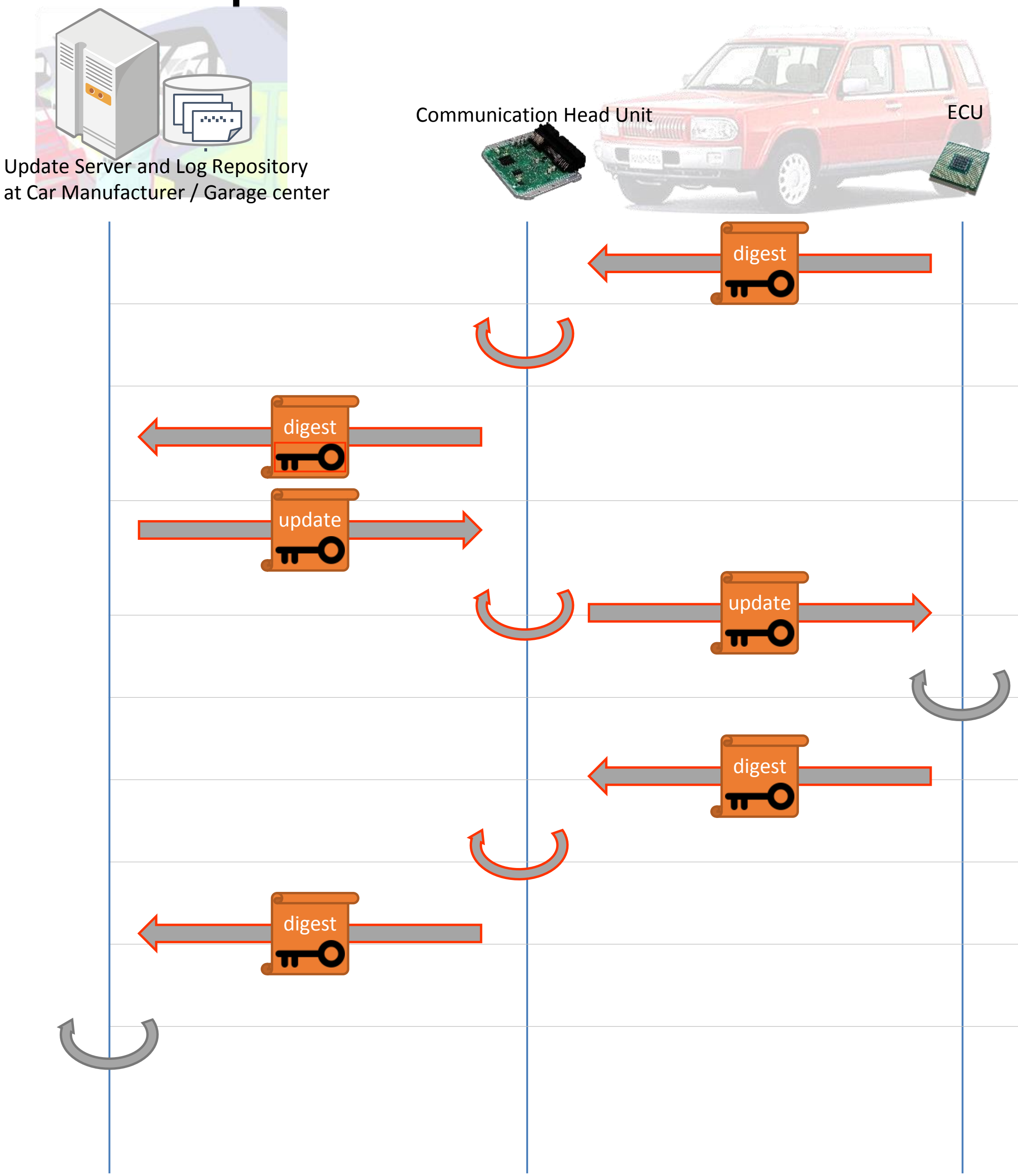
! Between Car and Manufacturer / Garage
! Encryption
! Authentication

Diagnosis of on-board devices

! Status check of ECUs
! Log collection
! Verification of update module

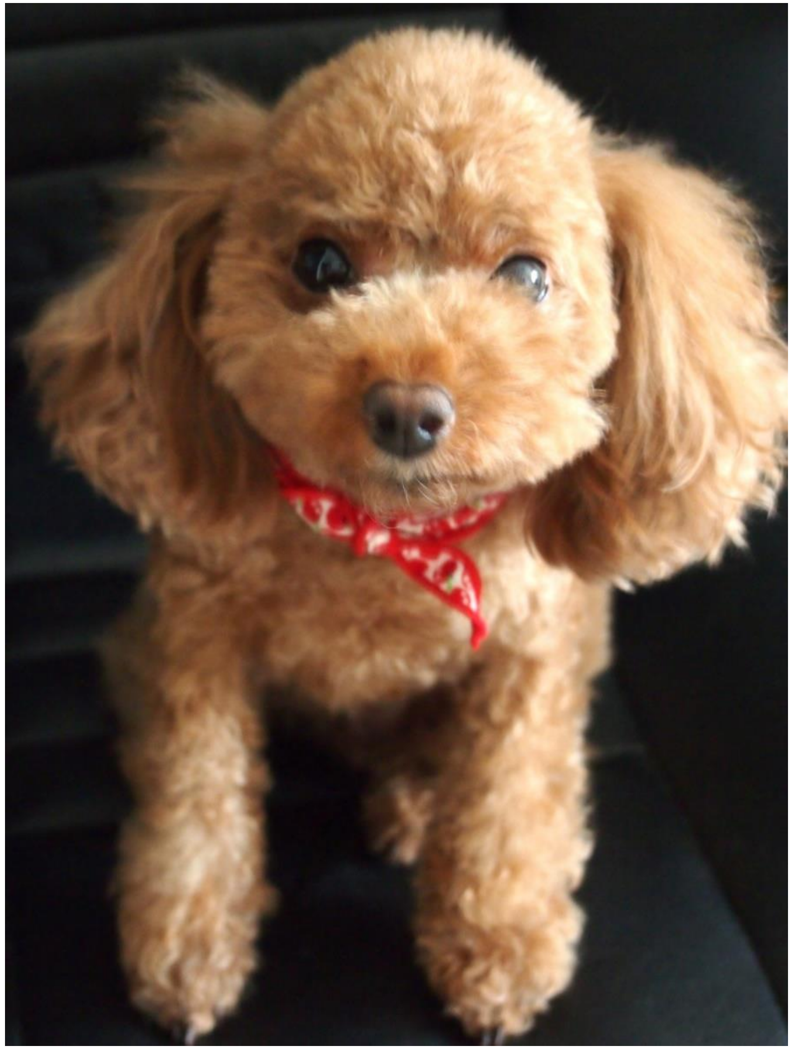

Update Server and Log Repository
at Car Manufacturer / Garage center
Secure Communication
Communication Head Unit
Aftermarket Communication Device
Embedded Information Device
Power Management Control ECU
Seat Belt Control ECU
Driving Support ECU
Parking Assist ECU
Skid Control ECU
etc.,

Example: data flow of remote update


Update Server and Log Repository
at Car Manufacturer / Garage center
Communication Head Unit
ECU
digest
digest
update
update
digest
digest

1. ECU generates a digest of its SW with its own secret key and sends it to the head unit
2. Head unit verifies the digest
3. Head unit merges collected digest and resigns it with its own secret key, then sends it to the manufacturer center
4. The center determines an update program, signs it with own secret key, sends it to the head unit.
5. Head unit verifies the update program and transmits it to ECU
6. ECU applies the update program by itself
7. Again, ECU generates a digest, sign it and sends it to the head unit for verification
8. Head unit verifies the digest
9. Head unit resigns the digest with own secret key, and sends it to the center
10. The center determines whether SW update process is successful or not. After the process has done successfully, the center stores the update log into own DB.

Thank you for listening Q&A



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