TNC17: Smart and Connected Communities - The Network and the People

PRESENTED BY: Florence D. Hudson, Senior VP and Chief Innovation Officer, Internet2
Paul Dekkers, Employee Network Technology and Product Development, SURFnet
Internet2 Smart Campus initiative was developed based on use cases from three member-led innovation working groups established in 2015 from a member innovation survey, creating a Collaborative Innovation Community.

**E2E Trust & Security (E2ET&S)**
- TIPPSS for IoT – Trust, Identity, Privacy, Protection, Safety, Security
- NSF EAGER Cybersecurity Transition to Practice Acceleration
- SDP (Software Defined Perimeter), Network Segmentation for IoT

**Distributed Big Data & Analytics (DBDA)**
- Health & Life Sciences / Genomics
- Smart Campuses & Cities
- NSF Big Data Hub Collaboration

**Internet of Things (IoT)**
- IoT Sandbox
- Smart Campuses & Cities
- Smart Grid Testbed
Internet2 Collaborative Innovation Community (CINC UP) includes Special Interest Groups pertinent to members, including Smart Campus.

- Smart Campus
- Smart Grid
- IoT Ethics
- TIPPS for IoT
- Cybersecurity Transition To Practice
- Healthcare & Life Sciences / Genomics

Join us! Email CINO@Internet2.edu
Internet2 Collaborative Innovation Community has grown to 377 individuals, from 161 organizations since starting in 2015. Join us – CINO@Internet2.edu.
Research & Education activities are growing in Smart Campus / Communities, IoT, end-to-end trust & security, big data & analytics, Smart Grid … Connecting the people and things, while leveraging the people and physical Network.
Internet2 Smart Campus Initiative is led by a Smart Campus CIO Advisory Council including thought leaders who are executing smart campus strategies

- Share best practices and recommendations to deploy Smart Campus capabilities
- Commissioned IoT Systems Risk Management Task Force
- Microsoft and Internet2 co-convened first annual Campus Connections Summit, February 2017, 140+ university “CIO + 1” attendees from around the world
ASU Smart Campus Journey began with a Smart Stadium

Gen 1: Game Day Experience
- Infrastructure upgrade
- Real Time Parking
- Sensor Packs
- A smarter sound game
- Upgraded mobile app

Gen 2: Stadium Suite
- Water flow sensors
- Alexa skillset
- Sentiment analysis
- Indoor wayfinding
- AWS Dash

Gen 3: Scaling to a Smart Campus
- Smart Fleet
- Smart Classroom
- Smart Assistant
Arizona State University’s Vision for a Connected Campus

A comprehensive connected campus blends both IoT-driven insights and digital engagement capabilities to deliver a leading higher education experience across university stakeholders.
Monthly Collaborative Innovation Community CINC UP Calls are held on a variety of topics, many pertinent to smart campuses.

- **Network Segmentation for IoT** presented by Cisco
- **OpenFog Consortium** presented by Princeton University
- **LoRa low-power WAN pilot for IoT research** presented by SURFnet (Netherlands)
- **Internet of Things Security and Blockchain** presented by IBM Blockchain Garage
- **AWS Greengrass: Unlocking the Promise of IoT** presented by Amazon Web Services
- **IoT Azure Suite** presented by Microsoft
- **IoT Pedagogy** presented by Marshall University, SUNY Cobleskill, Syracuse University
- **Privacy Decision Making in the Internet of Things** presented by Clemson University
- Interested in participating? Email **CINO@Internet2.edu**
CINC UP discusses Smart Campus and IoT pedagogy: Smart Campus and Internet of Things Class Projects
Internet2 IoT Systems Risk Management Task Force: Recommends Initial Exposure Benchmarking / Baselining via Shodan & Censys.io tools.

How to Find IoT Devices Connected to Your Campus Network

Why is this important?

IoT devices on our campus networks may be vulnerable to malware and increase the risk for information security and privacy compromises. Yet, many of these devices show up on campus without the knowledge of central IT. So how can we find those devices that put us at risk? The Internet2 IoT Systems Risk Management Task Force found two tools, Censys and Shodan, to be easy enough for non-security experts to use to find IoT devices.

Tools: Shodan and Censys

Shodan and Censys are search engines that find servers and other devices connected to the Internet that use Internet protocols specifically associated with industrial control systems and, increasingly, IoT devices & systems. They retrieve metadata about the devices such as geographic location, operating system, device name and serial number.

How to get started

WARNING: Consult your CISO office before proceeding since prior notice and authorization may be required.

Anyone can run basic searches in Shodan and Censys for free, although advanced searching and reporting features may have a cost. Create accounts at:

shodan.io

censys.io

Try searches with IoT keywords, such as “camera.” Also, Shodan has a specific filter for finding Industrial Control System devices: the ics category and Censys syntax includes the “scada” tag for Supervisory control and data acquisition components of industrial control systems.

This document is intended to provide different organizations within Higher Education institutions with items to consider as they engage with IoT systems vendors at the different phases of selection, procurement, deployment and management.

IoT systems are selected, acquired and deployed by higher ed institutions through multiple paths.

The historical acquisition approach of selection, acquisition, deployment and management of traditional enterprise IT systems through central IT is not sufficient for IoT systems.

Questions to consider in organizational approaches to IoT systems and vendor management.
- Who will monitor and manage the device?
- Is there a data feed to the device? Who will create and support it? Who will secure it?
- Are there trust, identity, privacy, protection, safety and/or security considerations?
- Is there a patch and upgrade plan? Who will do the patching? Who manages the plan?
- Are there interdependencies between any of these IoT systems? Who manages that?
- Is there a separate network segment for the IoT devices? Is it air gapped?

February 2017 Microsoft and Internet2 sponsored Campus Connections Summit participants identified initiatives to further the Smart Campus journey.

- **Student Success & Data Analytics**
  - The Agile University
  - Global Talent Profile
  - MentorBot Personal Tutor for Student Success
- **Safety & Security**
  - Cybersecurity Learning Hub
  - Digital Literacy
- **Energy & Sustainability**
  - Campus as a Living Lab Breaking Cultural Barriers
  - Achieving Carbon Neutrality SCOPE ME
- **Collaborative Research**
  - Research Portal “1 Portal for All”
Survey finds that U.S. university students are comfortable sharing personal data with universities, but want an improved college experience in return.

- 98% want school to use personal information to improve academic processes
- 95% expect the personal data shared to improve college experience, student life
- 82% think personal data shared now will transform future college experiences
- 62% want school to track graduation requirements & progress
- 59% want school to use personal data to help select, register for classes
- 53% want school to use data for scheduling academic advising sessions

*Source: Campus Technology, 2016.*
Future smart communities will be an interconnected “system of systems” to improve efficiency, safety, quality of life, energy use, & environment.

What can we enable if we think across the system of systems?
Addressing TIPPSS for IoT is essential to achieving safe, secure, scalable future smart city and campus architectures – TNC session 9-10:30am, June 1

- **Trust**: Allow only designated people/services device or data access
- **Identity**: Validate the identity of people, services, and “things”
- **Privacy**: Ensure device, personal & sensitive data is kept private
- **Protection**: Protect devices and users from harm
- **Safety**: Provide safety for devices, infrastructure and people
- **Security**: Maintain security of data, devices, people, etc.
• **Smart buildings/learning** (Not new. WiFi? Sensors?)
  - Student presence
  - Find a free desktop, good place to work
  - Similar ideas…
• Recent uptake...
  - “New” category in IoT: Low power, long range
  - New technology and networks: LoRa, Sigfox, NB-IoT, ... (similar characteristics)

• Interest from education and research:
  - Easy to deploy and study entire LoRaWAN stack and have something workable within 1 day
  - Sensors in research
Network landscape, IoT and low power

Bandwidth

Range

Low Power WAN

NB-IoT

Wi-Fi

3G

4G
For LPWAN: Mesh often not favourable: limited range, relaying data costs power (radio, CPU), coordination
LoRa, LoRaWAN, LPWAN...?

- LPWAN for Low Power WAN
  - Star topology
  - Long range
  - Low bandwidth

- Unlicensed spectrum under 1 GHz, ISM bands, range!

- Multiple solutions, LoRa(WAN) very interesting
LoRa modulation, speeds, distances

- 10 km
- 8
- 6
- 4

bitrate

energy / airtime

290 bps

530

970
LoRa, the Internet of Things

Paul Dekkers

25 JAN 2015

‘Things’ online

We are constantly surrounded by things; as far as I am concerned, there is no need for them to be online all the time – although I wouldn’t have minded if my fridge had let me know there was still some old bread in the freezer compartment. Come to think of it, quite a few things in life might be better if they were online: just take a walk through the city and you’ll see full waste containers, half submerged boats, parking spaces, bicycles, lantern posts. The air quality in some places also seems a bit suspect, and could certainly do with the odd measurement. I also keep running into more amusing and useful ‘Internet-of-things’ applications developed by LoRa users, such as beehive monitoring systems.
Workshops, hands-on

Hands-on workshop LoRaWAN

Datum: 23 MRT 2016

Bent u nieuwsgierig naar de populairste Internet of Things-technologie? Wilt u meer weten over LoRaWAN en is u afgewezen van bij de LoRaWAN open dag? In het kader van het LoRaWAN hands-on workshop kunt u niet alleen meer lezen over LoRaWAN en de mogelijkheden die deze technologie biedt, maar ook proeven en de voordeelen ervan kennen.

In deze hands-on workshop LoRaWAN gaan we een inzicht in de techniek van LoRaWAN nemen en laten zien hoe LoRaWAN werkt. Door u de voordeelen van LoRaWAN te laten zien en u te laten zien hoe deze technologie werkt, zal u beter begrijpen hoe LoRaWAN werkt en wat de mogelijke toepassingen zijn.

LoRaWAN binnen het Internet of Things-landschap

In de meeste toepassingen van LoRaWAN wordt gebruik gemaakt van een microcontroller zoals een Arduino. Door u de mogelijkheden van LoRaWAN te laten zien en u te laten zien hoe deze technologie werkt, wordt u beter in staat om zelf een LoRaWAN-apparaat te maken of zelf een LoRaWAN-apparaat te maken.
Infrastructure, coverage
Measuring coverage gateway

PH3V

Today I did some Predicted vs Realtime calculations.

Remarkable how well the prediction comes close to the real-time measurements. The original contains pixels of 50 by 50 meters. For example, on the bridge at Zaltbommel there is indeed, albeit limited, coverage. It is also clear to see that there is less eastward coverage. That's because of the hills.

The same prediction made on the basis of my antenna setup ... Antenna 7 meters, uh...

That was a big disappointment compared to Utrecht setup 😞

Gateway AA555A00080605B7 'De Uithof' Utrecht, The Netherlands

Green > -112dBm
Yellow > -127dBm < -112 dBm
IoT applications

easy development, prototyping
Student projects
Student projects with LoRaWAN
1. Fix to inside of door
2. Activate with smartphone
3. Monitor online

Fuel theft detected during truck journey

Sealed on 2016-03-13 at 16:22
Seal is intact
Cannot upload seal event log, no internet

Temperature: 1.2 °C
Applications? The network is there...

- vacuum pump
- asset-management
- dikes
- groundwater level
- digital seal
- trash-containers
- maintenance bridges
- traffic
- building mgmt
- student projects
- parking spots
- trains
- environmental, air-quality, noise
- cleaning-cart
- earthquakes
- smart meters
- track OV-bike usage (maintenance)
- track wildlife
- floods
- fridge researchers
- streetlights
- water plants
- leakage
- CO2 in lecture rooms
- groundwater level
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- leakage
- CO2 in lecture rooms
• What SURF can do
  - Share knowledge, workshops, hands-on:
    - Building (simple) sensors
  - Enable the network
  - Sustainable middleware
  - Build our own sensors (eduroam monitoring? strong auth?)
  - Challenge users!
Recommendations & Next Steps

- Attend TNC17 **Securing the Things** session June 1, 9:00-10:30AM
  - Presentations on potential attacks, possible defense mechanisms, and collaboration opportunities
  - Defining and Deploying TIPPSS for IoT, invitation to ITANA/Internet2 Enterprise IoT WG
- Attend TNC17 **Mobility Day**, June 2, 9:30AM-3:30PM
  - Topics to be covered include eduroam, govroam, WBA, hotspot 2.0, Internet of Things, 5G
- Join Internet2 CINC UP – email **CINO@Internet2.edu**
  - Participate in Working Groups: IoT, End-to-End Trust & Security, Distributed Big Data & Analytics
  - Join Special Interest Groups dedicated to: Smart Campus, Smart Grid, IoT Ethics, TIPPSS for IoT, Cybersecurity Research Transition To Practice, Healthcare & Life Sciences / Genomics
- Get familiar with the network, middleware, look at local (TTN) communities, find or facilitate projects with students, incubators, campuses
Questions?
paul.dekkers@surfnet.nl
@pauldekkers

fhudson@Internet2.edu
@FloInternet2