
INTERNET2
2016 GLOBAL SUMMIT
MAY 15-18
CHICAGO
20 1996 YEARS 2016
SMART CAMPUS INITIATIVE & INNOVATIONS
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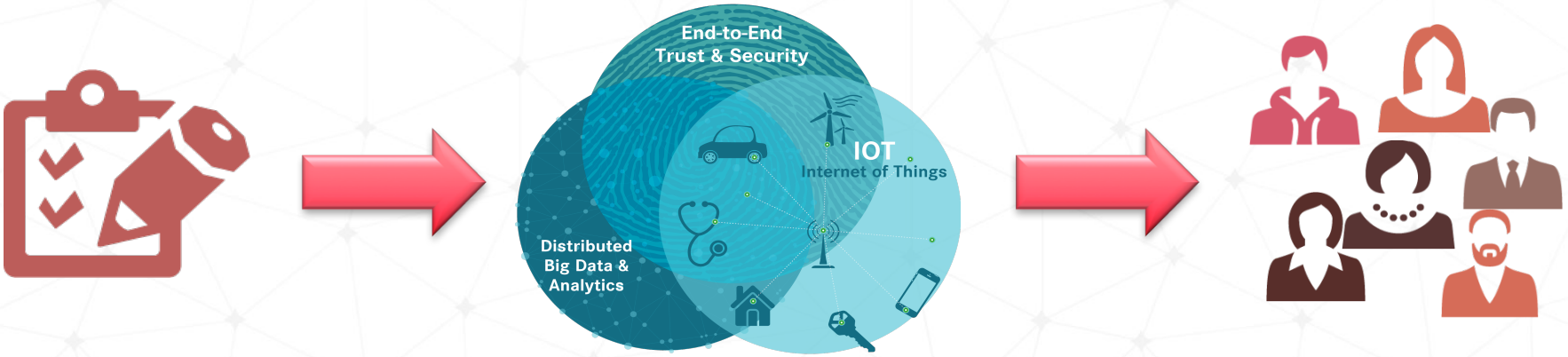
Smart Campus Initiative & Innovations

AGENDA

- **Evolution of the Collaborative Innovation Community:** Florence Hudson, Internet2
- **Introducing the Smart Campus Initiative:** Florence Hudson, Internet2
- **IoT Systems Risk Management Task Force:** Chuck Benson, University of Washington
- **CSG Session on E2ET&S for IoT:** Scot Ransbottom, Virginia Tech
- **Smart Cities and Campus Opportunities:** Glenn Ricart, US IGNITE
- **Campus Example, Sun Devil Stadium:** Gordon Wishon, Arizona State University
- **Next Steps:** Florence Hudson, Internet2

Collaborative Innovation Program

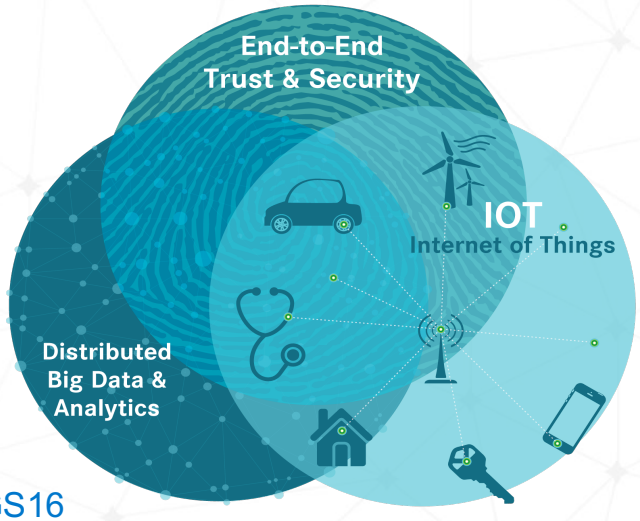
Established three new Collaborative Innovation Working Groups During Global Summit 2015 based on March 2015 Member Survey



Collaborative Innovation Program Current Focus Areas

E2E Trust & Security:

- End to End Trust and Security for IoT
- TIPPSS – Trust, Identity, Privacy, Protection, Safety, Security
- SDP (Software Defined Perimeter), Network Segmentation



Distributed Big Data & Analytics:

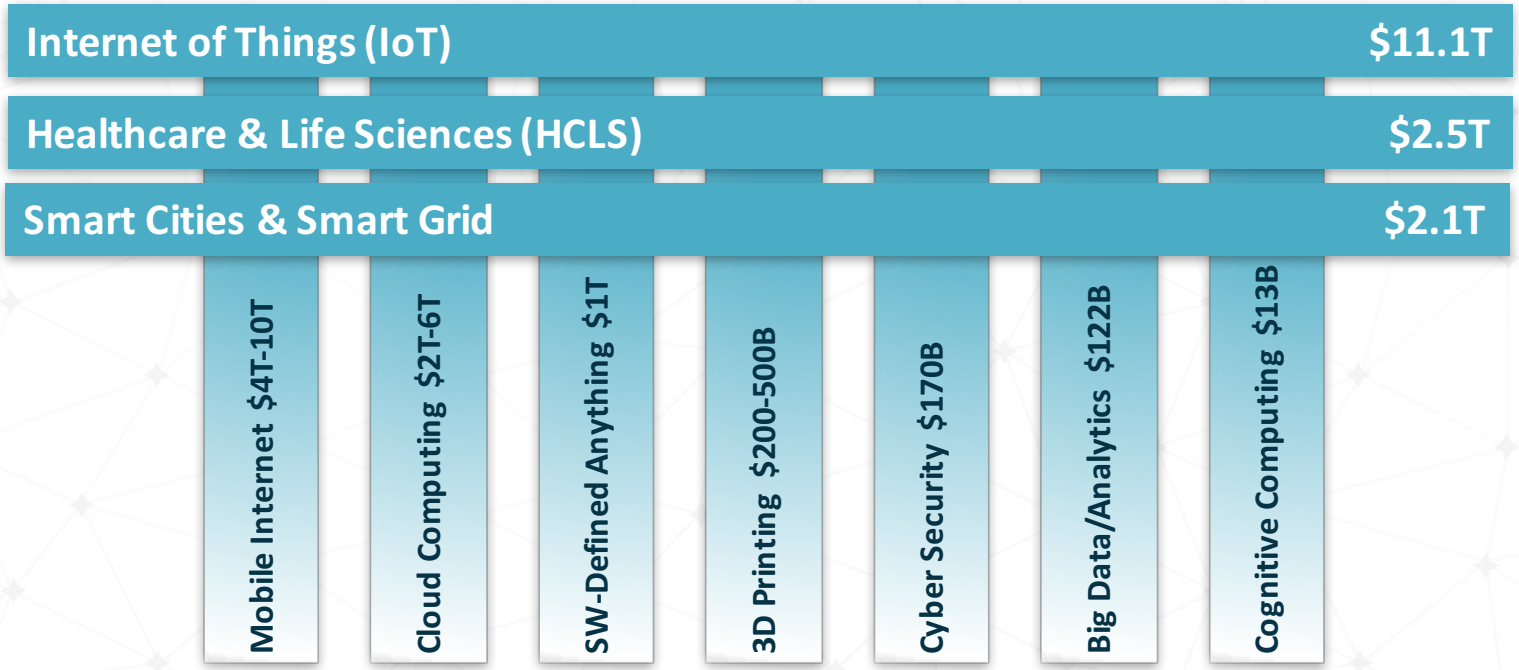
- Genomics
- Digital Humanities
- Smart Campus/Smart Cities

Internet of Things:

- IoT Sandbox
- Smart Grid Testbed
- Smart Campus/Smart Cities

Join a working group: http://bit.ly/CINCGS16

The Internet of Things, Healthcare & Life Sciences, and Smart Cities could represent $15T in global economic value in 2025



Economic value includes revenues, cost reductions & service improvements achieved

Sources: Internet2 CINO analysis; BizTech; Deloitte; Consultantcy.uk; Forbes; Markets and Markets; McKinsey; US Department of Agriculture, Economic Research Services.

Welcome to the Smart Campus Initiative

- Forum to share learnings and develop new insights and practical recommendations
- Create focused task forces to support collaborative development of practical recommendations
- Guided by a Smart Campus CIO Advisory Council

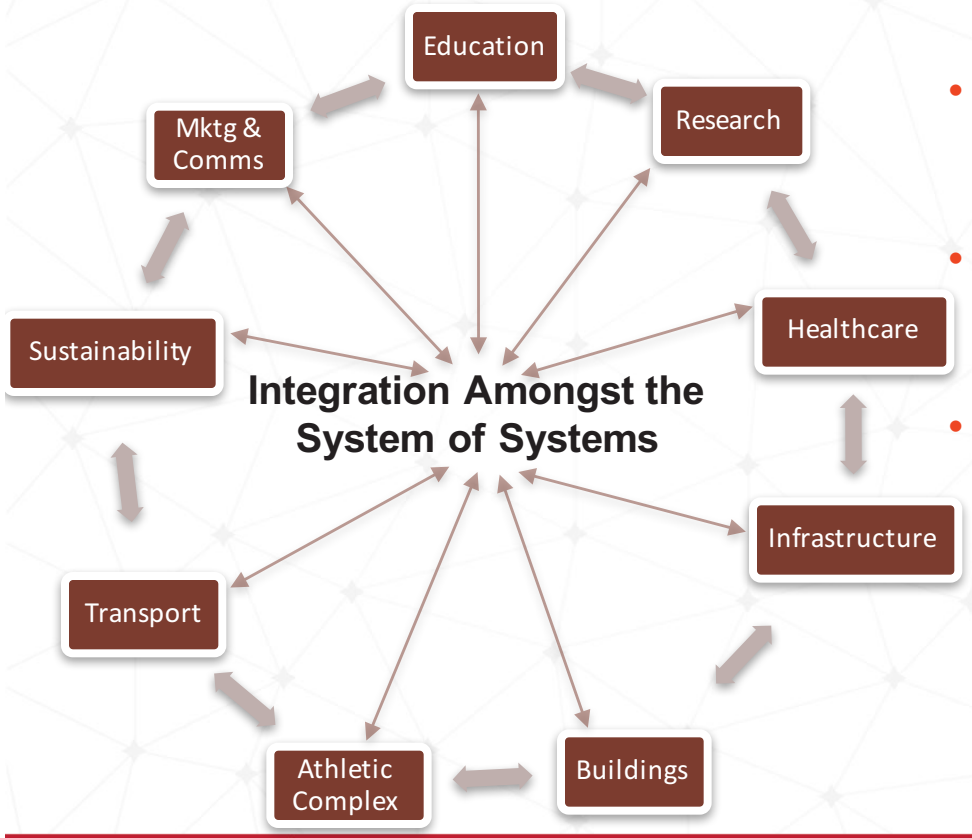
CIO Smart Campus Advisory Council Interview Results

Expectations

- "Knowledgeable knowledge transfer"
- Technology diffusion
- Stakeholder discussions for longer-term campus planning
- Enable the facilitation of smart campus to extend to a smart community

- **Smart Campus Potential Focal Areas**
  - Student experience & success
  - Facilities/Buildings: lighting, HVAC, etc.
  - Smart stadiums: fan experience & revenues
  - Identify & define common infrastructure standards
  - Security: physical, data, holistic approach
  - Connected vehicles
  - Identify adoption roadblocks
  - Smart Campus 2025: Anticipating future needs
- **Smart Campus Challenges**
  - Managing the data (e.g., data lake)
  - Standards
  - Ethics
  - Infrastructure management
  - Power supply: batteries, PoE
  - Privacy & security
  - Enterprise risk management

Defining a Smart Campus



- A Smart Campus leverages data to ***improve student success, experience and campus operations***
- Requires integration of Information Technology and Operational Technology to ***better inform decision making*** in each domain and across the campus
- Achieving a Smart Campus will involve cross-campus collaboration with multiple stakeholder partnerships. These partnerships will include, but not be limited to:
  - Facilities
  - Central IT
  - Campus Security
  - Administration
  - Research Community
  - Faculty & Students

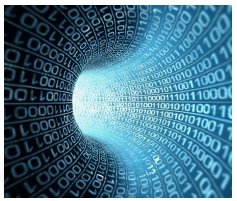
Addressing TIPPSS is essential to achieving safe, secure, scalable future smart city and campus architectures

Trust
Identity
Privacy
Protection
Safety
Security

Identifying a framework for segmenting IoT devices & the potential risks is a first step towards creating a TIPPSS environment

Hacking an IoT device can have implications across multiple fronts:

Trust, Identity, Privacy, Protection, Safety & Security



Data

Physical

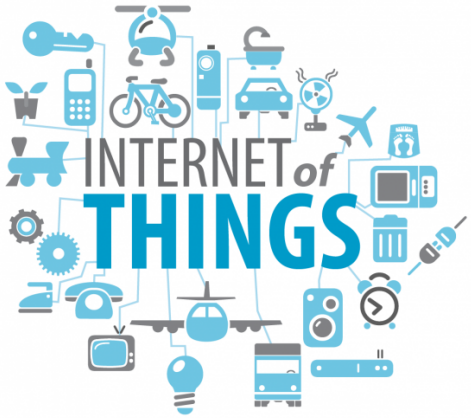
Financial

Reputation

Smart Campus Initiative: DRAFT Charter Statement

- Equip Internet2 members with the skills and guidance to effectively deploy Smart Campus capabilities by:
  - Sharing best practices from current Smart Campus projects
  - Engaging campus strategic stakeholders through the CIO to share interest and vision for a Smart Campus
  - Identifying needs and challenges that can be addressed with potential Smart Campus and IoT approaches
  - Providing recommended courses of action that resolve challenges, leveraging best practices

Smart Campus Initiative:
IoT Systems Risk Management Task Force



Great potential in IoT Systems in Higher Ed institutions -- Energy management, sustainability, building access control, research automation & environmental control, building automation, safety systems, academic learning systems …

IoT Systems

Implementation & Management

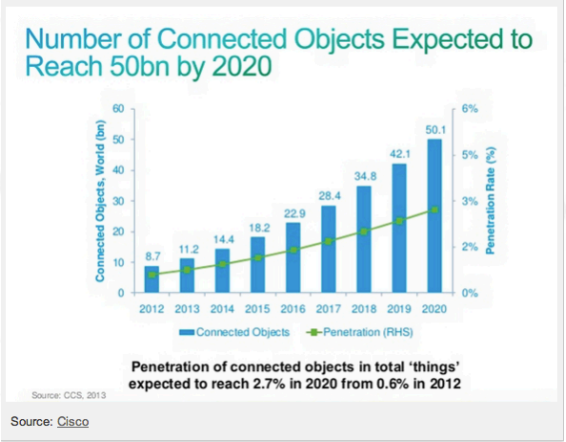
The Real World – e.g. Campus, City, …

But potential not realized if IoT System is not implemented & managed well. Topics include:

- Vendor management – articulating & raising expectations
- Vendor management – multiple proprietary systems
- System ownership
- IoT System selection, procurement, installation
- Costing models & approaches
- System risk identification & management
- Network segmentation & portfolio management
- Organizational/Culture change
- Others

Smart Campus Initiative: IoT Systems Risk Management Task Force

- IoT Systems are different from traditional enterprise systems
  - Large numbers of networked, computing devices
  - High variability within device types
  - Little language/conceptual framework for system planning & managing risk
  - Out of sight, out of mind – Systems embedded in the environment around us
  - IoT Systems tend to span multiple organizations within an institution



Smart Campus Initiative: IoT Systems Risk Management Task Force

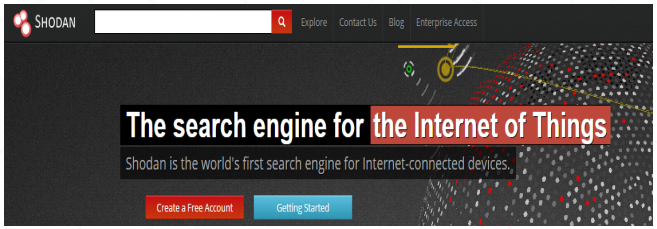
Some participating schools/networks:

- Clemson
- Cornell
- Indiana University
- MIT
- Princeton
- Rice
- Virginia Tech
- University of Pittsburgh
- University of Washington
- University of Wisconsin-Madison
- Yale
- HEA-Net (Ireland)

Some roles/titles of participants:

- AVC Operations & Maintenance
- AVP & Chief Facilities Officer
- Associate CIO
- Chief Technology Officer
- Deputy CIO/Chief of Staff
- Enterprise Architect
- Infrastructure Director
- IT Service Owner for Research
- Network Development Manager
- Research Cyber Infrastructure Liaison
- Security Manager
- Senior Applications Systems Engineer

Smart Campus Initiative:
IoT Systems Risk Management Task Force



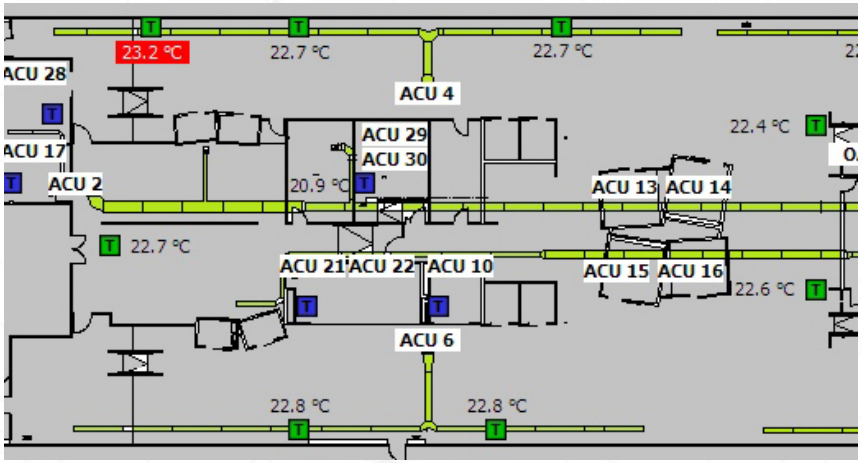
The search engine for **Power Plants**

The search engine for **Buildings**

The search engine for **Refrigerators**

The search engine for **Webcams**

censys



Smart Campus Initiative:
IoT Systems Risk Management Task Force

Proposed topics for Quarterly Report Outs to Smart Campus CIO Advisory Council:

Quarter 1 – Sept 2016: Ability to profile IoT Systems exposure w/public tool (e.g., Shodan.io or Censys.io)

Quarter 2 – Dec 2016: Vendor management – Requirements doc for IoT Systems vendors (process, checklist, etc.)

Quarter 3 – March 2017: Cost model for IoT Systems selection, procurement, & management

Quarter 4 – May 2017: Recommendations for further work in 3 – 5 areas

- network segmentation management ?
- organizational/culture change ?
- development of IoT Systems risk language/taxonomies ?
- dependence on non-interoperable proprietary IoT Systems ?
- other ?

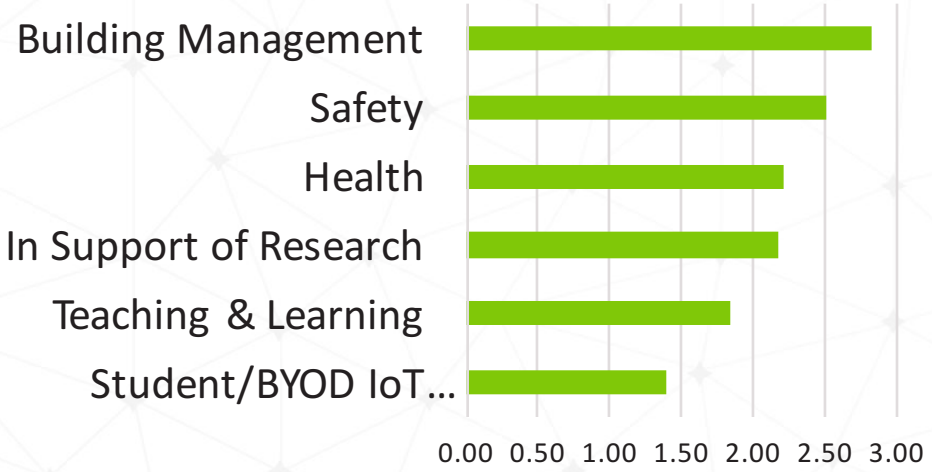
CSG Session on E2ET&S for IoT: IoT is becoming a campus reality in Smart Buildings, Research, & Healthcare

Participation in IoT use cases on or off campus

	On Campus	Off Campus
Smart buildings	6	0
Research projects	5	3
Connected healthcare	3	3
Smart stadiums	3	1
Connected vehicles	2	2
Smart museums	1	0

N = 6

Rank importance of IoT use cases on your campus




THE UNIVERSITY OF UTAH
usignite
Smart and Connected Communities
Glenn.Ricart@us-ignite.org
May 15, 2016

usignite

"US Ignite is an initiative that seeks to promote the development and deployment of next-generation gigabit **applications** with the potential for significant **societal impact**."

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4 Megatrends
4 Responses
US Ignite's Smart Gigabit Communities Program
Funding Opportunities
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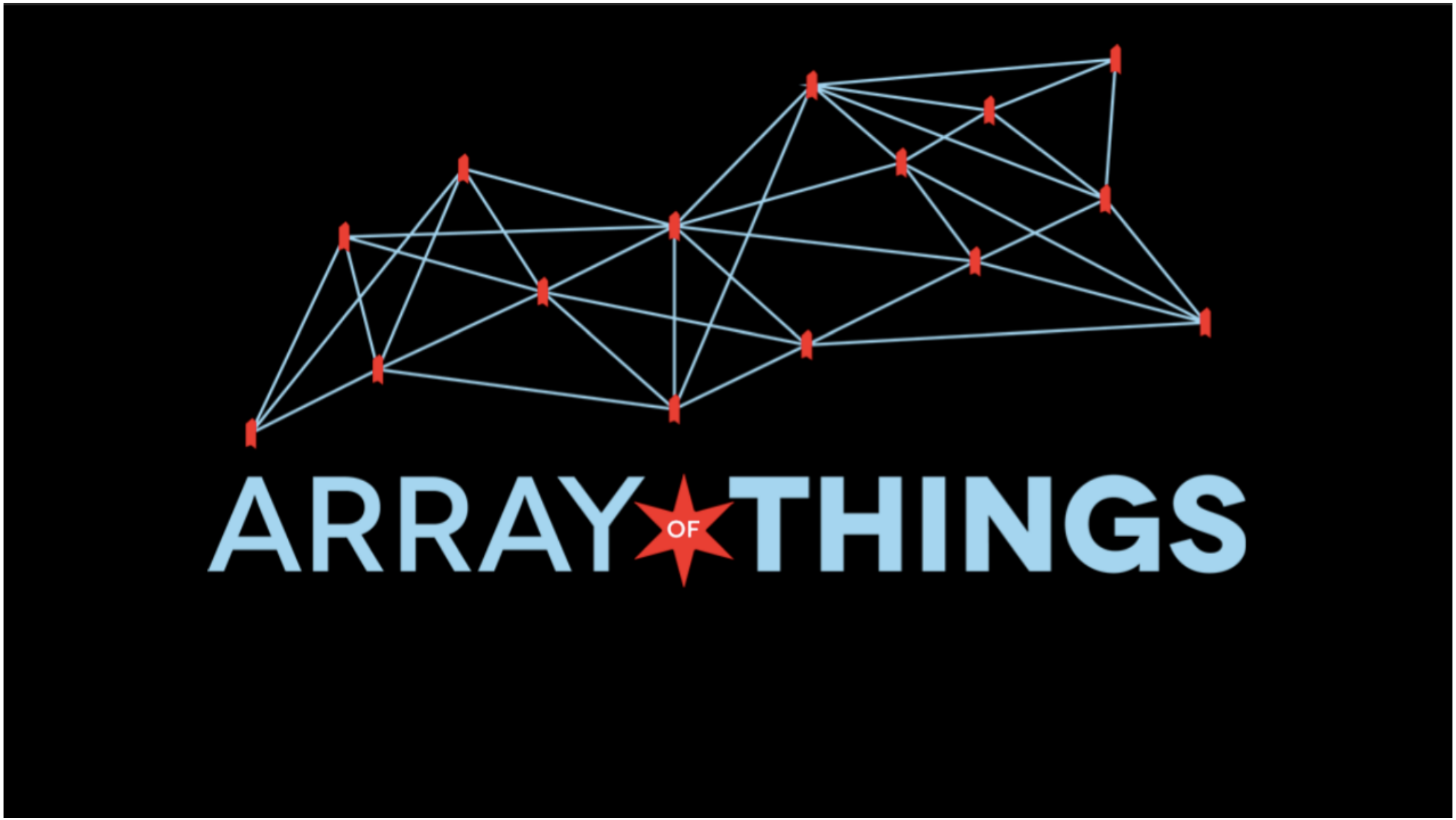
ARRAY OF THINGS

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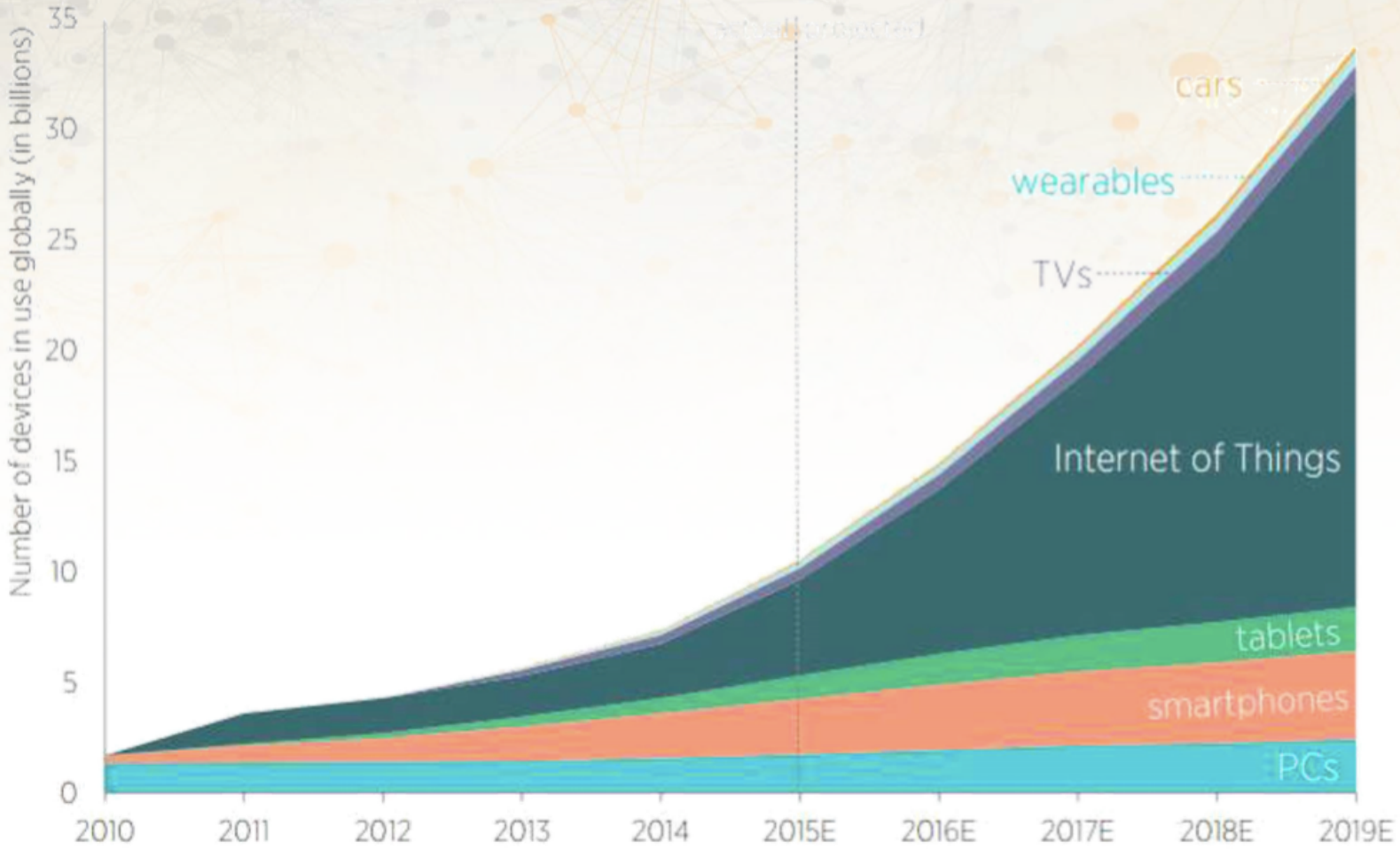
Figure 2. The Internet of Everything: Devices in Use Globally



Source: John Greenough, "The Internet of Everything 2015," *Business Insider Intelligence*, produced by Adam Thierer and Andrea Castillo, Mercatus Center at George Washington University, 2015.

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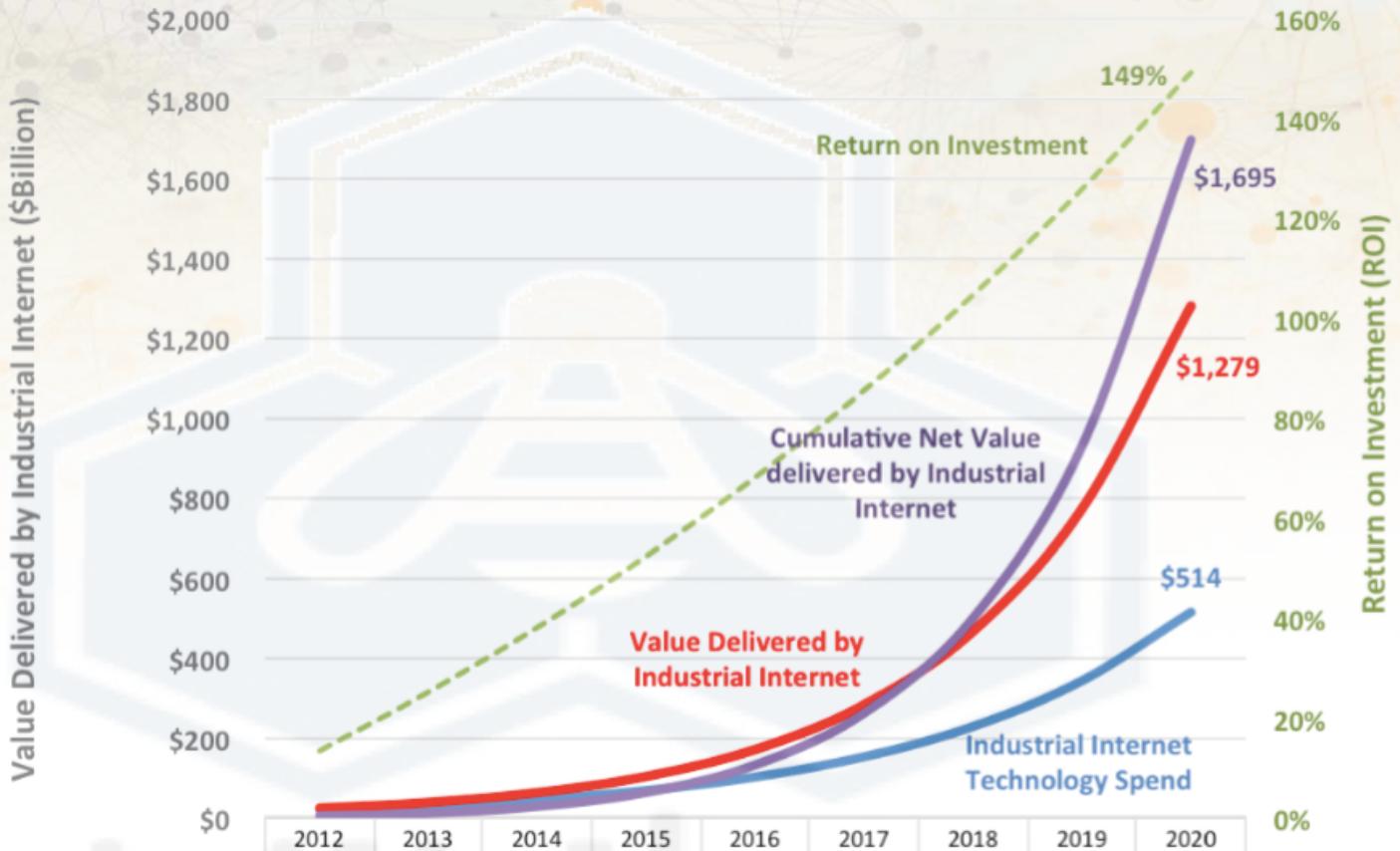
Projection of Value Delivered by Industrial Internet 2012-2020 ($B)



	2012	2013	2014	2015	2016	2017	2018	2019	2020
Industrial Internet Technology Spend	$20	$30	$45	$67	$101	$152	$228	$342	$514
Value Delivered by Industrial Internet	$23	$37	$62	$103	$170	$281	$466	$772	$1,279
Cumulative Net Value delivered by Industrial Internet	$3	$10	$27	$62	$131	$261	$499	$929	$1,695
Return on Investment	13%	25%	38%	52%	68%	85%	105%	126%	149%

Source: © Multiple Sources Integrated by Wikibon, 2013

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4 Megatrends:
1. Communicating things outnumber people
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Wireless Innovation

A Golden Age

- White space spectrum (100x)
- Coordinated WiFi (10x)
- mm-wave (1000x)
- Cloud RANS (Radio Access Networks) (10x)
- New FCC permissions for campuses
- Building-assisted wireless (100x)
- Citizen's Broadband service (10x-100x)
- Beam-forming array antennas (10x)

- Remember: multi-gigabit (fiber) feeds required in many more places


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4 Megatrends:
1. Communicating things outnumber people
2. Golden age of wireless breakthroughs
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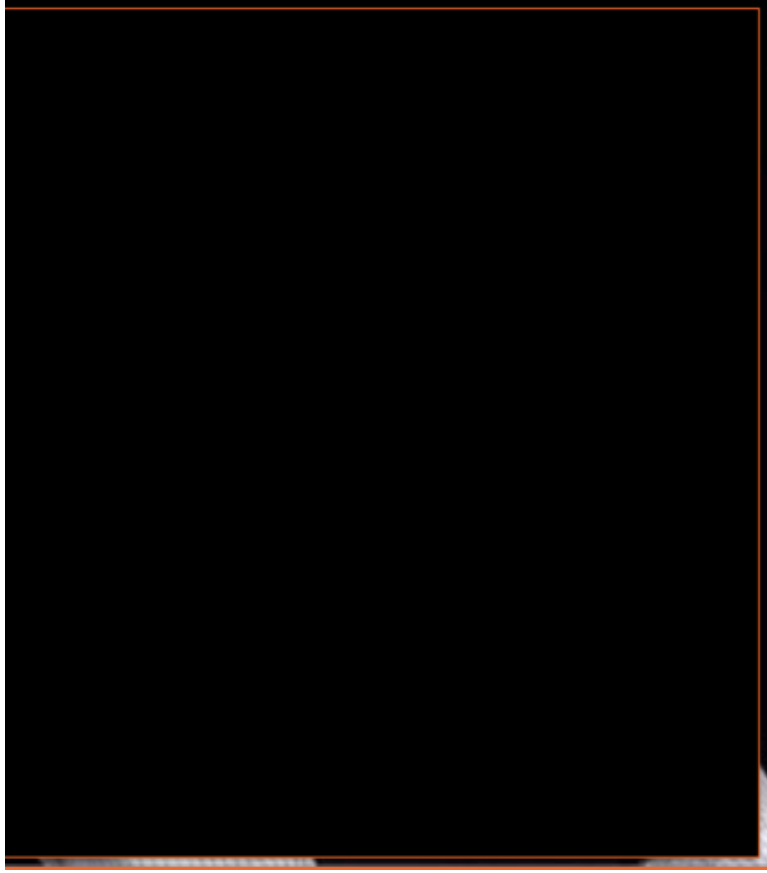
“Software is eating the world.”

–Marc Andreessen, VC



Software innovation outpaces hardware innovation

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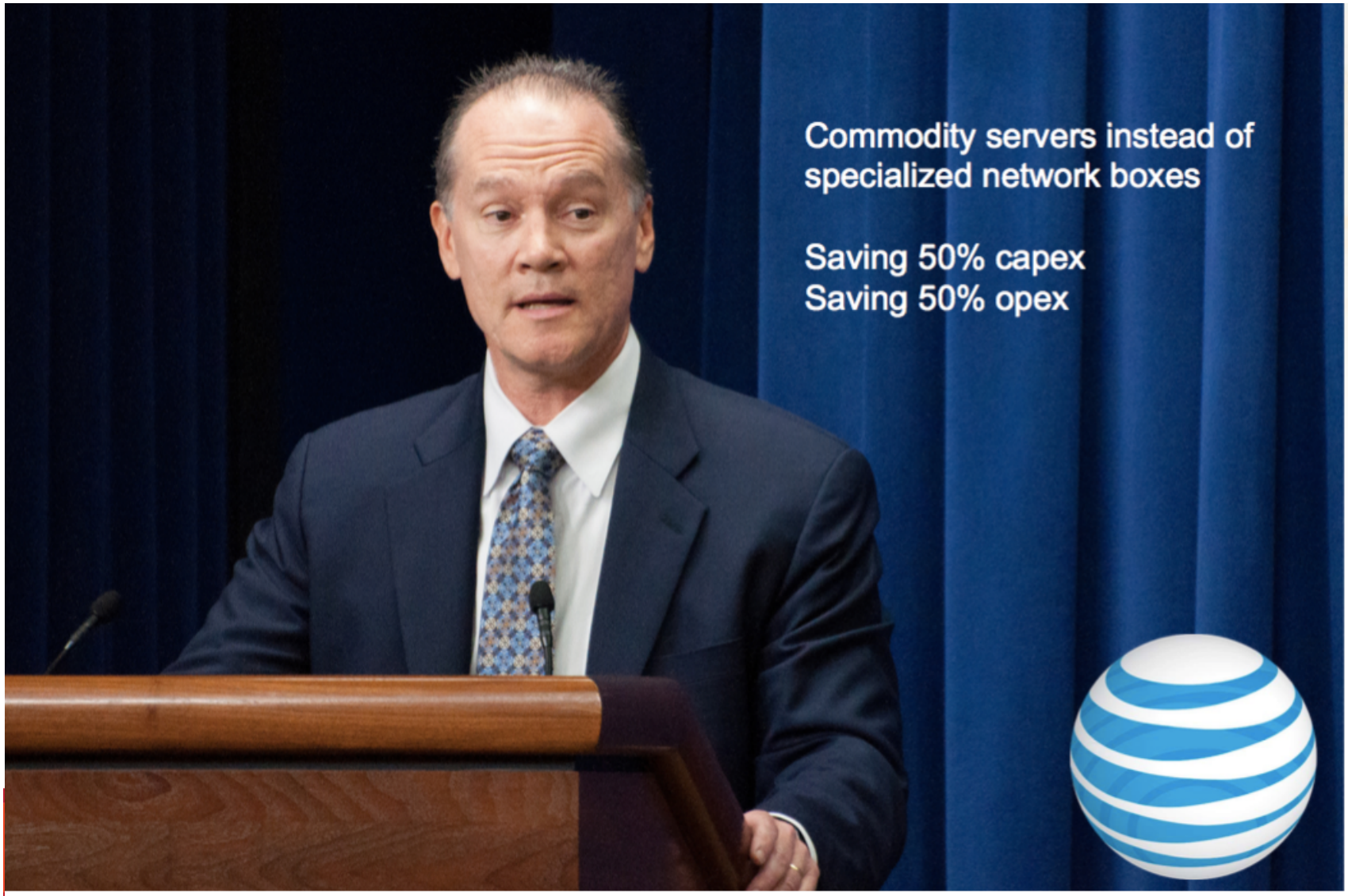

NFV
SDN
SDI
SDx

at&t

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4 Megatrends:
1. Communicating things outnumber people
2. Golden age of wireless breakthroughs
3. Software-defined infrastructure
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Gigabit Access Networks

	Traditional broadband	Google Fiber + competitors	Improvement
Dowstream	10-50 Mbps	1 Gbps	20 to 100 times
Upstream	0.5-5 Mbps	1 Gbps	200 to 2000 times
Cost per gigabyte-month	28 cents (due to caps)	0.02 cents	14000 times
Time to load Facebook web page	1.2 seconds	1.1 seconds	8%
Fast enough for streaming VR	No	Yes	Reduce cost of learning with VR 80%
Fast enough for intra-heartbeat monitoring	No	Yes	Reduce cost of cardiac monitoring at home

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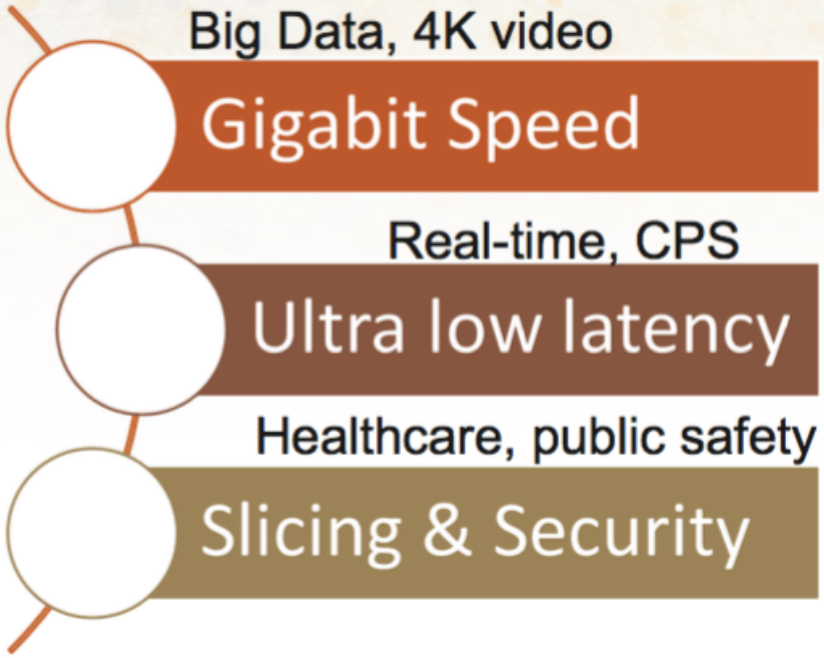
Gigabit



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4 Megatrends:
1. Communicating things outnumber people
2. Golden age of wireless breakthroughs
3. Software-defined infrastructure
4. Gigabit access
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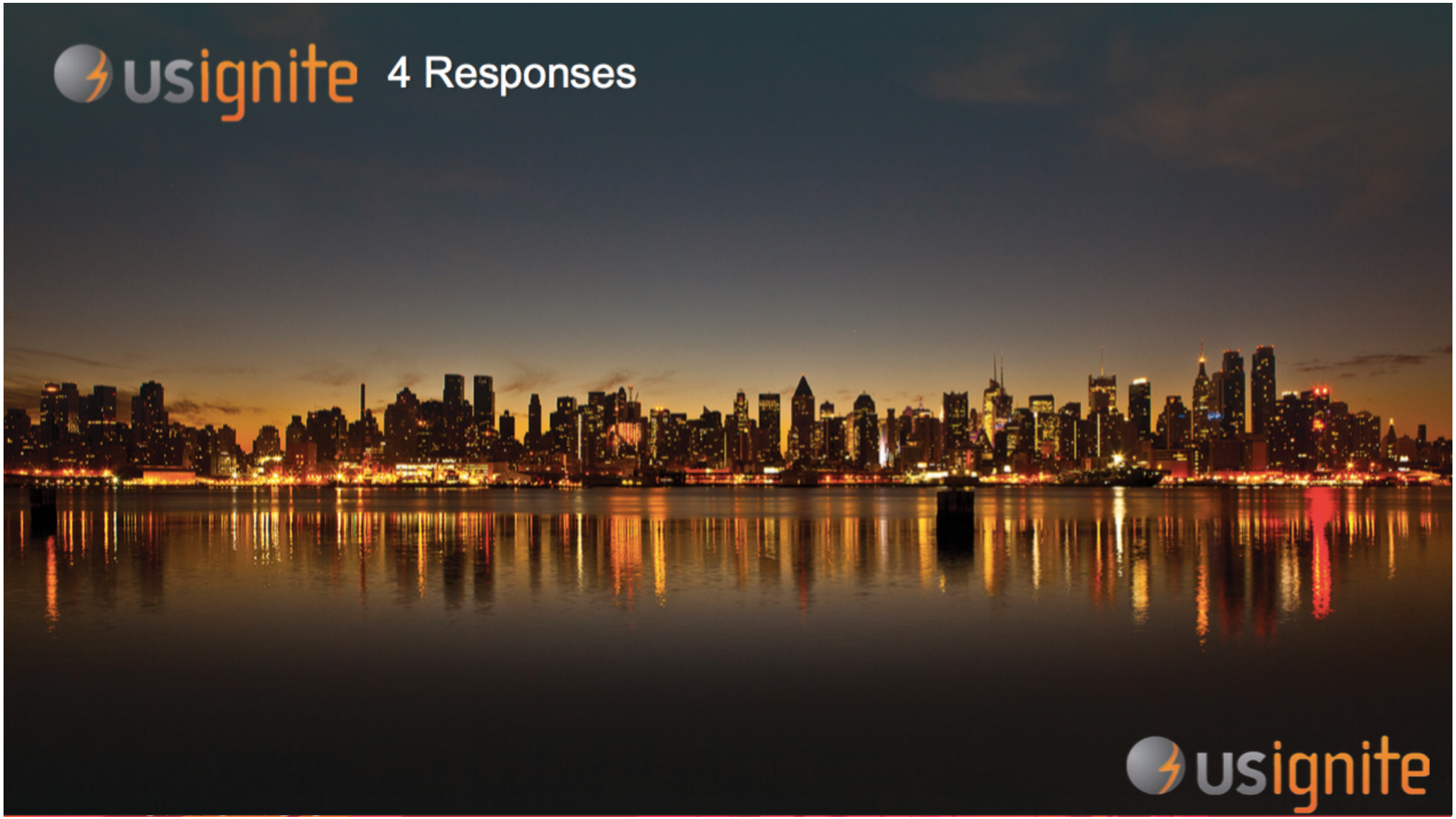
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4 Responses
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Locavore = Metro gig access + Fog, Cloudlet, Edge

NFV

Keep Local Gigabit Traffic Local

Digital Town Square

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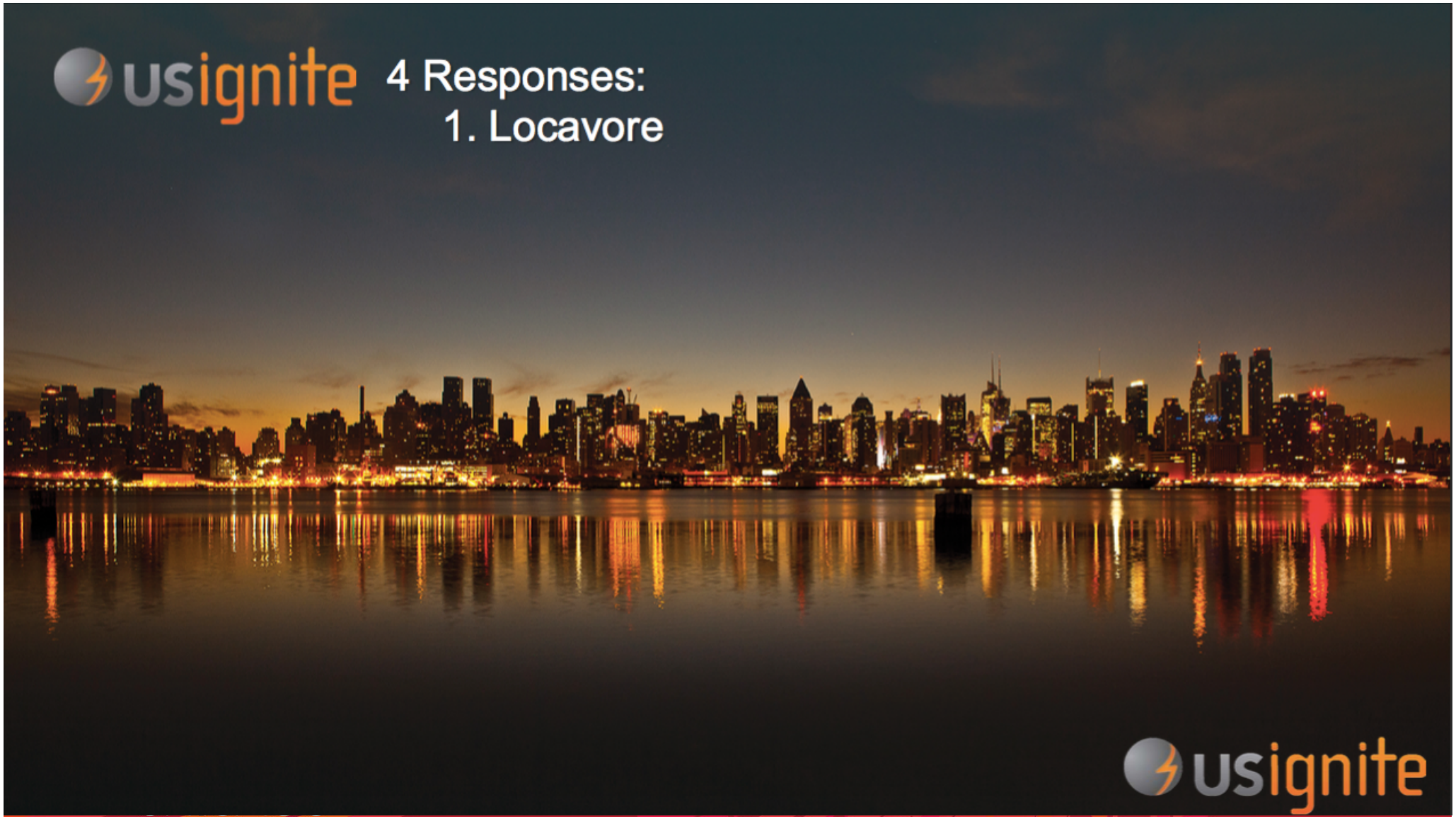
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4 Responses:
1. Locavore
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Research Issues

Architecture, design, prototype, test deploy in US Ignite city(-ies)

Security bindings preserved across SDX connections

"Transformer" drop-in components
e.g., Wired to wireless transformer

Distributed SDX (with these properties)

App engine integration (e.g. Docker)

Spontaneously-formed mesh-SDX

Highly reliable SDXes (non-stop in the face of any "n" failures)

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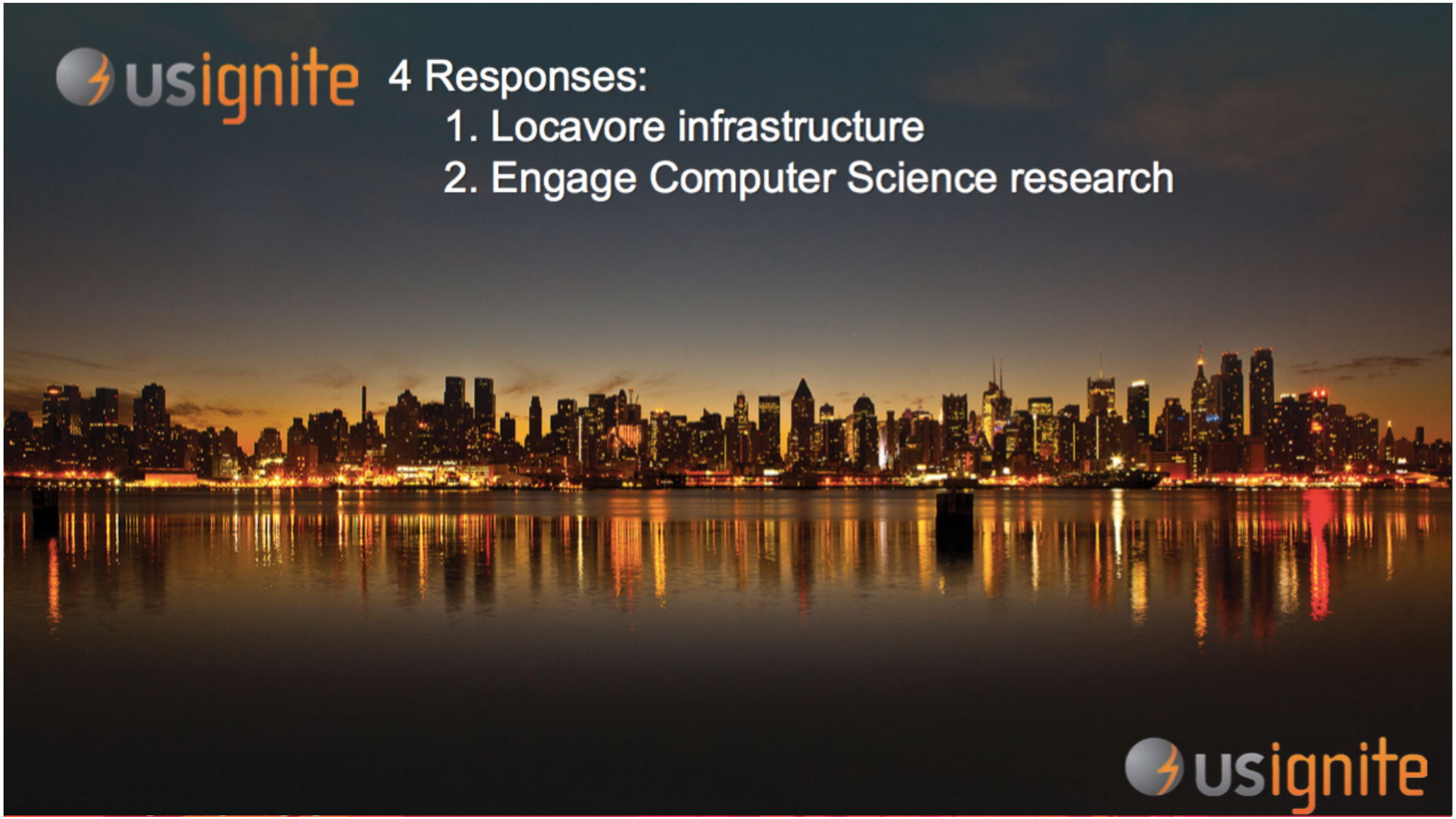
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4 Responses:
1. Locavore infrastructure
2. Engage Computer Science research
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Technical glitches plague computer-based standardized tests nationwide

"And Alaska officials this month canceled all K-12 standardized testing for the year, citing "chaos" in schools because of repeated testing disruptions. The state was the victim of a freak accident: Someone operating a backhoe inadvertently severed a fiber-optic cable in Kansas, cutting the Last Frontier's connection to its test vendor, the Achievement and Assessment Institute at the University of Kansas."

Washington Post, April 15, 2016, p. 1

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Resilient Local Digital Economy

Keep Local Gigabit
Traffic Local

Digital Town Square

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4 Responses:
1. Locavore infrastructure
2. Engage Computer Science research
3. Resilient local digital economy
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Smart City

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4 Responses:
1. Locavore infrastructure
2. Engage Computer Science research
3. Resilient local digital economy
4. Smart campus, smart city, smart community
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Major Smart Cities Efforts

IEEE Smart Cities

THE WHITE HOUSE
WASHINGTON

Also: DoT, DoE, DHS, HUD

IBM Smarter Cities

Cisco Smart+Connected Communities

MetroLab Network

NIST

GC TC 2016

NSF

Smart Gigabit Communities

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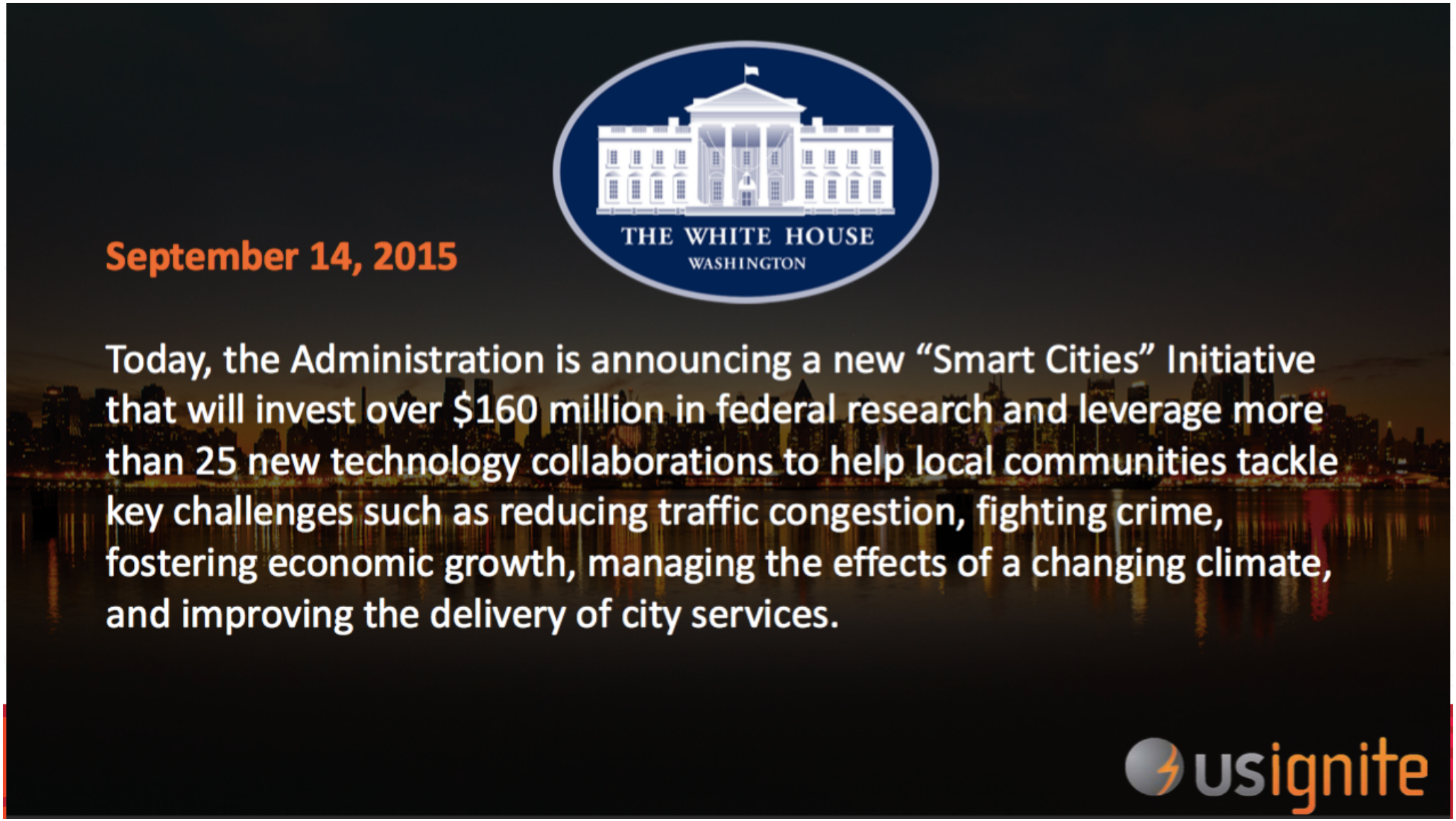
THE WHITE HOUSE
WASHINGTON
September 14, 2015
Today, the Administration is announcing a new “Smart Cities” Initiative that will invest over $160 million in federal research and leverage more than 25 new technology collaborations to help local communities tackle key challenges such as reducing traffic congestion, fighting crime, fostering economic growth, managing the effects of a changing climate, and improving the delivery of city services.
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"A new foundation-wide effort devoted to Smart and Connected Communities"

$6 Million for an interoperable, interconnected, highly responsive Metro Internet in 15 cities

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NIST

$5M investment in Smart Cities

Global City Teams Challenge

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MetroLab Network

University + City

MacArthur Foundation

traffic21
a transportation research institute of Carnegie Mellon University

Technologies for Safe and Efficient Transportation
THE NATIONAL USDOT UNIVERSITY TRANSPORTATION CENTER FOR SAFETY
Carnegie Mellon University UNIVERSITY of PENNSYLVANIA

San Diego, California
METROLAB NETWORK SPRING SUMMIT
MAY 9 – MAY 11, 2016

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GC
TC
2016
GlobalCityTeams.org
Current round: Sept. 2015 to June 2017
Next event: Tech Connect, Austin, June 13-15
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US-ignite.org
Announcement of Smart Gigabit Communities
at: Tech Connect, Austin, June 13-15
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Glenn Ricart <glenn.ricart@us-ignite.org>

SGC Funding Opportunities

1 message

Nishal Mohan <nishal.mohan@us-ignite.org> Tue, Apr 5, 2016 at 6:00 AM
Reply-To: Nishal Mohan <nishal.mohan@us-ignite.org>
To: Glenn <glenn.ricart@us-ignite.org>

CONNECT WITH US

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Dear Smart Gigabit Communities,

Welcome to the US Ignite Smart Gigabit Communities (SGC) monthly newsletter. This month we want to focus on potential funding sources for your smart gigabit applications. Additionally, please make a note on your calendars that the annual US Ignite Application Summit (co-located with the GCTC Expo and Smart Cities Innovation Summit) will be held in Austin, TX on June 13-15, 2016. More information about these exciting events coming soon.

Best,
Nishal and the SGC team

FEATURED

US Ignite: Networking Research and Application Prototypes Leading to Smart & Connected Communities

The new NSF 2016 US Ignite Program solicitation in partnership with the DOJ has been released! This is an exciting and important funding opportunity for your SGC gigabit applications and platforms with up to $600,000 for focus Area 1 proposals and up to $1,000,000 for focus Area 2 proposals. The proposal **deadline is June 14, 2016**. The US Ignite Program solicitation has been revised for FY 2016.

- The two "Tracks" from the FY 2015 solicitation have been revised and relabeled "Focus Areas."
- Similar to Track 1 in the previous solicitation, Focus Area 1 seeks proposals for innovative application ideas and prototypes that leverage or enhance advanced networking technologies and support progress toward Smart & Connected Communities;
- Focus Area 2 has a different emphasis than the previous Track 2, and seeks proposals for fundamental research that will advance both the capabilities and our understanding of gigabit networking infrastructure to meet future application demands; and
- The U.S. Department of Justice (DOJ) Office for Access to Justice (ATJ) is participating in the program.

POTENTIAL FUNDING SOURCES

NSF Dear Colleague Letter: Computer Science for All
NSF is seeking proposals to STEM+C and other existing CS, CT and STEM education programs that advance the CS for All initiative.
Deadline: Varies by Program

NSF Cyber-Physical Systems (CPS) Research Program in partnership with several Federal Agencies
Develop the core system science needed to engineer complex cyber-physical systems that people can use or interact with and depend upon.
Deadline: June 07, 2016

NIDA Application of Big Data Analytics to Drug Abuse Research
Encourage deeper or novel insights into the biological and behavioral processes associated with substance abuse and addiction.
Deadline: Standard due dates apply for the R01 grant mechanism.

DHS Basic and Applied Homeland Security Research across a Spectrum of Topics
Promote revolutionary changes in technologies; advance the development, testing and evaluation, and deployment of critical homeland security technologies; and accelerate the prototyping and deployment of technologies that would address homeland security vulnerabilities.
Deadline: December 31, 2016

NIJ Data Resources Program
Analysis of Existing Criminal Justice Data Sources from the National Archive of Criminal Justice Data (NACJD) and other public sources.
Deadline: April 25, 2016

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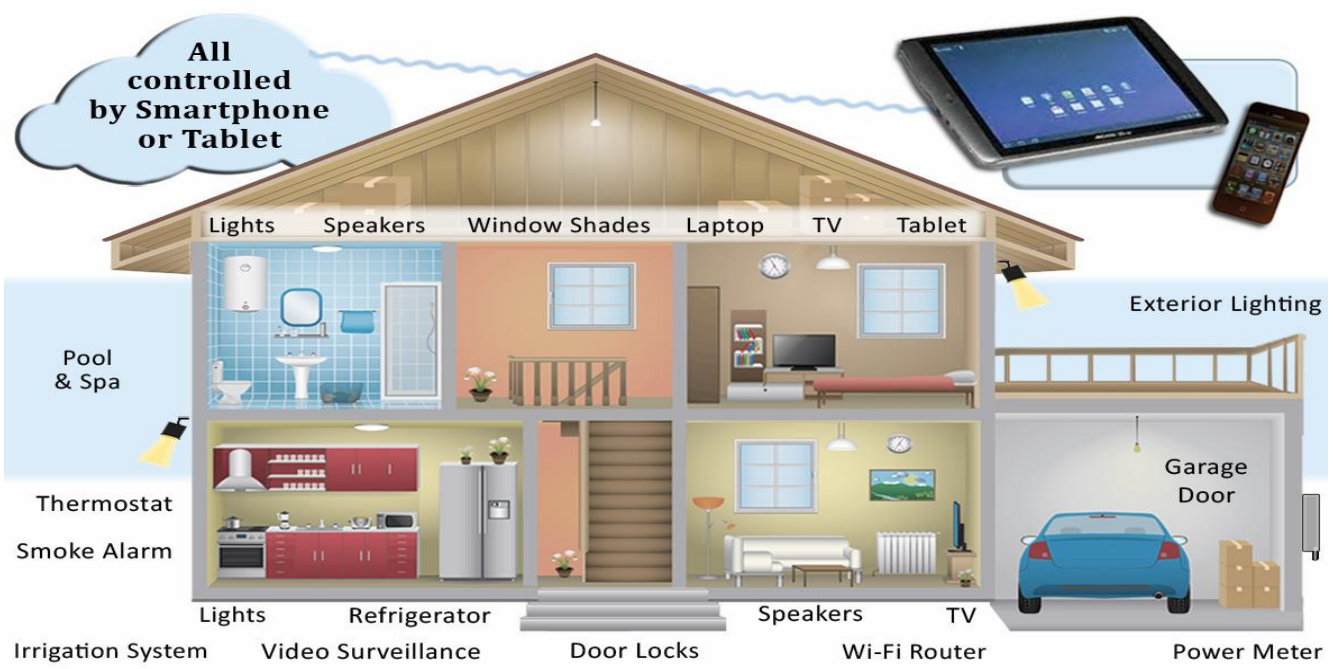
ASU Arizona State University

UNIVERSITY TECHNOLOGY OFFICE

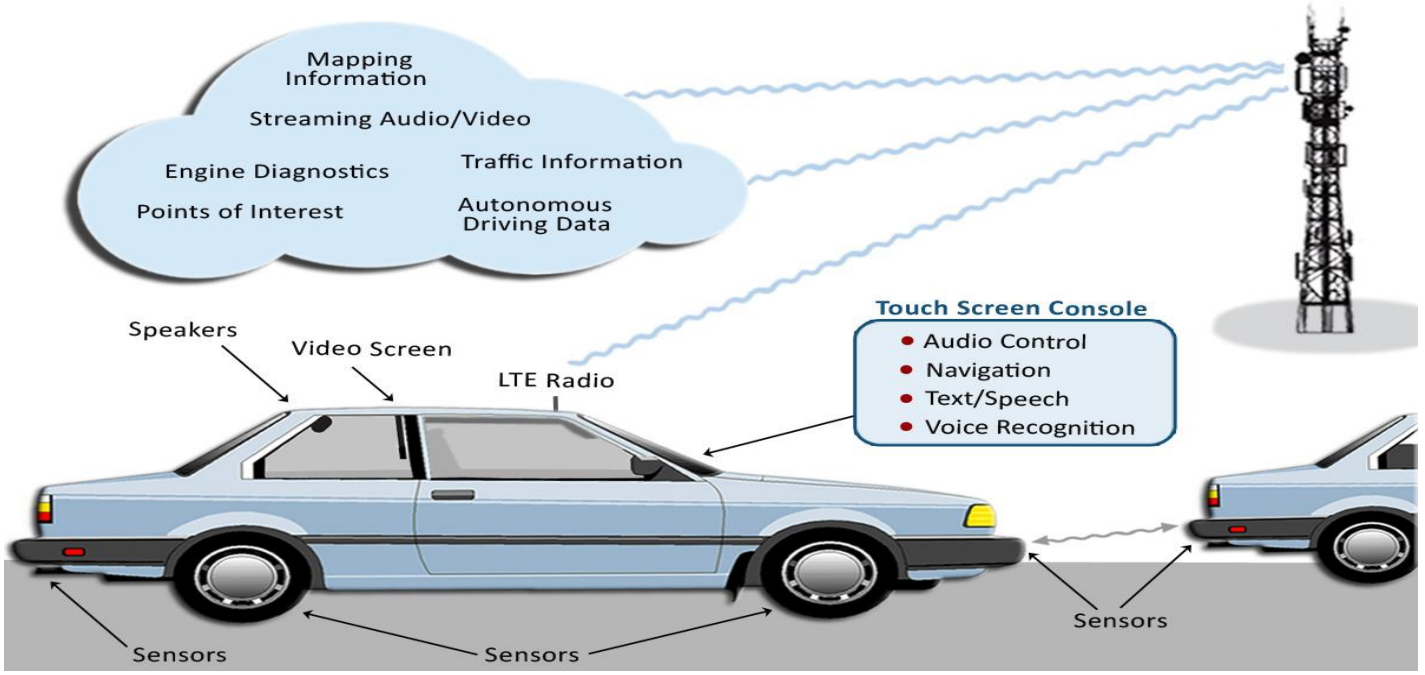
Leveraging the Internet of Things

we are in the process of instrumenting the planet

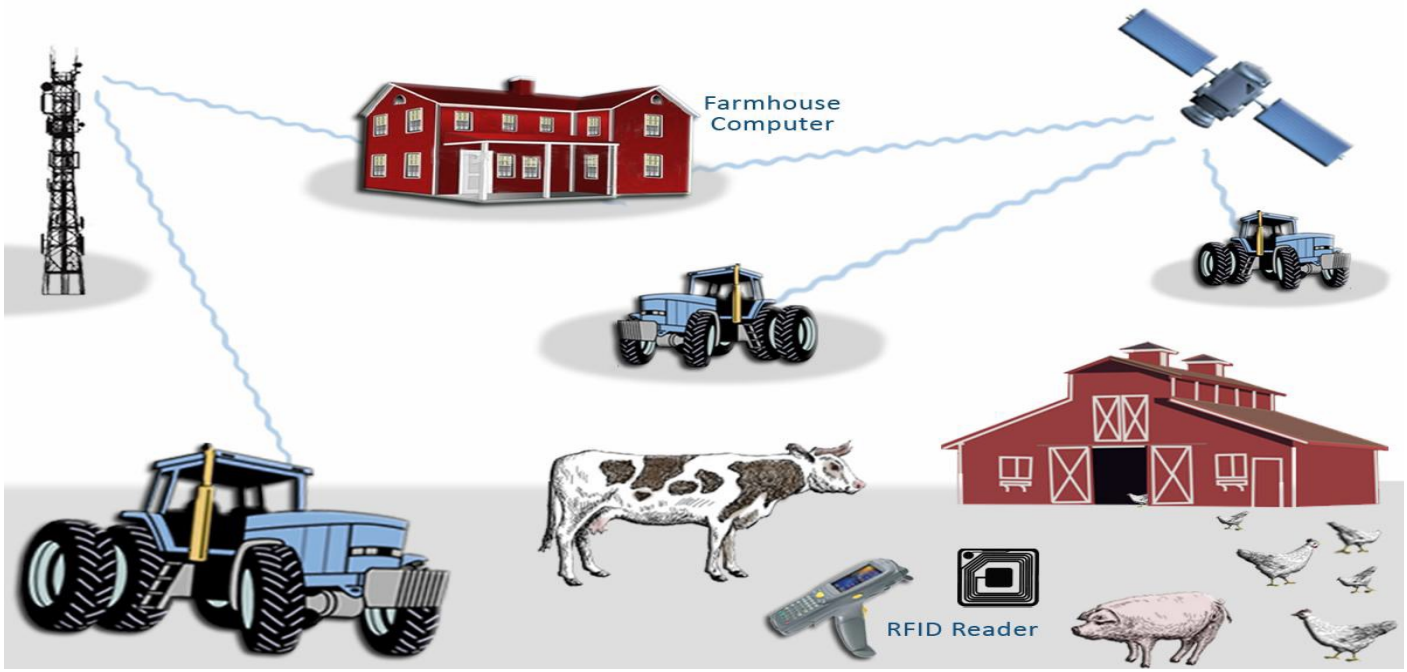
Smart Home


All controlled by Smartphone or Tablet
Lights
Speakers
Window Shades
Laptop
TV
Tablet
Exterior Lighting
Pool & Spa
Thermostat
Smoke Alarm
Garage Door
Lights
Refrigerator
Speakers
TV
Irrigation System
Video Surveillance
Door Locks
Wi-Fi Router
Power Meter

Smart Cars

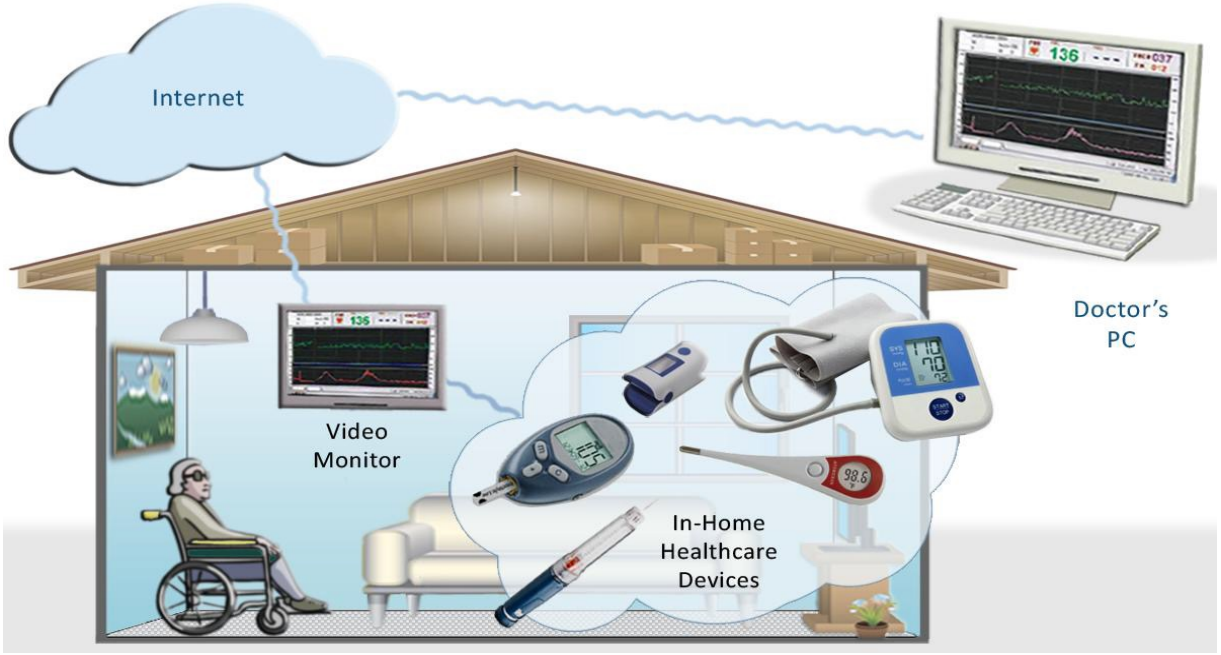

Mapping Information
Streaming Audio/Video
Engine Diagnostics
Traffic Information
Points of Interest
Autonomous Driving Data
Touch Screen Console
Audio Control
Navigation
Text/Speech
Voice Recognition
Speakers
Video Screen
LTE Radio
Sensors
Sensors
Sensors

Smart Farms

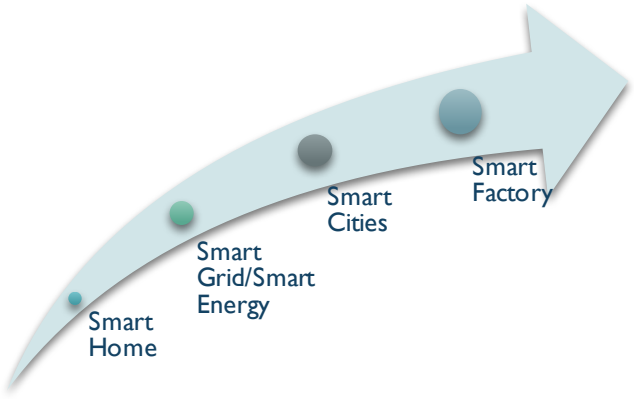


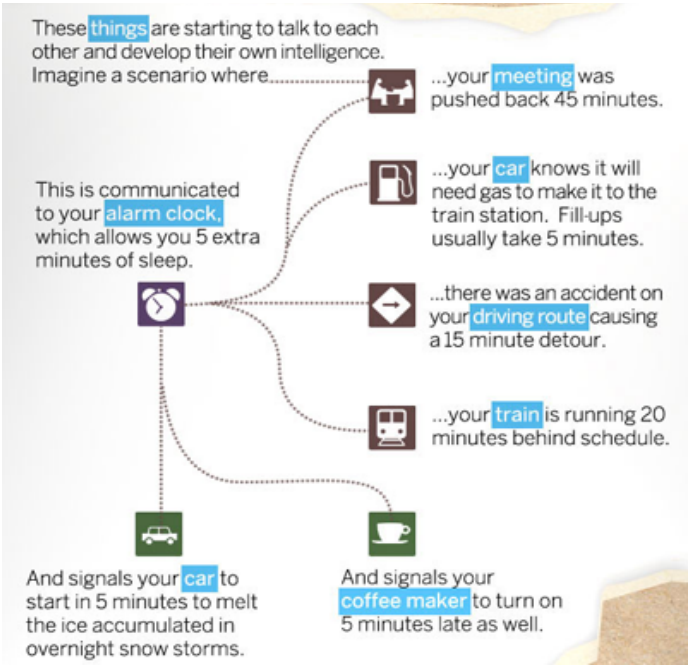
Current Scenario

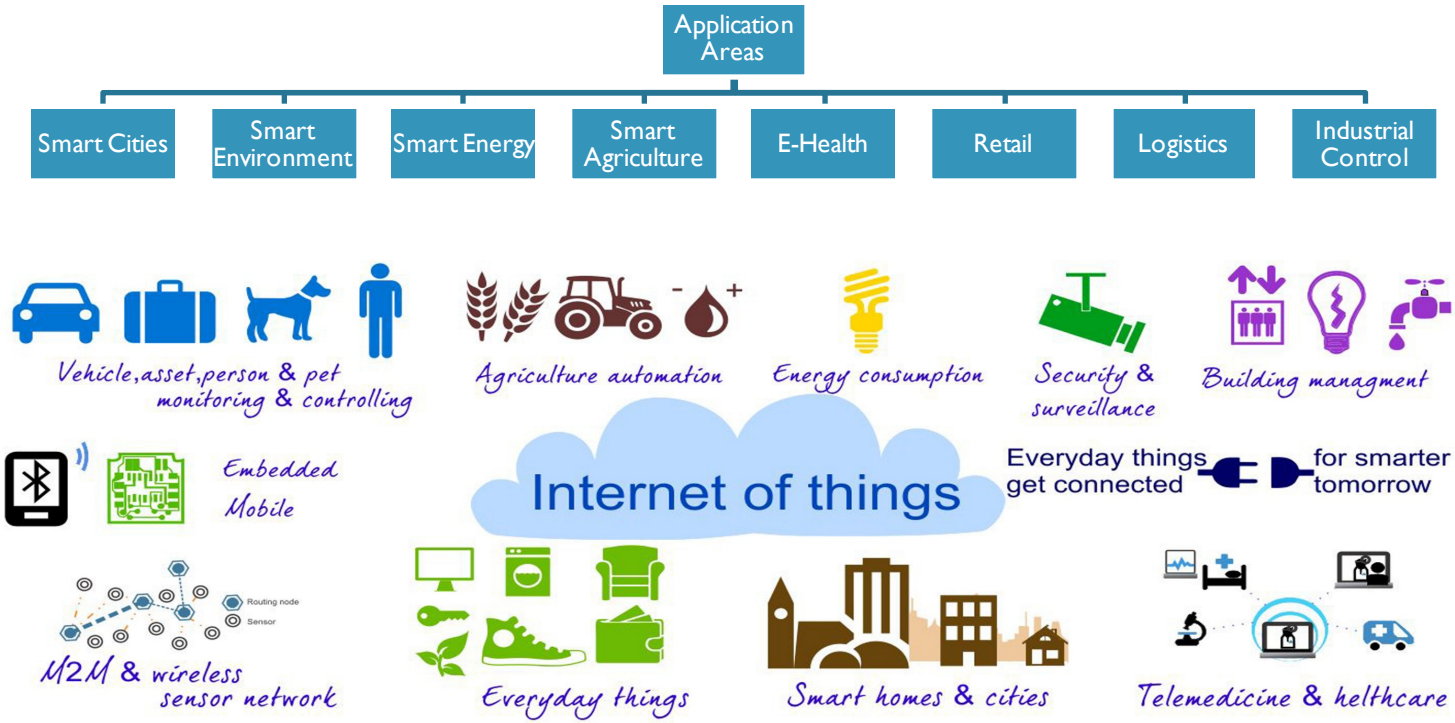
E-Healthcare



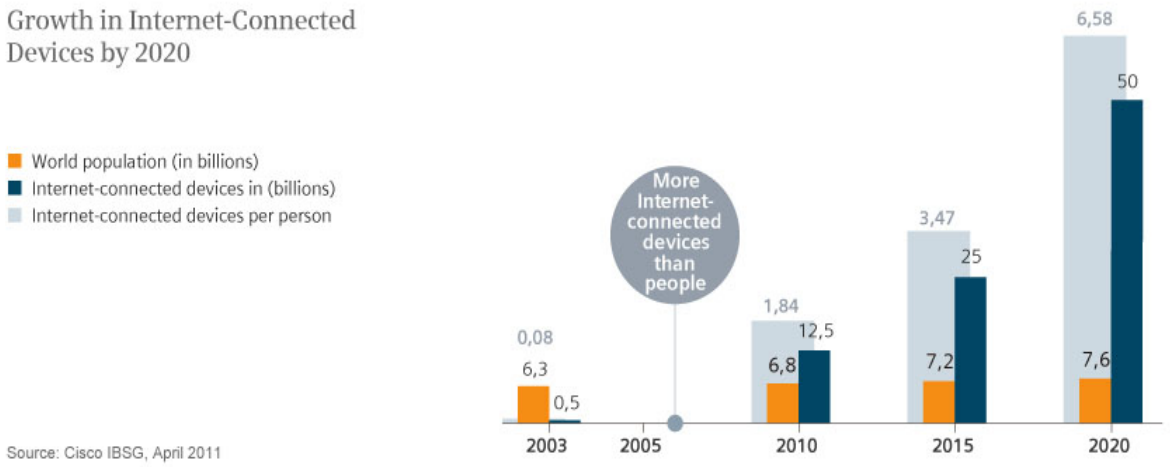
Future Scenario






Application Areas
Smart Cities
Smart Environment
Smart Energy
Smart Agriculture
E-Health
Retail
Logistics
Industrial Control
Vehicle,asset,person & pet monitoring & controlling
Agriculture automation
Energy consumption
Security & surveillance
Building managment
Embedded
Mobile
Internet of things
Everyday things get connected for smarter tomorrow
Routing node
Sensor
M2M & wireless sensor network
Everyday things
Smart homes & cities
Telemedicine & helthcare

Internet connected things



SIZING THE OPPORTUNITY

$19.0 Trillion*

VALUE AT STAKE

$14.4. Trillion PRIVATE SECTOR

Includes both industry-specific and horizontal use cases:

- Customer experience
- Innovation
- Employee productivity
- Supply chain
- Asset utilization

$4.6 Trillion PUBLIC SECTOR

Includes cities, agencies, and verticals such as healthcare, education, defense:

- Increased revenue
- Reduced cost
- Employee productivity
- Connected militarized
- Citizen experience

Estimate based on Cisco Bottom-up longitudinal analysis of 61 Global Use Cases, Including 21 for Private Sector and 40 in the public sector (*2013 - 2022). Value-at-stake is net present value.

HAPIfork

The HAPIfork is an electronic fork that helps you monitor and track your eating habits. It also alerts you with the help of indicator lights and gentle vibrations when you are eating too fast.

http://www.hapi.com/products-hapifork.asp

MyVessyl Cup

It can hold 13 ounces of liquid. The battery takes 60 minutes to fully charge and will last for 5-7 days. Also has wire-free charging.

https://www.myvessyl.com/

Smart Tooth Brush

The Beam Brush is a connected toothbrush that engages users with their daily hygiene routine.

http://www.beamtoothbrush.com/toothbrush/

Smart Egg Tray

Egg Minder syncs with your smartphone to tell you how many eggs you've got at home (up to 14 eggs) and when they're going bad.

http://www.quirky.com/shop/619

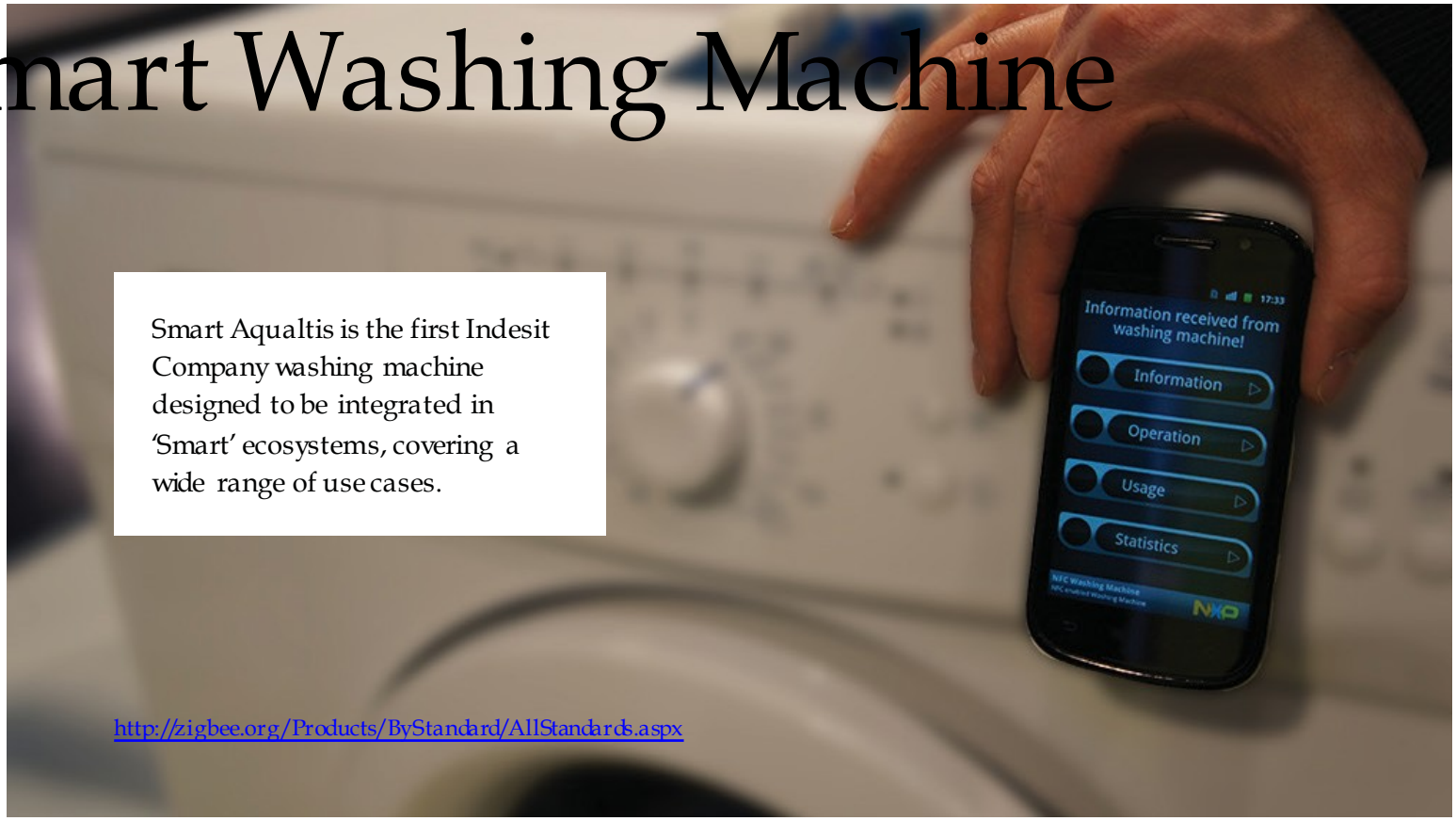
Smart Propane Tank

Glucose Monitoring

A cellular-powered glucose meter transmits each test result to a secure server and provides instant feedback and coaching to patients. This equips doctors, nurses, diabetes educators with real-time clinical data.

http://www.telcare.com/

Smart Washing Machine



Smart Aqualtis is the first Indesit Company washing machine designed to be integrated in 'Smart' ecosystems, covering a wide range of use cases.

http://zigbee.org/Products/ByStandard/AllStandards.aspx

Smart Piggy Bank

The Porkfolio wirelessly connects to an app on your device so you can track your balance and set financial goals from afar. Its nose lights up in celebration every time a U.S. coin is inserted and it holds up to $100 in quarters.

http://www.quirky.com/shop/607-porkfolio-save-big-with-this-pig

Hydroponic System

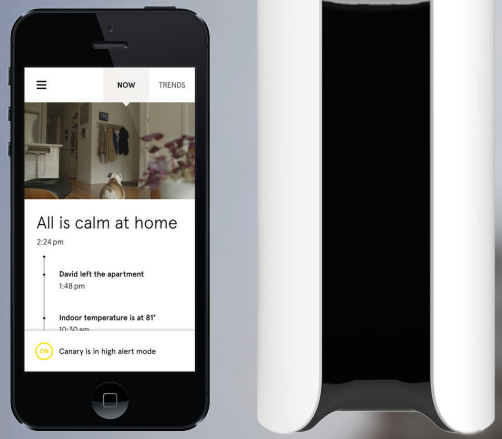
Niwa is the first fully automated hydroponic system that attends to all of your plants' needs and water them, feed them and make sure they have optimal growing conditions 24/7.

http://getniwa.com/

Smart Sprinkler Control

Smart Home Security

Canary is a complete security system packed into a single, device. It adapts to your home over time and sends intelligent notifications with HD video directly to your smartphone.



http://canary.is/

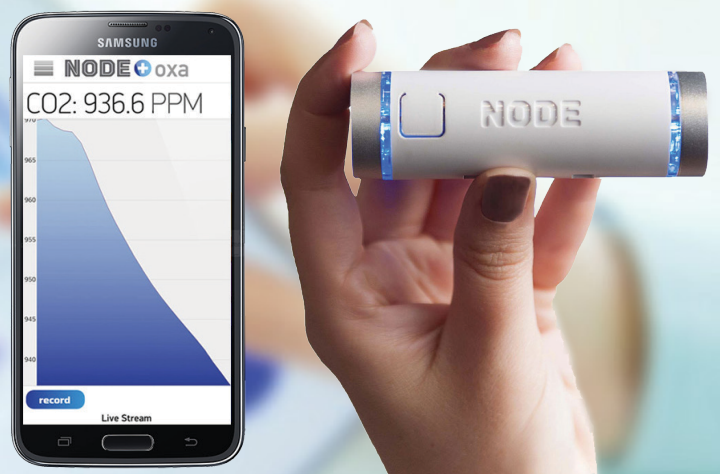
Smart Lighting

Control your bulbs one at a time or altogether. Find just the right shade of white. Pick that perfect tone to match the moment. Or recreate any color from a photo.

http://meethue.com/

Analyze with NODE+

Analyze speed, acceleration, movement, direction, shock, tilt, magnetic fields, and more.



http://variableinc.com

Smart A/C

Aros learns from your budget, location, schedule, and usage to automatically maintain the perfect temperature and maximize savings for your home.

https://www.quirky.com/shop/752-aros-smart-window-air-conditioner

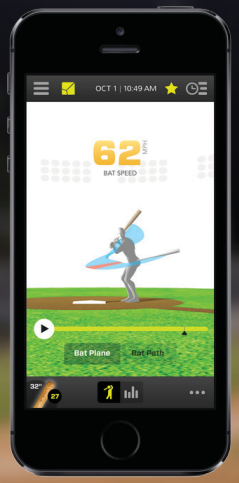
Bluetooth-Enabled Insoles

Shares navigation, directions and orientation.

http://lecha1.com/products.html

Swing Analyzer

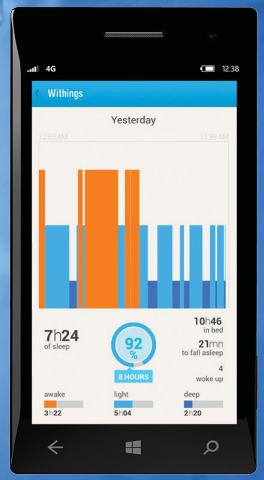
Make your Zepp Sensor multi-sport, all you need to do is purchase additional sport specific mounts and download the app.



http://www.zepp.com/

Smart Sleep System

Visualize your sleep cycles, understand what wakes you up, and compare nights. From the palm of your hand you can control your personalized wake-up, and fall-asleep programs.



http://www.withings.com/us/withings-aura.html

Sense Mother

Sense Mother is at the head of a family of small connected sensors that blend into your daily life to make it serene, healthy and pleasurable.

http://sen.se/store/mother/

Blood Pressure Monitor

Smart Weather Station

The Netatmo Weather Station allows you to use indoor temperature, relative humidity and CO2 readings to live in a healthier home.

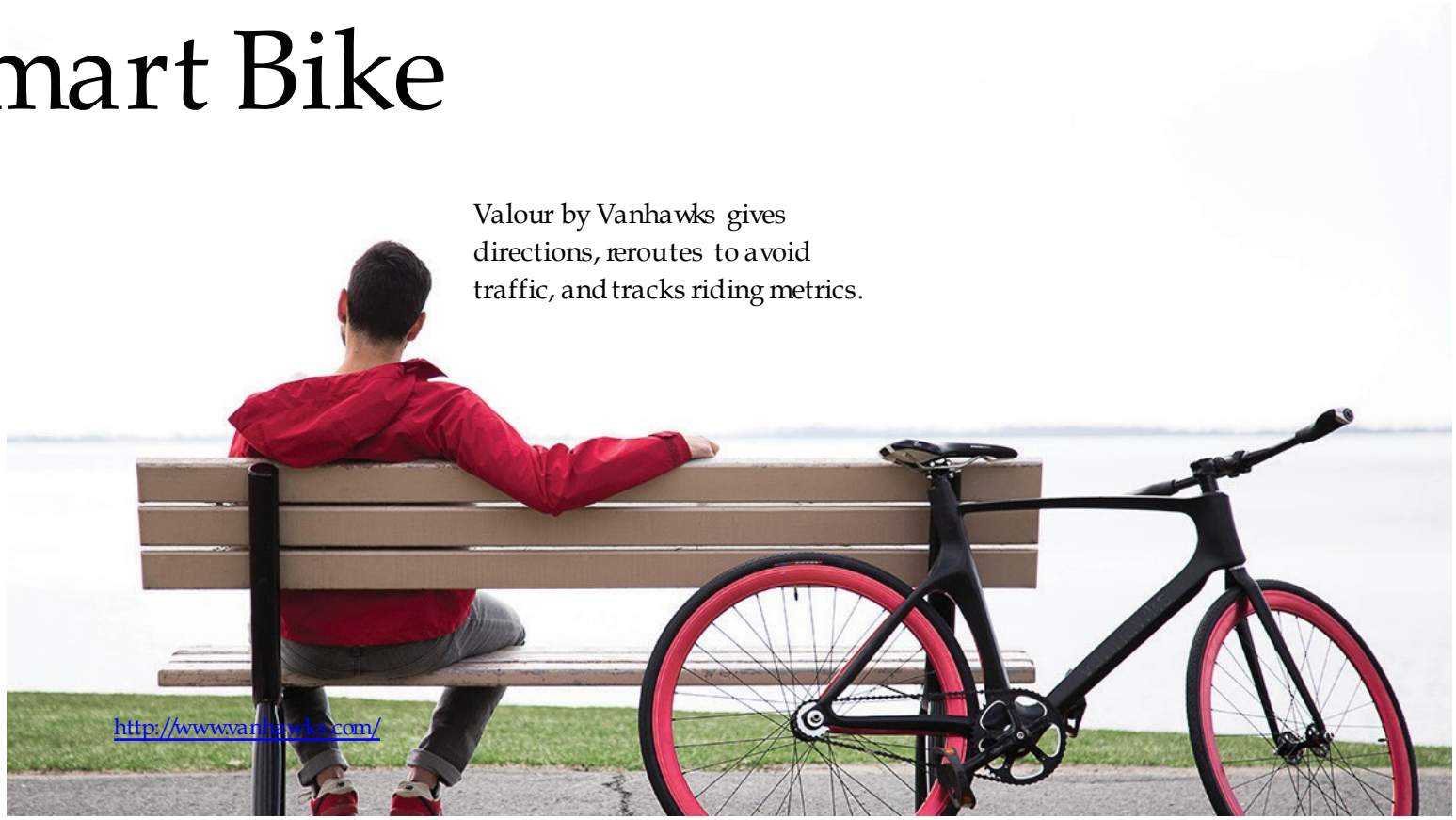
http://www.netatmo.com/en-US/product/weather-station/

Smart Slow Cooker

Smart Tennis Racket

Smart Bike

Valour by Vanhawks gives directions, reroutes to avoid traffic, and tracks riding metrics.



http://www.vanhawks.com/

Smart Garbage Cans

BigBelly alerts when it needs to be emptied so smarter collection decisions can be made.

http://www.bigbelly.com/solutions/stations/smartbelly/

Drop

Baking assistant that gives recipes, directions, substitutions, shopping lists, etc.

http://getdrop.co/

Petnet

Petnet will control your pet's feeding from anywhere and tracks their nutrition.

http://www.petnet.io/

Smart Mirror

A reflective mirror with programmable applications and digital display for the home, office and public environments (hotels, hospitals, retail shops).

http://www.cybertecturemirror.com/

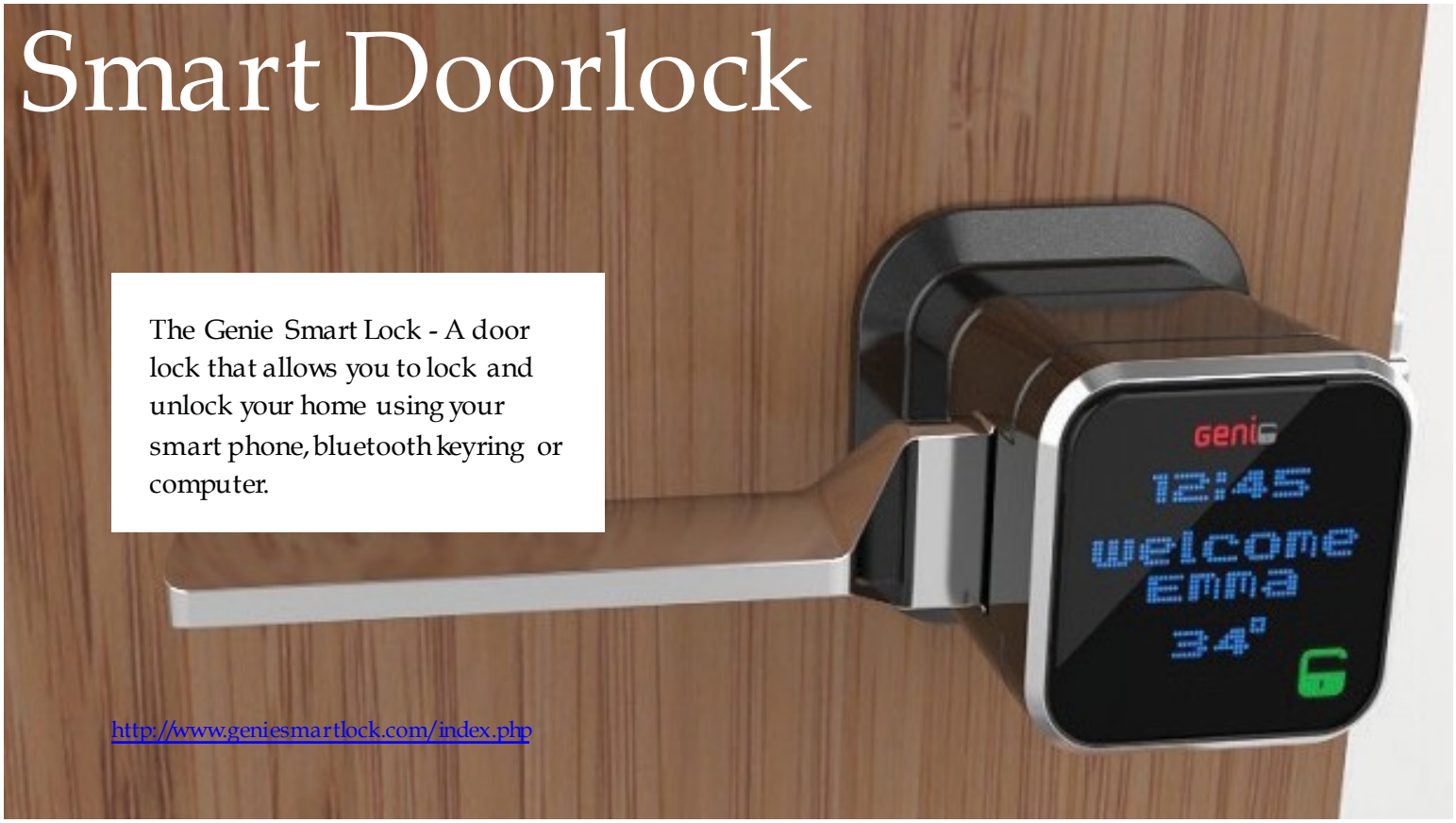
Smart Gardening

Smart Cardio

eCardio is a single component, dual-modality remote cardiac monitor.

http://www.ecardio.com/

Smart Doorlock



The Genie Smart Lock - A door lock that allows you to lock and unlock your home using your smart phone, bluetooth keyring or computer.

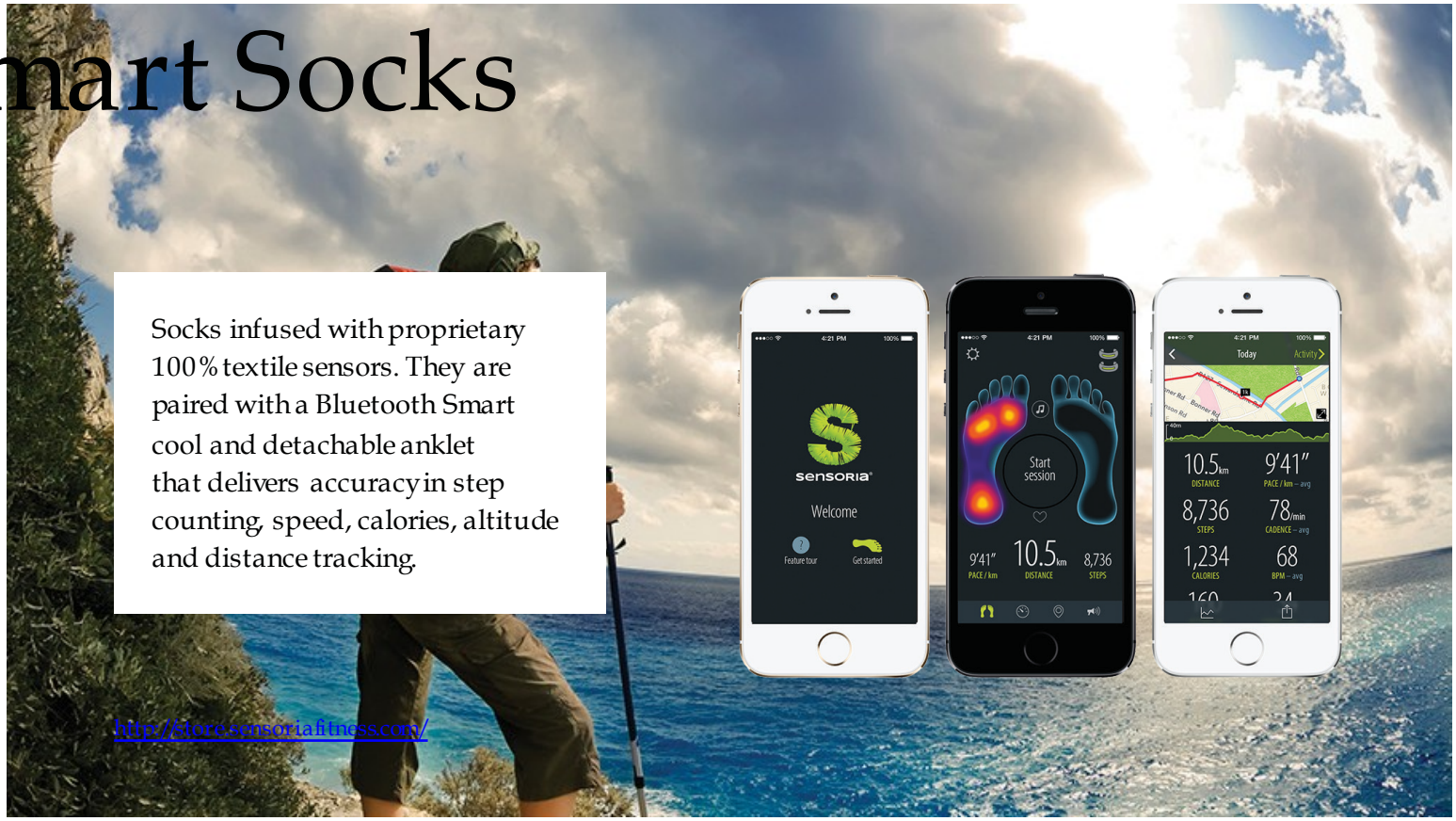
http://www.geniesmartlock.com/index.php

Nod

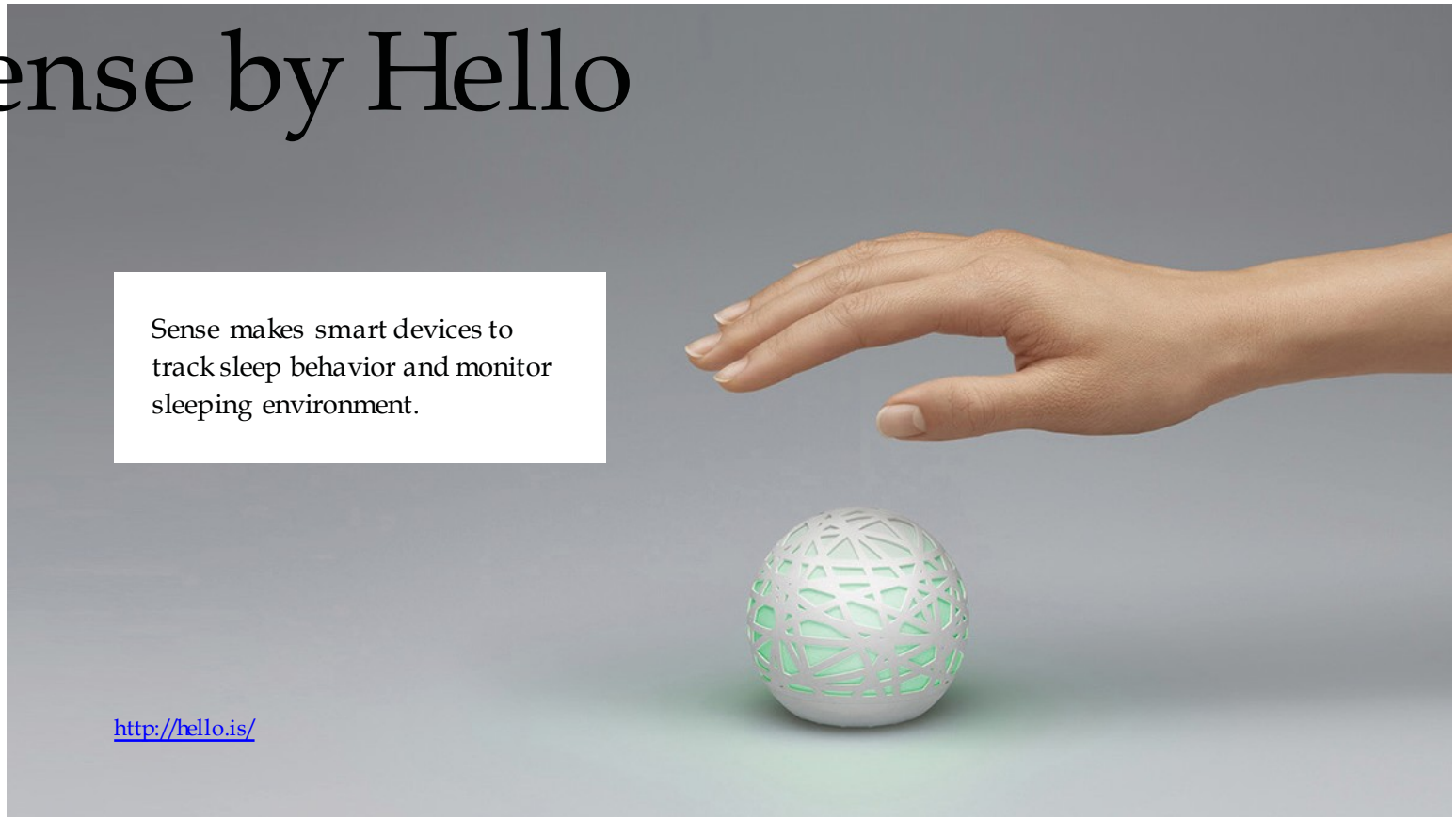
Nod transforms your movements into commands. It brings the world around you to life, as you control everything from your laptop to your living room lights with a wave of your hand.

https://hellonod.com/

Smart Socks


Socks infused with proprietary 100% textile sensors. They are paired with a Bluetooth Smart cool and detachable anklet that delivers accuracy in step counting, speed, calories, altitude and distance tracking.
sensoria
Welcome
Feature tour
Get started
Start session
9'41"
PACE / km
10.5km
DISTANCE
8,736
STEPS
Today
Activity
10.5km
DISTANCE
9'41"
PACE / km – avg
8,736
STEPS
78/min
CADENCE – avg
1,234
CALORIES
68
BPM – avg
http://store.sensoriafitness.com/

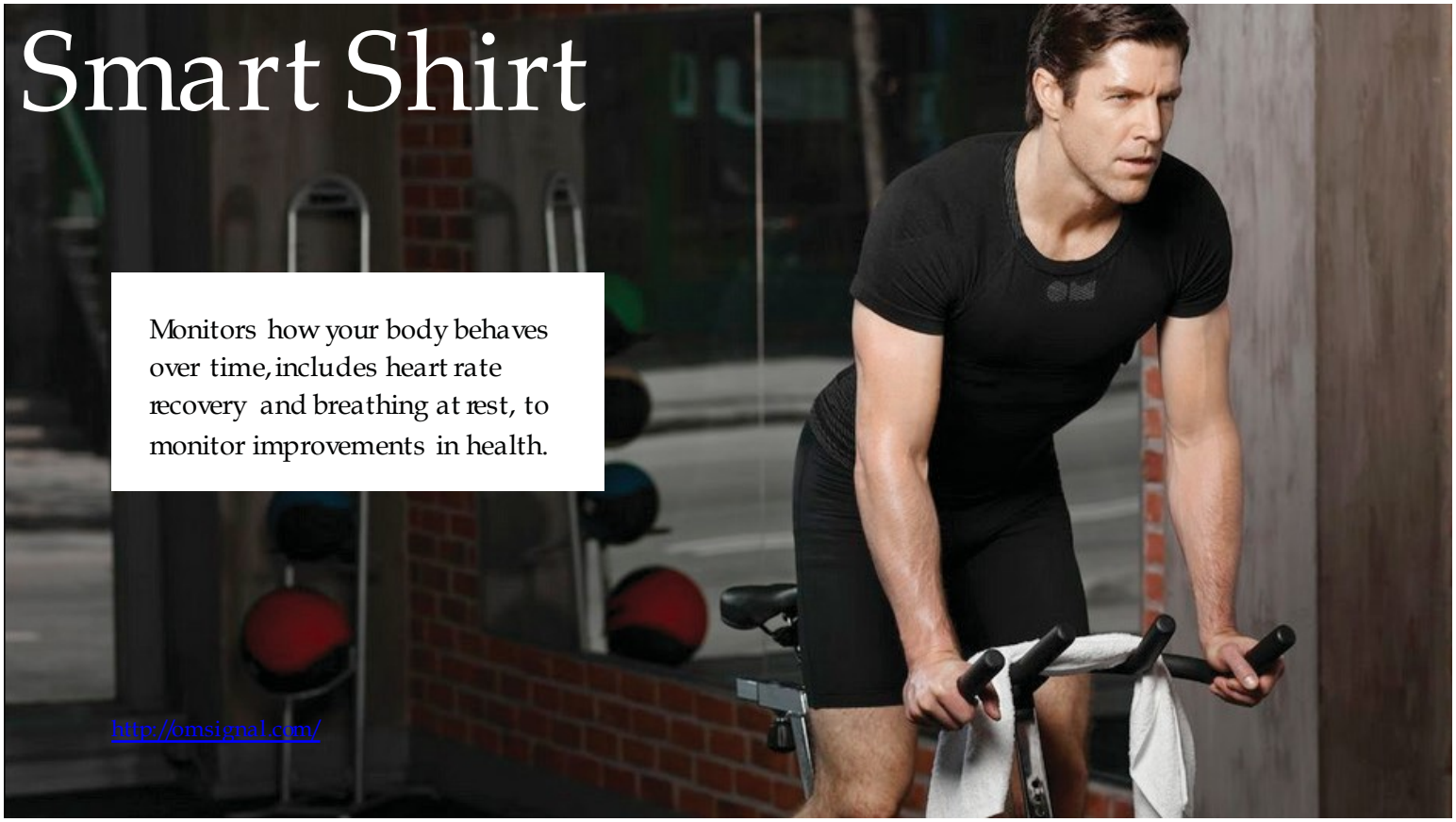
Sense by Hello



Sense makes smart devices to track sleep behavior and monitor sleeping environment.

http://hello.is/

Smart Shirt

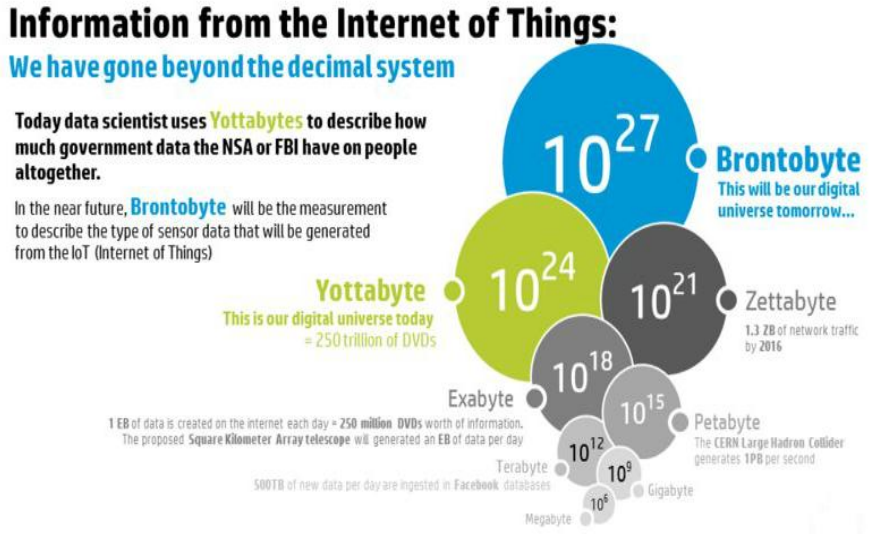


Monitors how your body behaves over time, includes heart rate recovery and breathing at rest, to monitor improvements in health.

http://omsignal.com/

Major Challenges

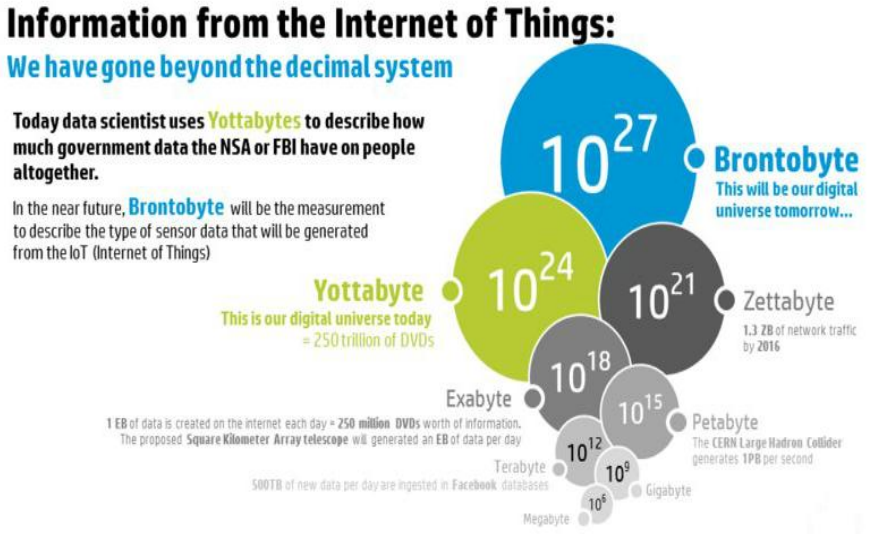
- Big Data Explosion
- Countless components
- Security & Privacy
- Lack of Standards
- Power efficiency



Major **Opportunity**

- Big Data Explosion

It's not about the things, it's about the data!



data provides context

context leads to insight

how can we use this data/context to improve services and positively influence student success?

what would a smart campus look like?

the obvious

energy conservation/sustainability

predictive maintenance

transportation/logistics

retail/vending

marketing

safety & security

the not so obvious

within one year, tracking individuals, with medium fidelity
within two years, with high fidelity

and, interactivity in real or near-real time

with this data, behavioral patterns can be discerned

Goal: Delivery of a highly personalized campus experience for every student, at scale

What if?

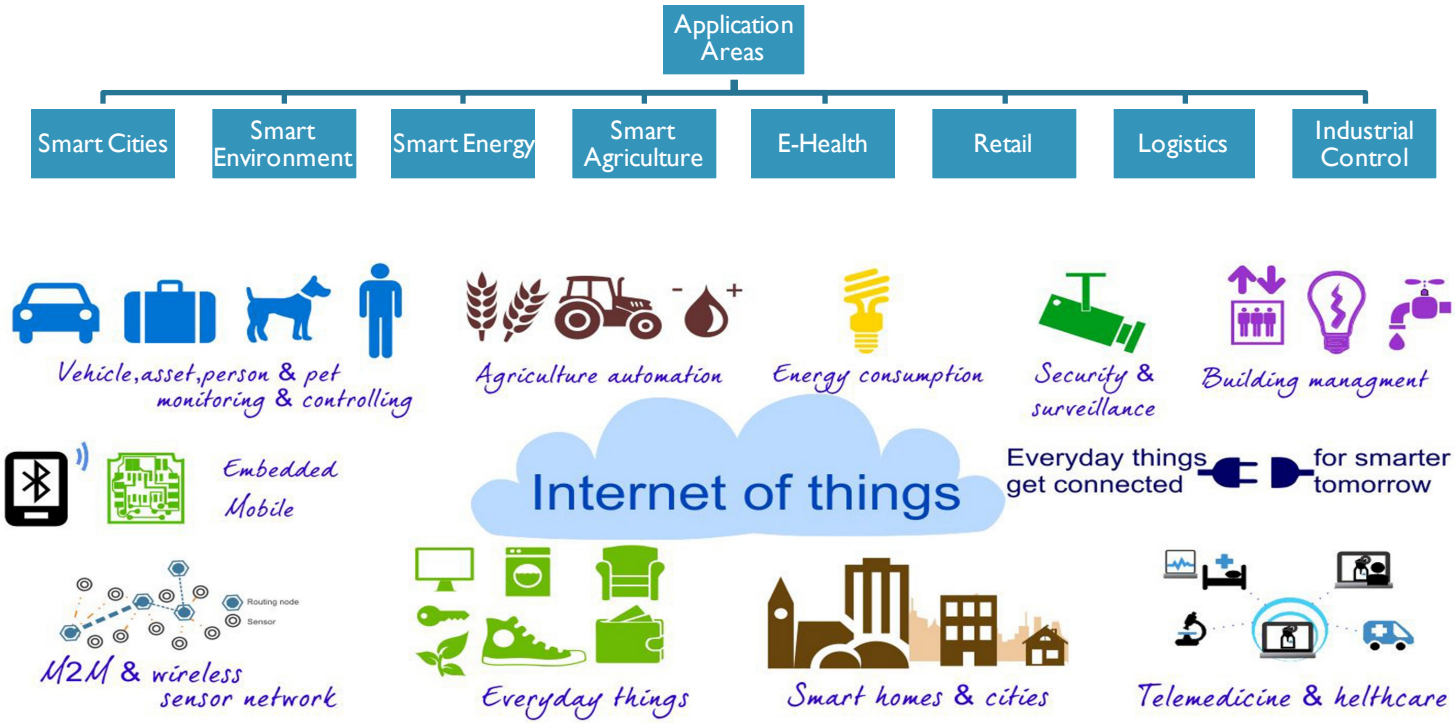
-- improved support for students with disabilities? Beacon, app enabled

visually impaired – audible menus, street crossings, facilities information

-- buildings, facilities 'know your identity' and anticipate your needs?

And most importantly,

-- can we correlate this new contextual data with student success (in any/all domains)?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Energy consumption
Security & surveillance
Building managment
Embedded
Mobile
Internet of things
Everyday things get connected for smarter tomorrow
Routing node
Sensor
M2M & wireless sensor network
Everyday things
Smart homes & cities
Telemedicine & helthcare

Vision for 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.

Smart Campus

Implementing IoT technologies across multiple layers of the campus environment to help inform university decision making and improve the day-to-day life of students, faculty, administrators, and alumni

Digital Student

Delivering world-class on campus and digital experiences by looking at services from the outside-in putting students, faculty, administrators and alumni at the heart of design

Student
- Higher Student Retention
- Higher Student to Teacher Ratio
- Higher Student Engagement

Faculty
- Higher Student Interaction
- Early Detection of Disengagement
- More Personalized Attention

Administration
- Better Resource Utilization
- Secured & Safe Infrastructure
- Automated and Continuous Process Improvement
- New Revenue Streams

accenture
High performance. Delivered.

Microsoft

EQUATION FOR EXERIENCES:

TIME + IDENTITY + PROXIMITY = CONTEXT

A new student overwhelmed by her first day gets help!

TIME

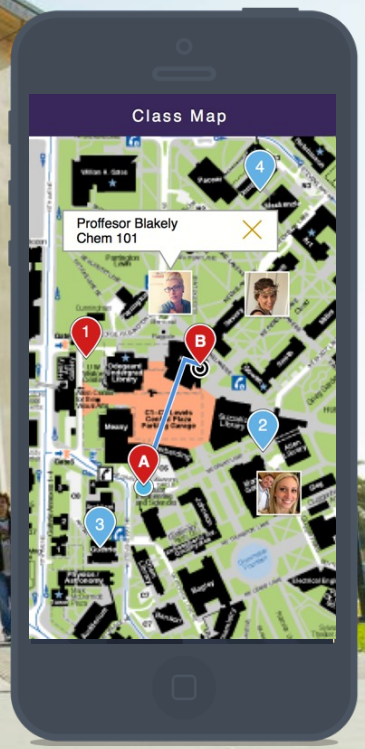
It's 10 minutes before class

IDENTITY

Freshman, next class Chem 101, Prof. and friends near

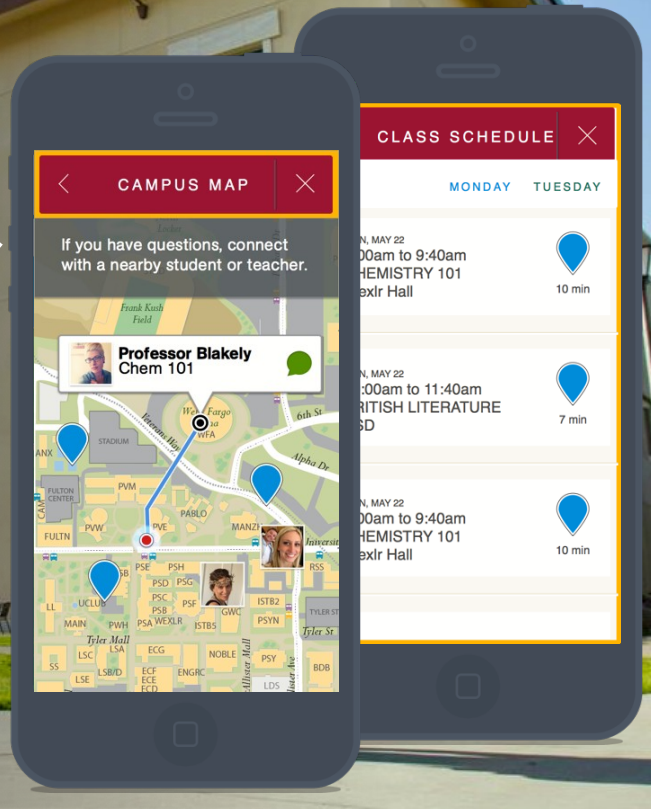
PROXIMITY

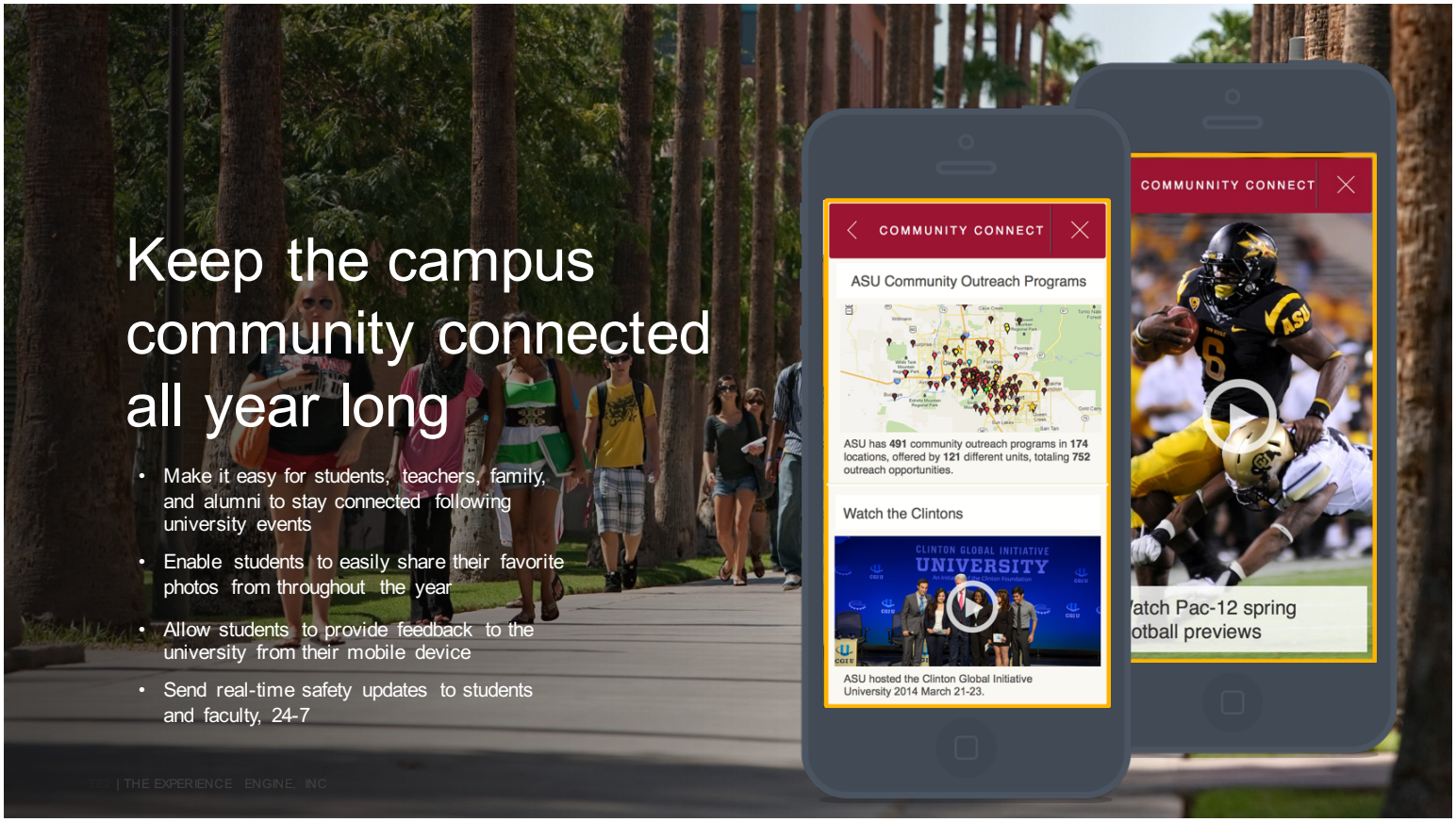
On campus near the Library



Redefine special events like student orientation & commencement

- Help students and families navigate and experience campus for Orientation and Commencement
- Provide update-to-date itineraries or class/event schedules for campus special events
- Connect incoming students who are in the same programs of study
- Provide prospective students and parents with recommended activities during their visit
- Notify students, family, alumni in real-time with important information





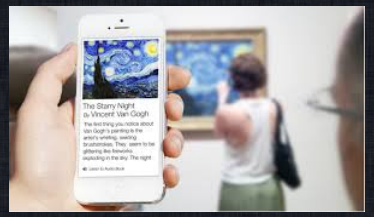
‘connected’ buildings

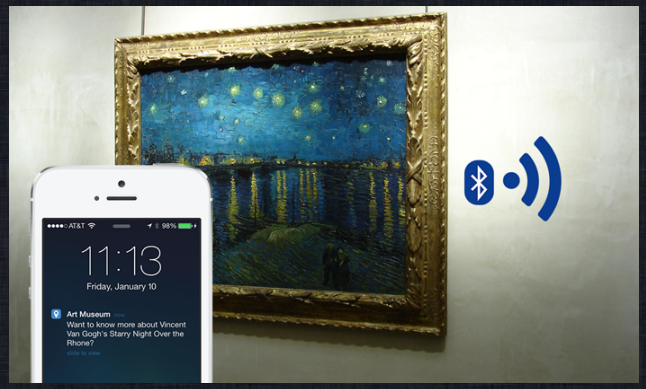
museum app (or library, etc)

you choose what you want to see, the app can design a path

as you get near things, the app pops up information

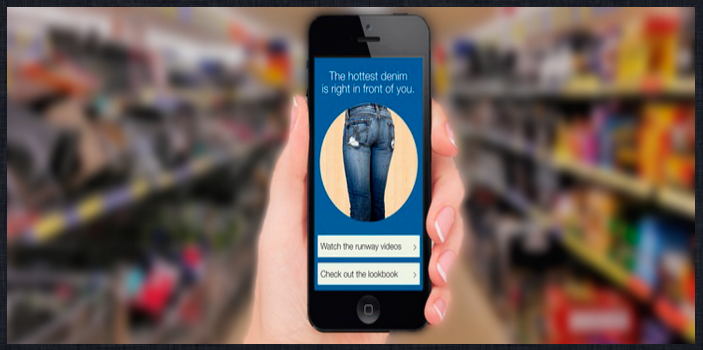
- Information can be pre-stored in the app
- Information can be pushed to the app





retail

- bookstore
  - app triggers coupons/discounts as you walk near specific locations
    - Pre-store app updates
    - Live in-store updates
    - Profile-based live store updates



An instrumented smart campus uses the data and insight that becomes available through technology to improve the lives of its student body, community partners and workforce.

The use of sensors, big data and analytics is creating a myriad of possibilities to improve the design and delivery of services.

Smart campuses are built on a robust infrastructure. At the core of this infrastructure is a diverse, secure and scalable network capable of connecting sensors.

Without high standards of connectivity, the vision for a smart campus cannot be realised. Beyond network, a vast systems infrastructure is also critical to ensure that data can be transformed into insights, decisions and activity.

current efforts/proofs of concept


Sun Devil Stadium
SOUTHEAST ENTRANCE
Coca-Cola
ASU
Coca-Cola
ASU

IoT Research Partners

Arizona State University
Dublin City University
Intel
Sun Devil Stadium
Croke Park Stadium

Select Use Cases

Student Ticketing

- Complement Paciolan
- Equal access to seats for students on all campuses
- Simplify wristbanding process
- Promote attendance

Game Day Navigation

- Traffic, parking real-time info
- Campus walking directions
- Bus/shuttle schedules
- Custom event maps

Select Use Cases

In Seat Experience

- Digital signage integration
- Personal/group messaging using beacon / Wi-Fi data
- Polling, Gaming, Stats
- In seat ordering

Pre-Post Event

- Event-based posts/feeds
- Social media integration
- Location sharing
- Targeted coupons

ASU/DCU/Intel research collaboration in Sun Devil Stadium/Croke Park Stad

Crowd motion studies/facial expression recognition

Environmental monitoring/feedback (fan control)

Queue wait time estimation (concessions, restrooms)

Noise monitoring/feedback (Victory Cheer game)

Athlete performance monitoring/feedback (wearables)

Real time parking density feedback/wayfinding

Pitch/playing surface health

Ground water monitoring

ASU ARIZ
UNI

CHNOLOGY OFFICE
UTO.ASU.EDU

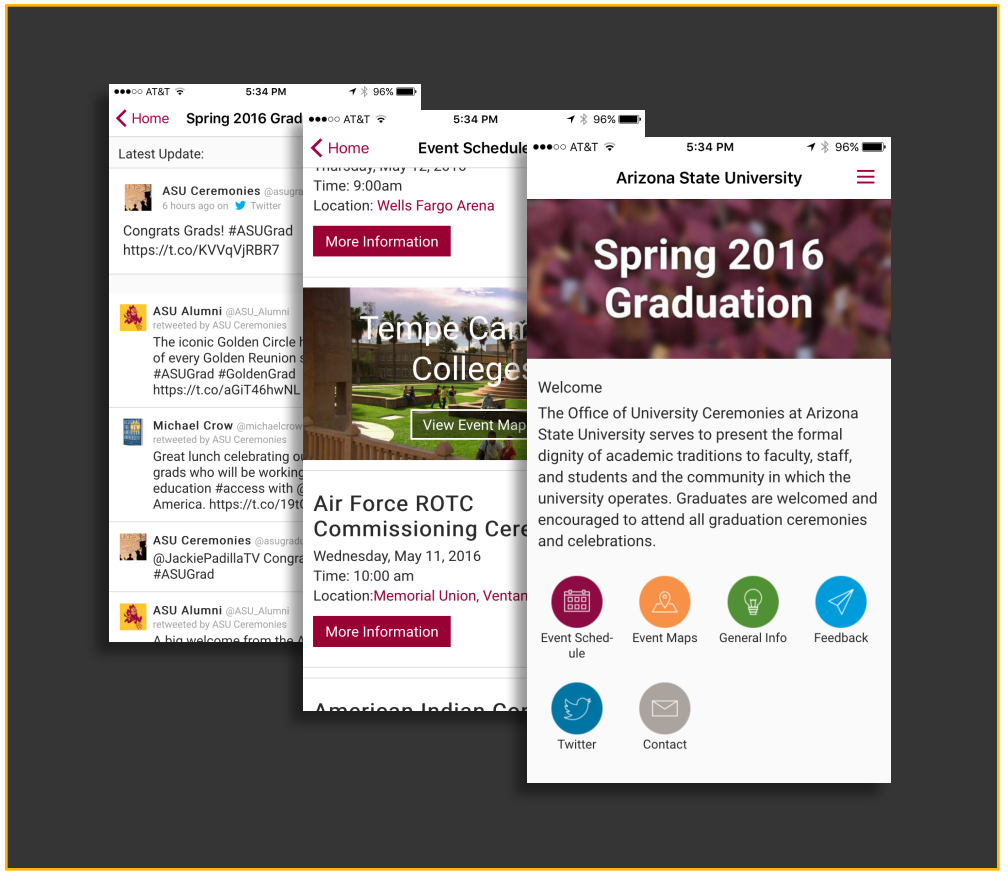

09/14/2015

What we've done, thus far.

- ASU Mobile App Update
  - Push Notifications
  - Message Center
  - Mobile Version of ASU Maps
  - Game Day App
  - Social Media Aggregation
  - Splunk Analytics
- Devils on Campus (Modo Labs)
  - 2015 December Graduation
  - 2016 Spring Welcome
- Get Loud Stadium Game
- ASU Maps
- Shake App (POC)
- Attendance App (POC)

Graduation

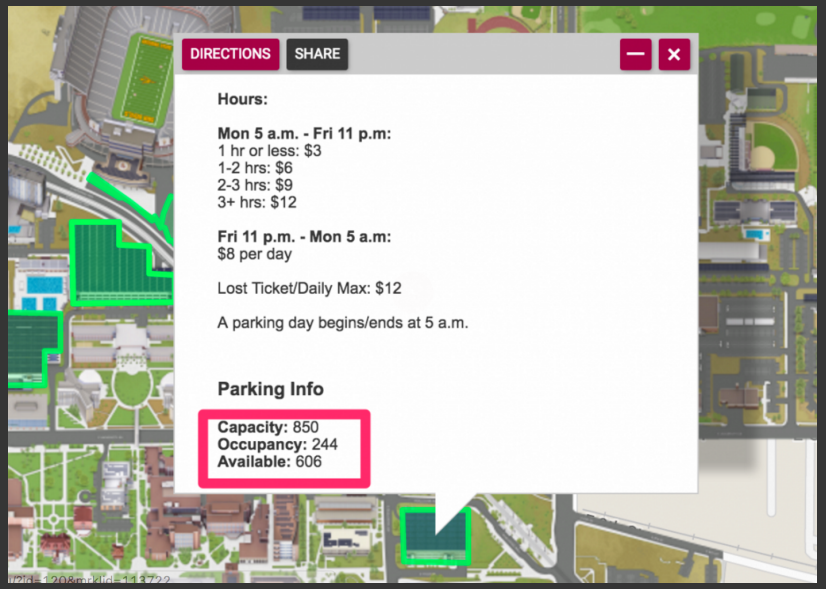
- - Devils on Campus App
  - Beacon
  - Tracking of attendance metrics
- - Automated Push Campaigns based on location.
- Push Notifications
  - Trained stake holders to send push notifications.



ASU Arizona State University

Real Time Parking

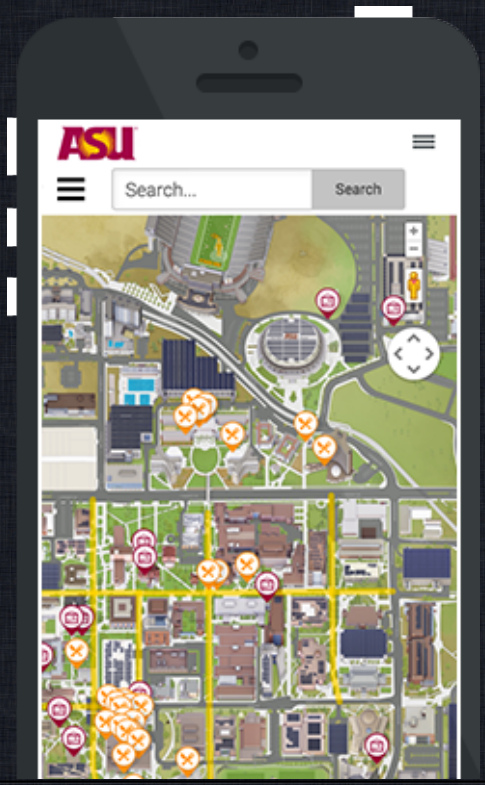
- Live parking data is displayed on the ASU's interactive map layer with color-coded polygons: red lots are full; yellow lots are almost full; green lots have plenty of capacity.

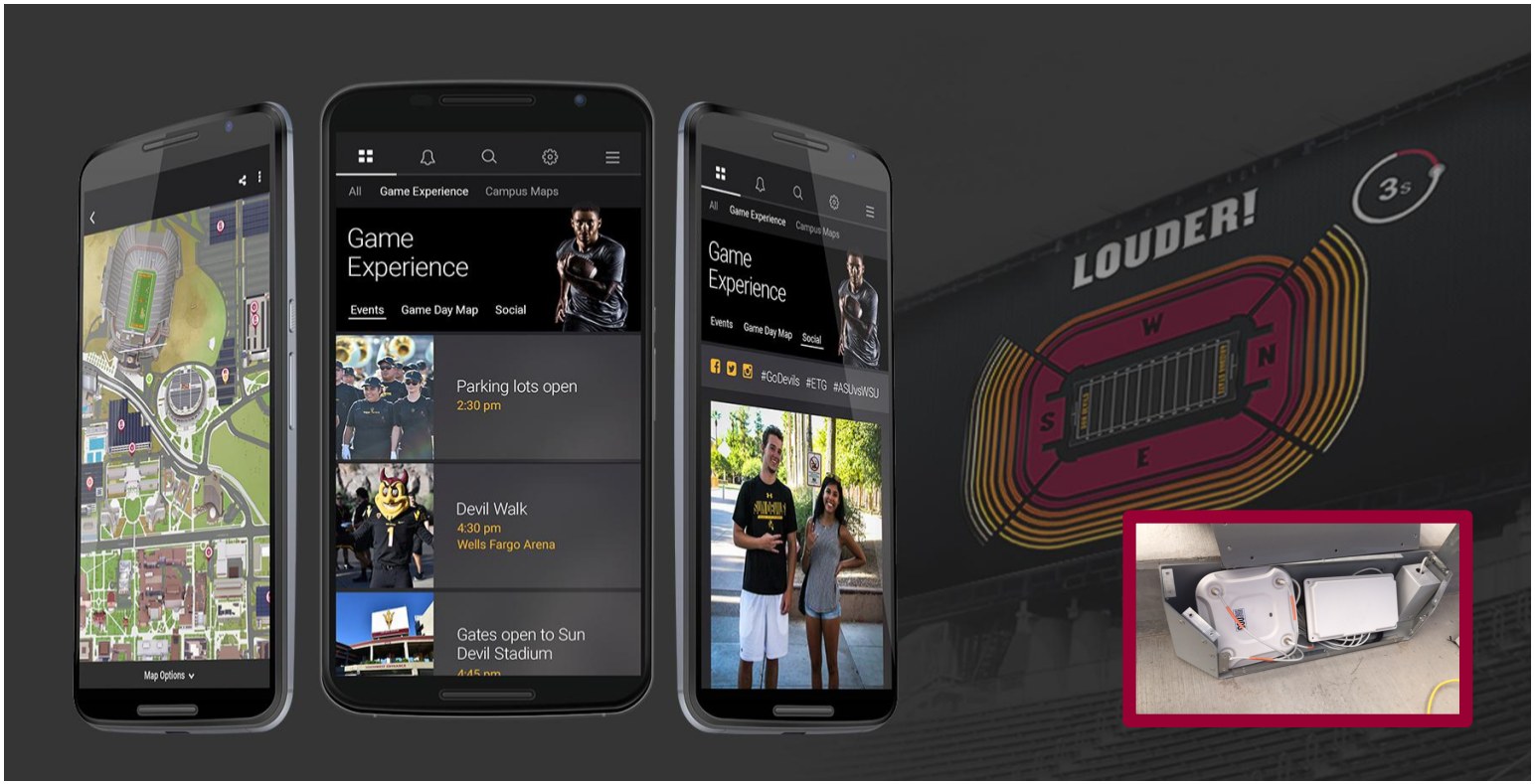


Campus Bird

(Maps / Wayfinding)

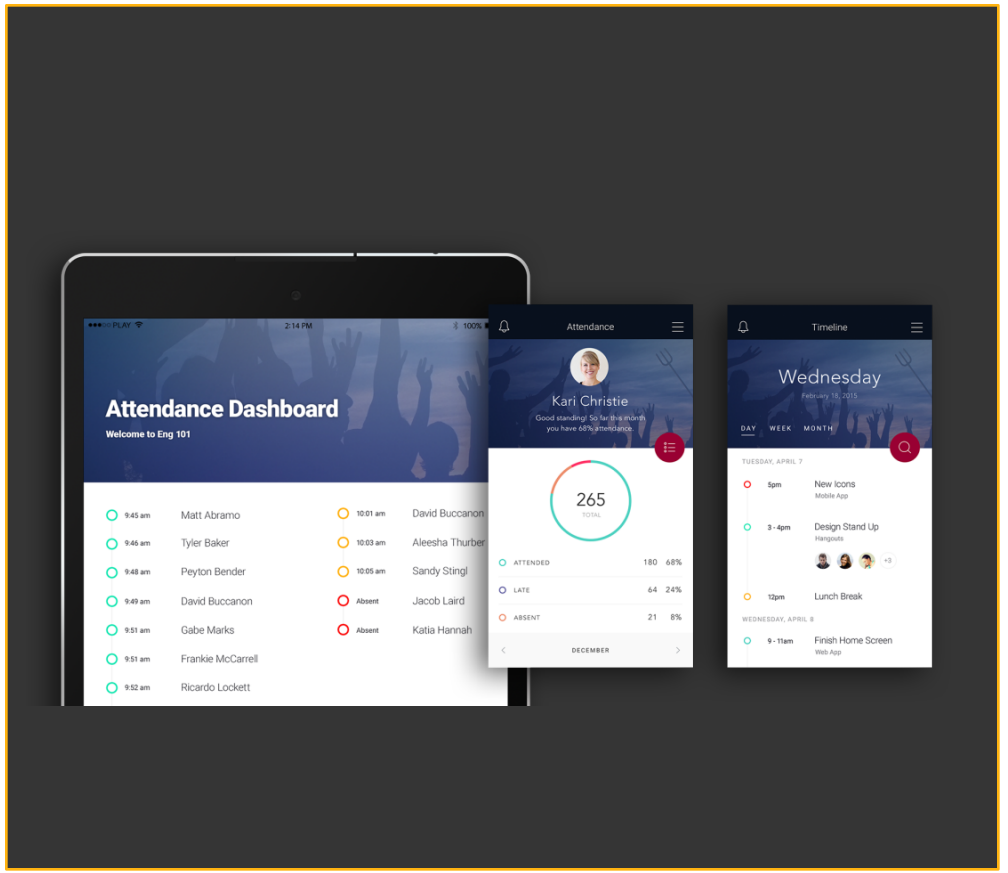
- Custom event maps
  - Only relevant POIs
  - Custom POI infor for events
  - Time-boxed availability
- Geo-fence definitions
- Ads / coupons associated with map categories or POIs
- Internal building maps




All
Game Experience
Campus Maps
Game Experience
Events
Game Day Map
Social
Parking lots open
2:30 pm
Devil Walk
4:30 pm
Wells Fargo Arena
Gates open to Sun Devil Stadium
Map Options
#GoDevils #ETG #ASUvsWSU
LOUDER!
3s
W
N
S
E

Attendance

- People Counting
- Queue Time (Hardware Solution)
- Queue Time (Software Solution)
- Device Development and Testing
- Blue Tooth Bracelet
- Cisco CMX for Wifi based identification



ASU Arizona State University

Smart Campus Roadmap

- Mobile standards
- Native authentication within ASU Mobile App to ensure secure display of user specific data
- Centralized push messaging management system
- Leveraging Cisco MSE/CMX for data visualization
- Wearable with BLE and NFC
- Attendance App
- Facilities, Transportation, Student Services, Health Services

- Athletics Phase II:
  - Wayfinding/nearest POI
  - Loading all POI data into maps (bathrooms, concession stands, wheelchair access, etc.)
  - Navigation to stadium (traffic diversions, emergency notifications, etc.)
  - Smart vending machine
  - Pre-order food, drinks, (in-seat ordering)


API GATEWAY
Service Bus
CLOUDFLARE
Congent delivery network
EC2
Custom development
FIREHOSE
PEOPLESOFT
Student record end point
SALESFORCE
Customer relation-ship manager
ANALYTICS
GTM, Splunk, (Newrelic/AppDynamics)
splunk>
CAMPUS BIRD
Primary mapping solution
T2
AUTHENTICATION
Single sign-on via Cognito, IAM & Shibboleth
APP DEVELOPMENT
EC2, Gitlab, Test Flight, Cordo-va, Angular, JSON feeds
PANTHEON
Website development and Mobile feeds
TE2
Push notifications and in-app messaging
POSTANO
Quily deploys media to all social applicaitons
MODO LABS
Easy deploy mobile app environment
SEARCH
In-app search functionality
Solr
GSA
APP STORE
Apps are deployed to both Android and iOS app stores
KONTAKT.IO
BLE, Beacon manager
TE2/MMS
ASU Apps
Future State
ASU MOBILE ECOSYSTEM

components of future strategy

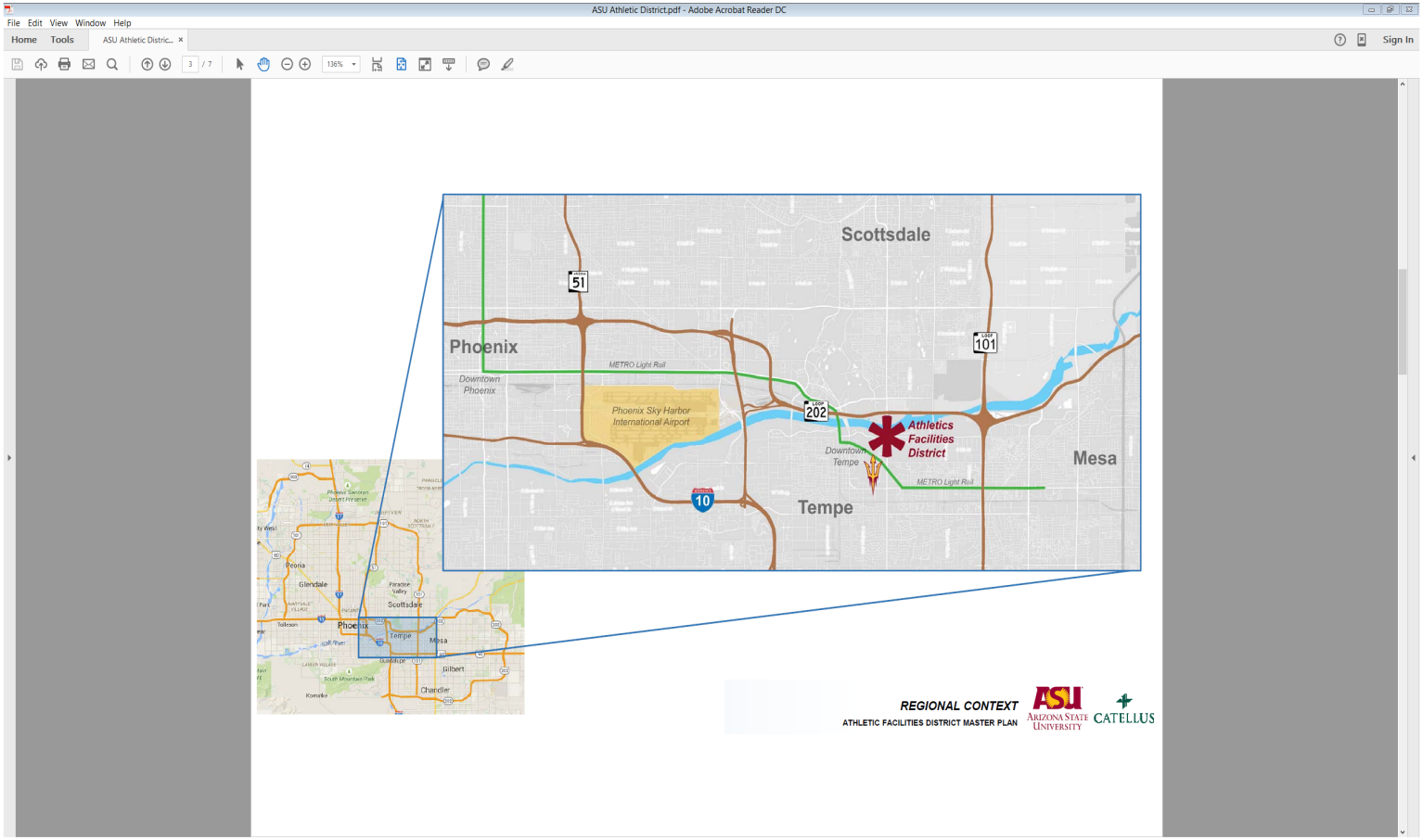
research collaborations
corporate partnerships
infrastructure investments
data science and analytics
privacy, security policies
learn from others
Chicago (opengrid.io), NYC, Denver, Atlanta, Fujisawa, Dublin
standards

Goal – personalize the campus experience for every constituent, especially students

As well as being a hub, a smart campus is also a compelling anchor. At the heart of cities, the smart campus is a powerful source of momentum and innovation.

What's Next?

Building a connected Sun Devil community



ASU Athletic District.pdf - Adobe Acrobat Reader DC

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BUILDING FROM A STRONG FOUNDATION

IMMEDIATE AREA CONTEXT

ATHLETIC FACILITIES DISTRICT MASTER PLAN

ASU Arizona State University CATELLUS

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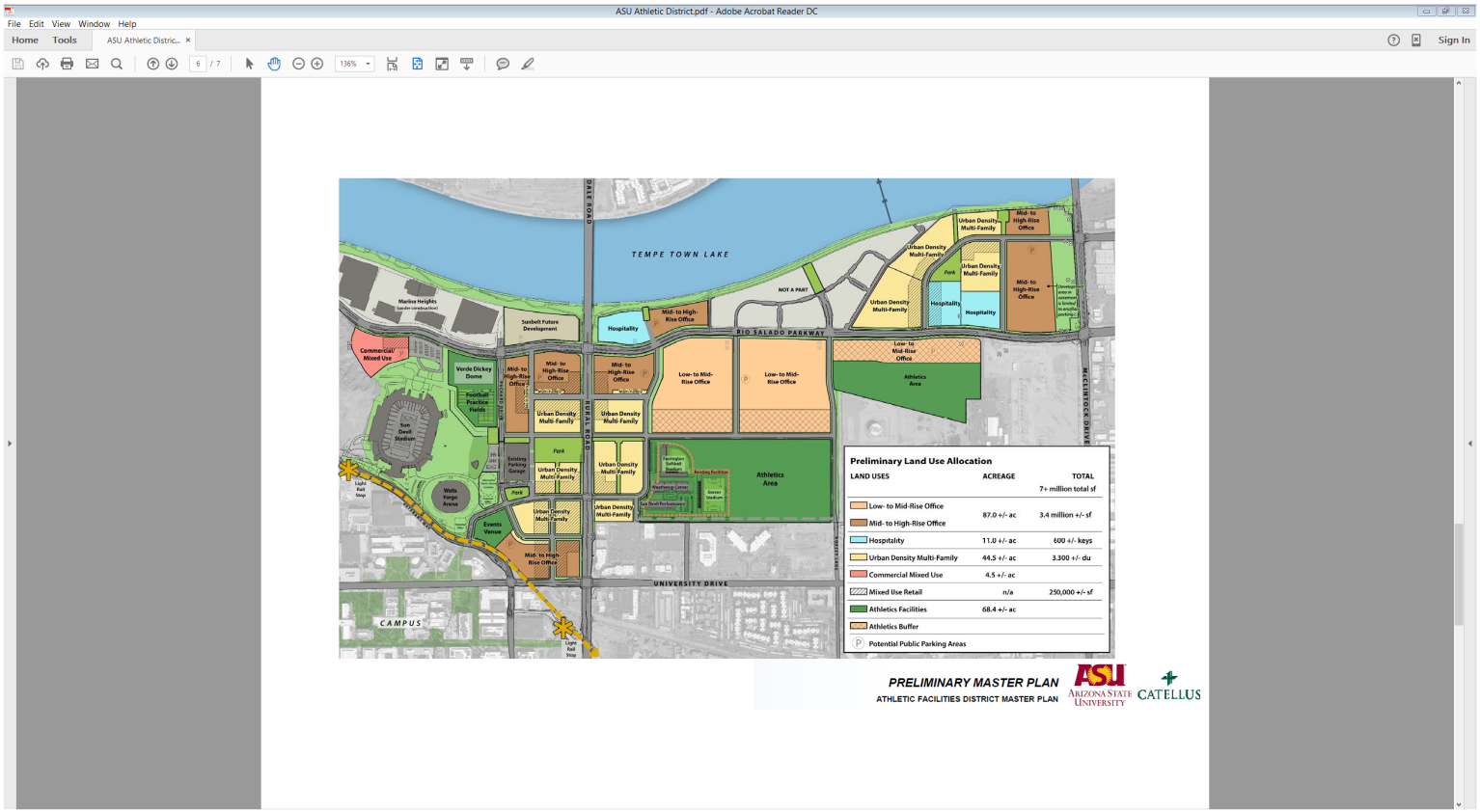
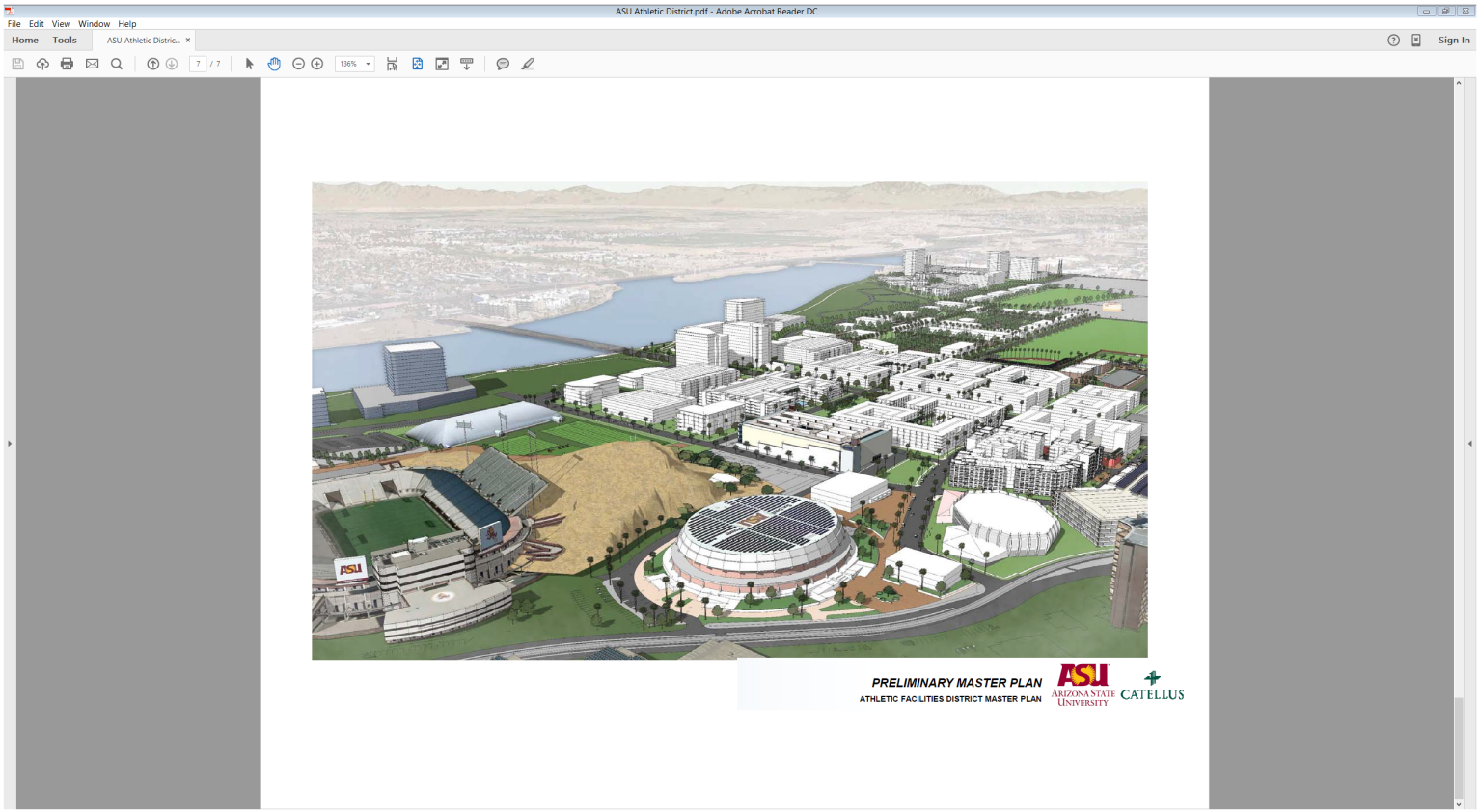
GUIDING PRINCIPLES FOR DISTRICT PLANNING AND DEVELOPMENT

- Urban character
- Sustainability
- Walkability
- Live/Work/Play
- Discipline
- Quality
- Best-in-class developers

GUIDING PRINCIPLES
ATHLETIC FACILITIES DISTRICT MASTER PLAN

ASU ARIZONA STATE UNIVERSITY CATELLUS





Next Steps

- Smart Campus Advisory Council quarterly calls
- Potential workshop in person at the City University of New York
- North Carolina Smart Grid Testbed on Internet2 + Regional Network expansion opportunity
- IoT related policy, ethics and education discussion underway with colleagues at Berkeley, Princeton, Virginia Tech, UMBC, University of Pennsylvania
- Let Chuck Benson know if you're interested in participating in the IoT Systems Risk Management Task Force: Email iotsys-tf-request@internet2.edu
- Save the date! CINC Up Call for entire Collaborative Innovation Community on Monday, June 6 at 2PM ET. Topic: OpenFog Consortium presented by Mung Chiang, Princeton University and OpenFog Consortium Board Member
- Let us know if you'd like to participate in the IoT Working Group, or any of the other Collaborative Innovation Community Working Groups: Email CINO@internet2.edu

Join us for other Collaborative Innovation Community Meetings during Global Summit

- **Sunday, May 15**
  - Healthcare and Life Sciences Working Meeting: 10:30AM-12PM, Cook Room, 3rd Floor
  - Smart Campus Initiative & Innovations: 4-5:30PM, Kane Room, 3rd Floor
- **Monday, May 16**
  - Internet of Things (IoT) Innovation Working Group Meeting: 8-9:30AM, Kane Room, 3rd Floor
  - End-to-End Trust & Security Innovation Working Group Meeting: 10-11:30AM, Kane Room, 3rd Floor
- **Tuesday, May 17**
  - Distributed Big Data and Analytics Innovation Working Group Meeting: 7:30-8:45AM, Kane Room, 3rd Floor
- **Wednesday, May 18**
  - Gender Diversity in the Internet2 Community: 7:15-8:45AM, Addison Room, 4th Floor
  - Innovation Development and Management – Think Local, Act Global: 12-1:15PM, Kane Room, 3rd Floor


INTERNET2
2016 GLOBAL SUMMIT
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SMART CAMPUS INITIATIVE & INNOVATIONS
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