IEEE
Internet of Things

Vint Cerf - December 15th 2015

Version for Email

Context & Perception

The living room of the future

The Internet of Things is here and it touches and helps us all in different ways

me	*Fitbit and quantifiable health*
my home	*Nest and home devices*
my community	*MIT SENSEable City Lab - Copenhagen Wheel Project*
my country	*Sigfox - global cellular connectivity for IoT*
my planet	*Aclima - Air quality monitoring*

The impact of IoT from an individual to the planet...

civics	health	education	science	entertainment
Government open data data.gov.uk	*Smart Contact Lenses* Google	*Connected edu platforms* SAM Labs	*Scientific data sharing* CERN Higgs Candidates	*Mixed reality* Magic Leap

...it evokes complexity and fears over privacy and security risks

"How the Internet of Things opens your home to cyber threats"
PC World

"Internet of Things Security Issues Require a Rethink on Risk Management"
The Wall Street Journal

"The dark side of wearables: How they're secretly jeopardizing your security and privacy"
Tech Republic

...how can we change user experiences to make the underlying benefits clear

IoT is only a bunch of connected gadgets	→	**IoT objects are embedded in the fabric of my life**
'It's not secure'	→	*'I'm in the centre of my IOT ecosystem and I'm in control of my data and its privacy''*
'It's just a gimmick, it won't last'	→	*'It's useful on many levels, I can see it's here to stay and I'm happy about that'*
'It's complicated'	→	*'It's easy and built to make complex things become easier. '*
'I have no idea of what I'm getting myself into'	→	*'I understand what I'm doing and the trade-offs I'm assuming.'*
'It's a configuration nightmare''	→	*"It was so easy, most devices configured themselves"*

Three formulations

What if we...

1. **Reimagine isolated objects with the power of the net**
   How useful will objects be when they are amplified with everything the internet can do?

2. **Match relevant objects & services for genuine user benefit**
   The true benefit of the IoT movement will be felt when we connect contextually relevant objects to the right services and information.

3. **Foster the potential to create ensembles of objects**
   The utility of an ensemble of objects is its orchestration and how it facilitates rich environments where interaction is intuitive (i.e. standardized) and allows for useful and mutually reinforcing actions among the objects.

1) Re-imagine isolated objects with the power of the net

Understanding the implications of what happens when an ‘ordinary’ object is connected to the net.

Object

Dumb object

Connectivity

Connect Ensembles

Net

Computing, learning, context, awareness, voice recognition

Object web

1) Re-imagine isolated objects with the power of the net

Understanding the implications of what happens when an
‘ordinary’ object is connected to the net

Washing Machine

Single purposed

No user customization

Rudimentary notification system

Not aware of its energy consumption

Connectivity

New features

New services

New business models

Net

Context

Learning

Access to services and API’s

Access to other devices

Washing Machine web

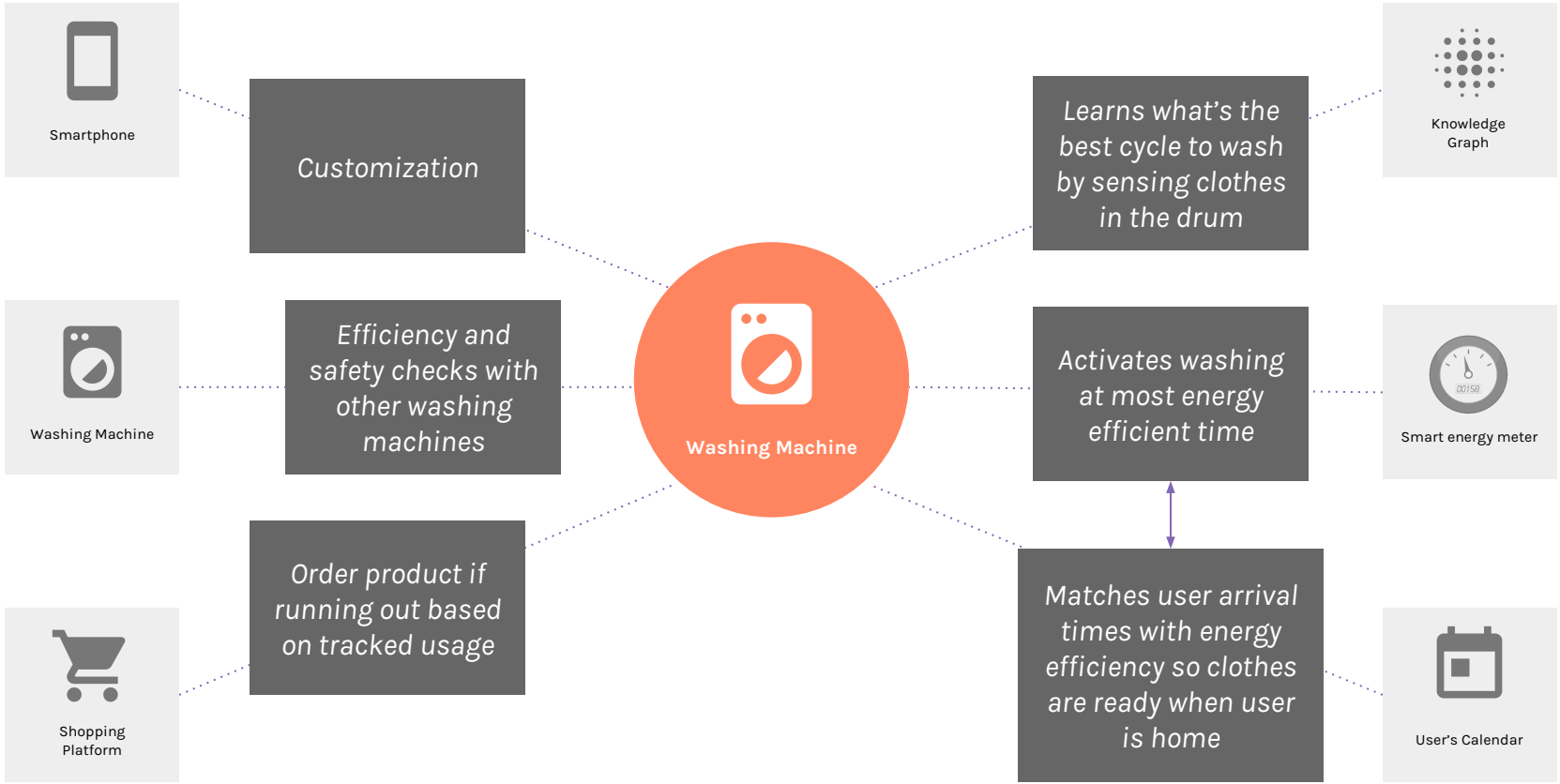
Adaptive

Efficient

Optimized

Personalized

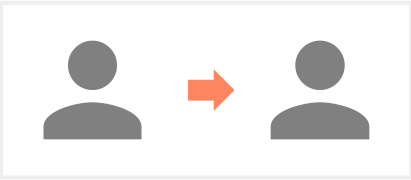
2) Focus on facilitating ensembles of objects & services



3) Find the right relevant objects and connections

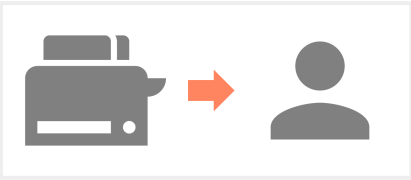
The Internet created the **information graph** -> that changed how we produce, access, share and generate knowledge

Total access and ubiquity of content



Social media created the **social graph** -> that changed how we establish and foster relationship with others

Enabling power to the crowd



The Internet Of Things creates the **physical graph** -> **that changes how we interact with objects and environments**

Adaptive, self regulating environments that understand context and adjust accordingly

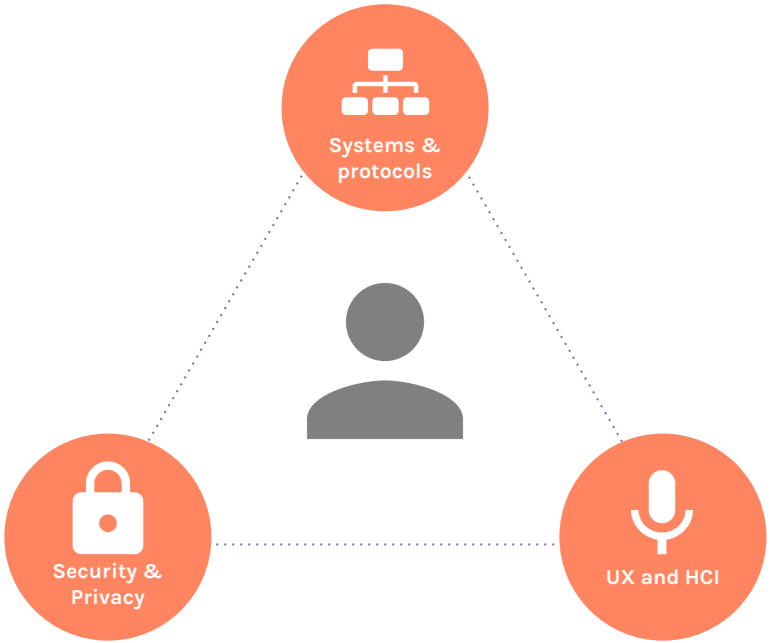
Three fundamental pillars

Three fundamental pillars

1. **Data and identity management** will be fundamental to our IOT systems regardless of hardware or software producer.

2. Systems, protocols and IoT schema are based on open standards, that will enable **interoperability** as well as modularity.

3. **New human-device interaction paradigms and techniques** will need to be developed and refined as keyboards will be used far less.



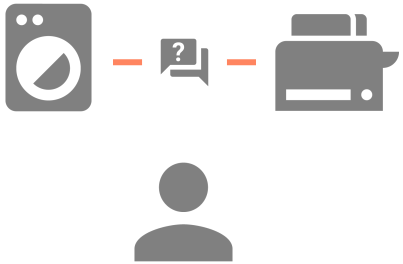
1) Data & Identity Management

A user controlled system with management controls will elicit greater trust and adequate privacy while security and safety can be handled mostly by service provider.

Device hardware and software consider safety first and and auto update by manufacturer

I know my data is secure.

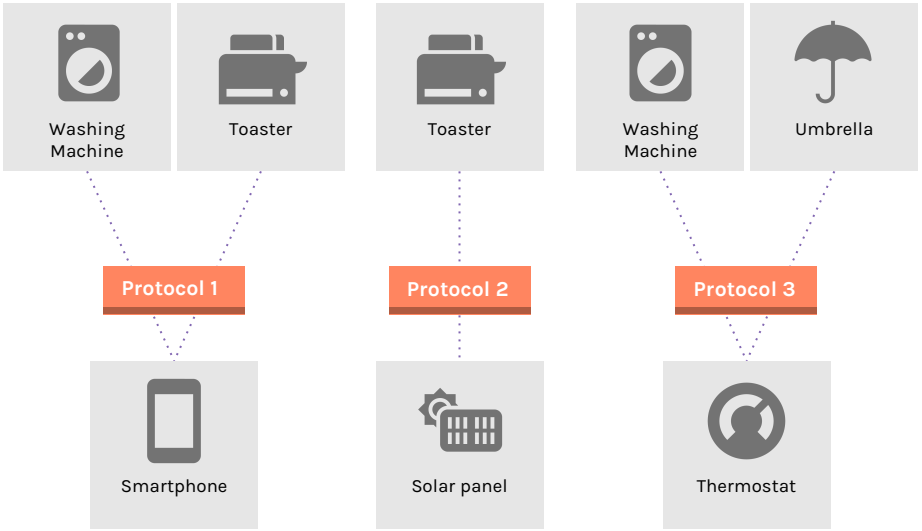
I have control over my data digital identity and data per sensor, per account, per product, per home



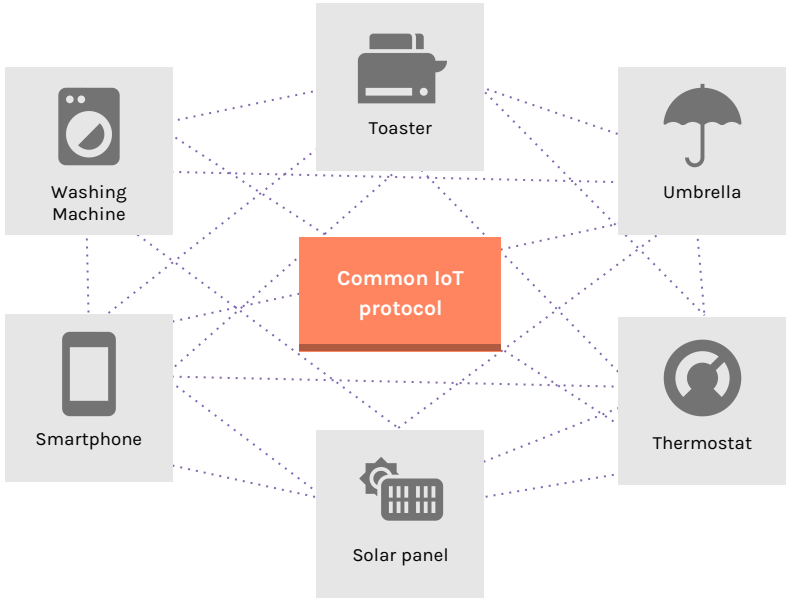
I know my devices will ask before sharing any data with other devices.

2) Openness & Interoperability

Walled Garden Approach



Interoperable, open IoT

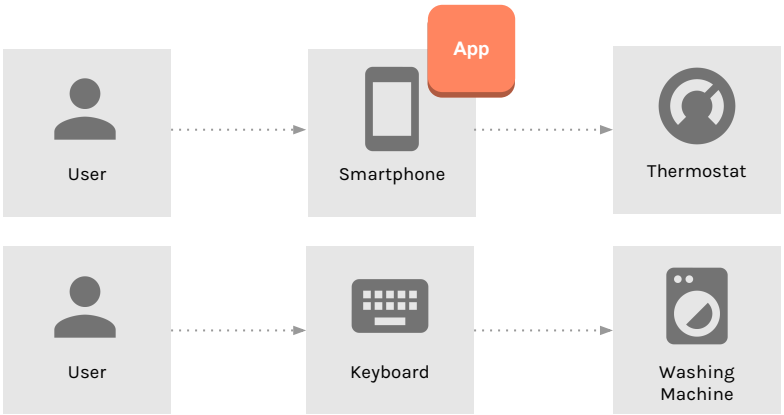


Brillo and Weave

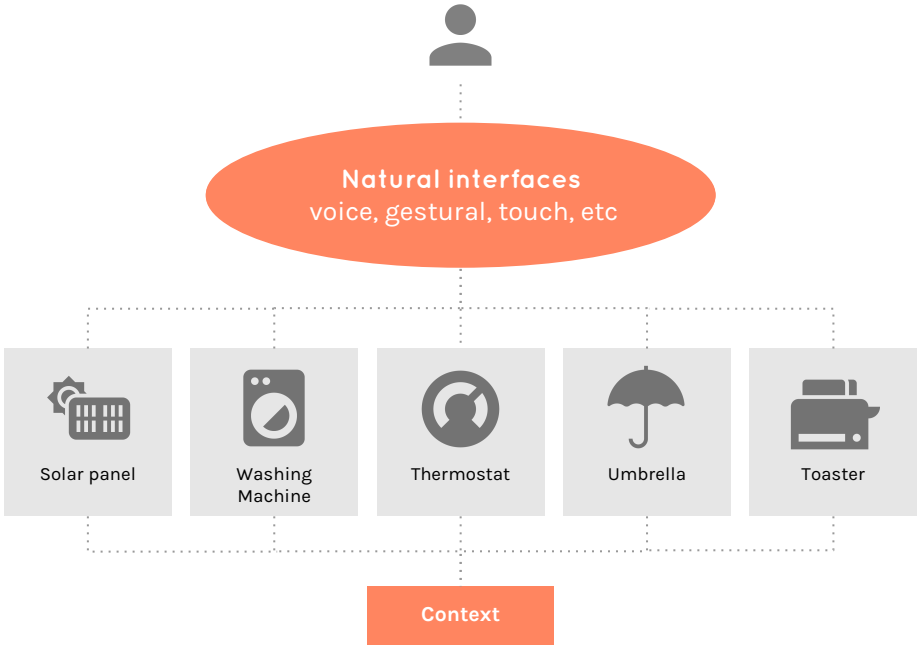
enable a partner ecosystem of smart, simple, secure connected devices

3) New paradigms for user interface and interaction design

App trap



User in one mode



3) Reimagining interaction with ‘things’ beyond traditional interfaces

Music player reimagined as tactile experience

Dial Player, RCA

Traditional maps reimagined as smart navigation for bicycles

BeeLine

Mouse & keyboard reimagined as interactive textile

Project Jacquard from Google ATAP

A perspective we like...

A perspective we like...

hard IoT

Network of electronic gadgets, software and sensors -> enables these objects to collect and exchange data

soft IoT

Collection of fluid relationships -> between people, objects and spaces

Reference: Usman Haque

IoT Expedition

Research & Open Innovation

Let’s pioneer, research and innovate together

Mission:

Enable effective use and spur broad adoption of the Internet of Things
by making it as easy to discover and interact with connected devices,
as it is to find and use information on the open web.

The resulting open ecosystem should facilitate experimentation with applications and user experience, ensure privacy and security, develop systems that guarantee interoperability.

Carnegie Mellon University

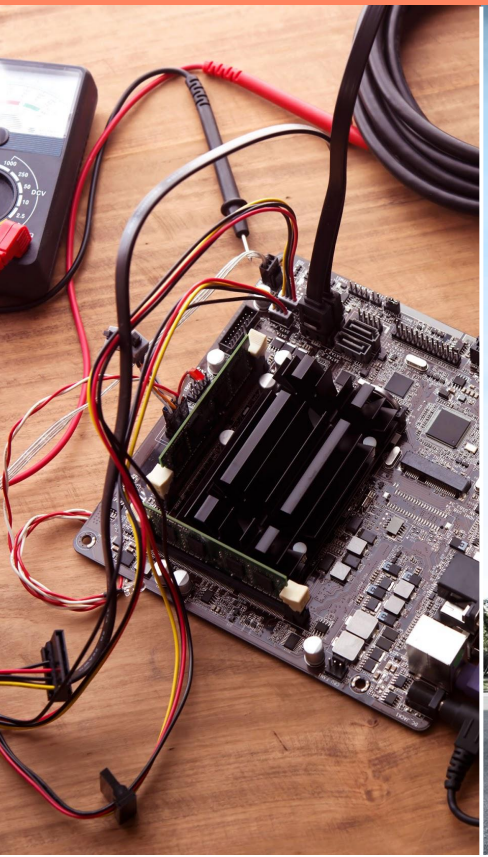
CORNELL TECH

Google

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

+ […]

Internet of Things Living Lab: A modular, open IoT-in-box Ecosystem



Developed by entrepreneurs, makers, engineers

With potential to scale to smart cities

Promote interoperability and stress testing in the wild

Testbed for prototyping & evaluating ideas. Share, build discover apps to enhance campus lift

Call to action

1. Let’s expand the success story of the Internet in terms of permissionless innovation and a leveled playing field for all competing innovators.

2. Let’s promote an interoperable ecosystem based on open standards.

3. Let’s make identity and data management an essential (new) part of the technological architecture from the very beginning of the IoT evolution.

"Let's take the internet to the next physical level"

Vint Cerf