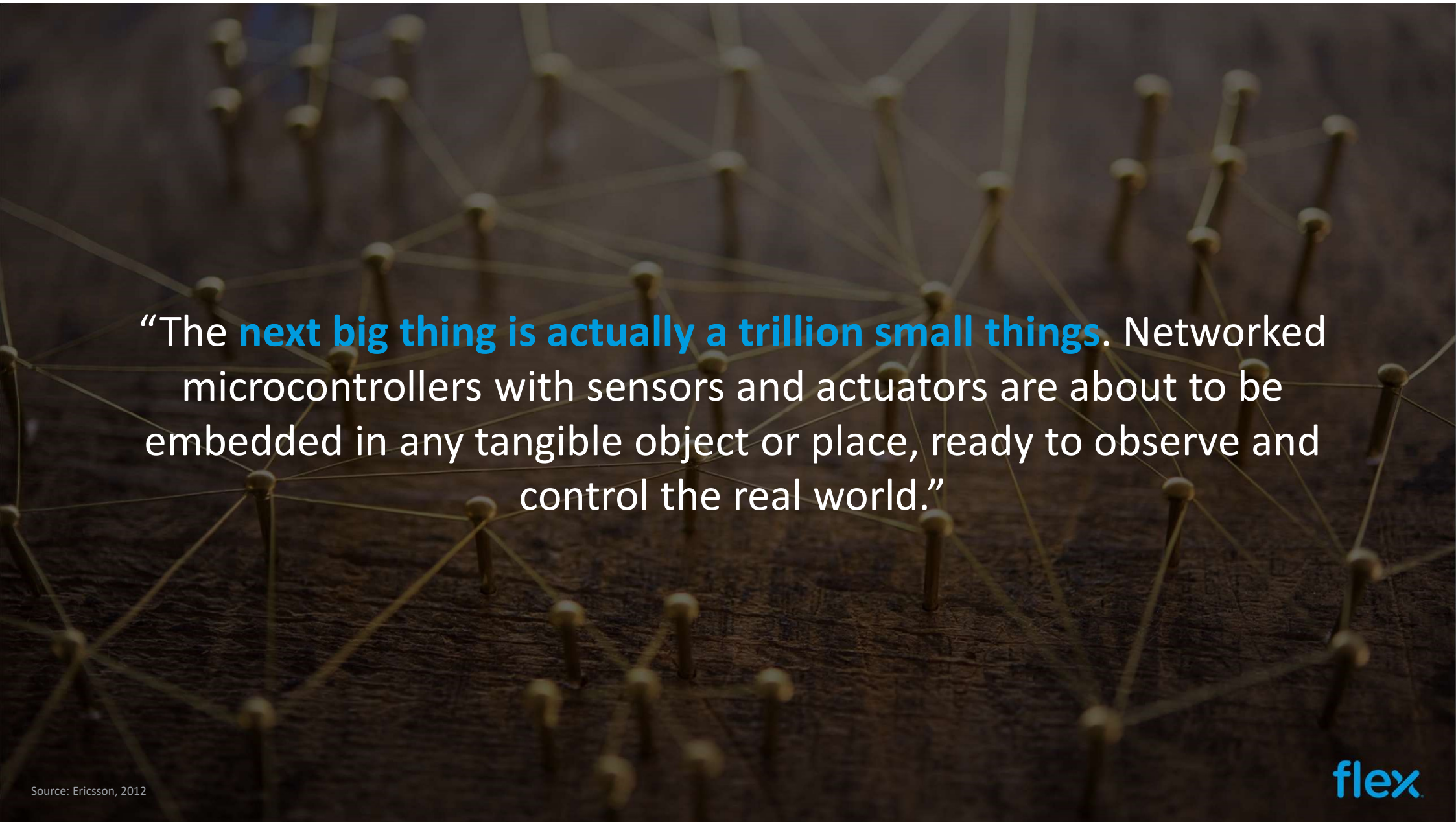
The Age of intelligence

Keith Churches - Innovation Services

May 2018


"The next big thing is actually a trillion small things. Networked microcontrollers with sensors and actuators are about to be embedded in any tangible object or place, ready to observe and control the real world."
Source: Ericsson, 2012
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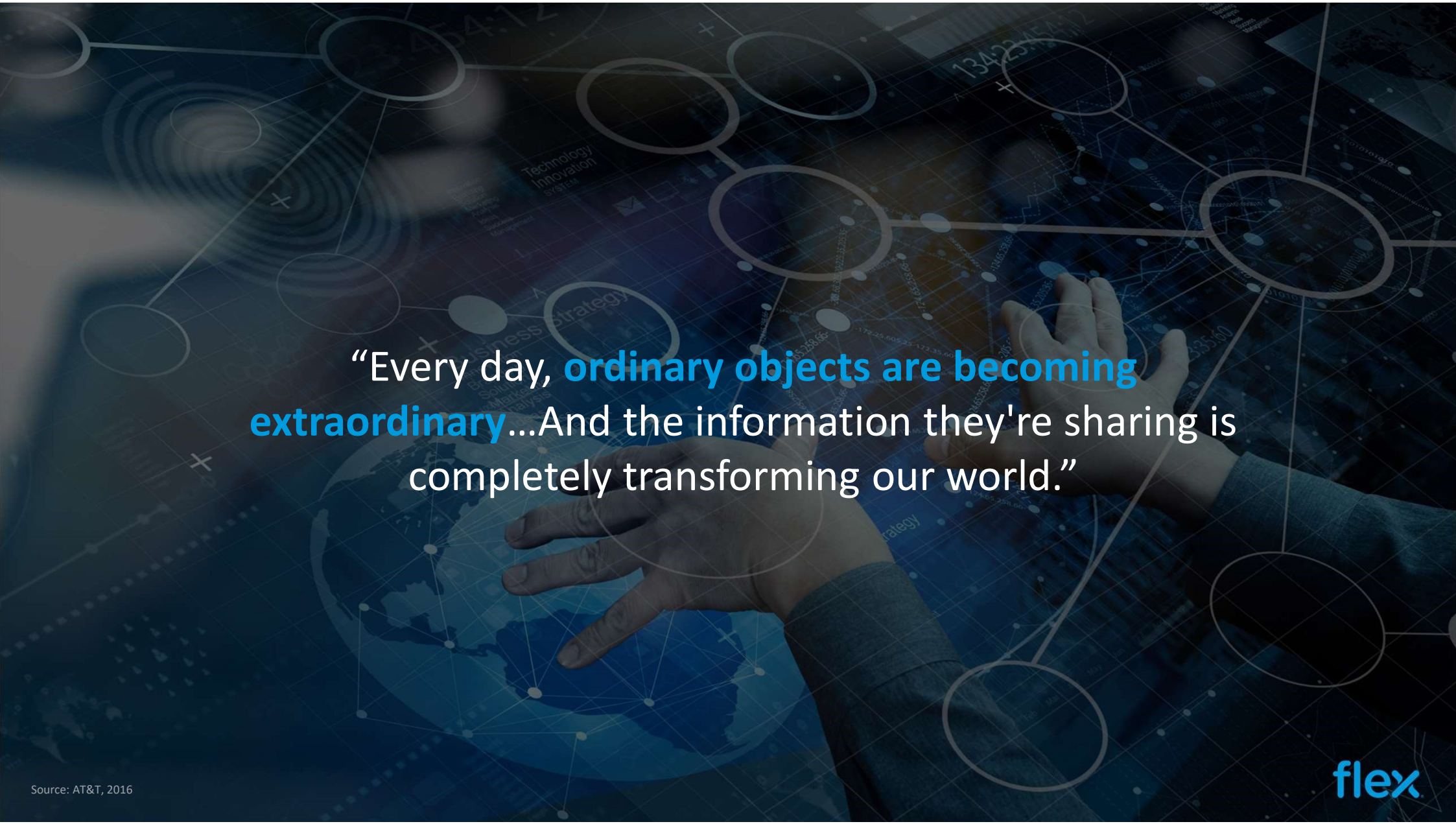

Source: AT&T, 2016

"…we are at the start of **another industrial revolution**…[that] will rival past technological marvels, such as the printing press, the steam engine, and electricity."

Source: AIG, 2015

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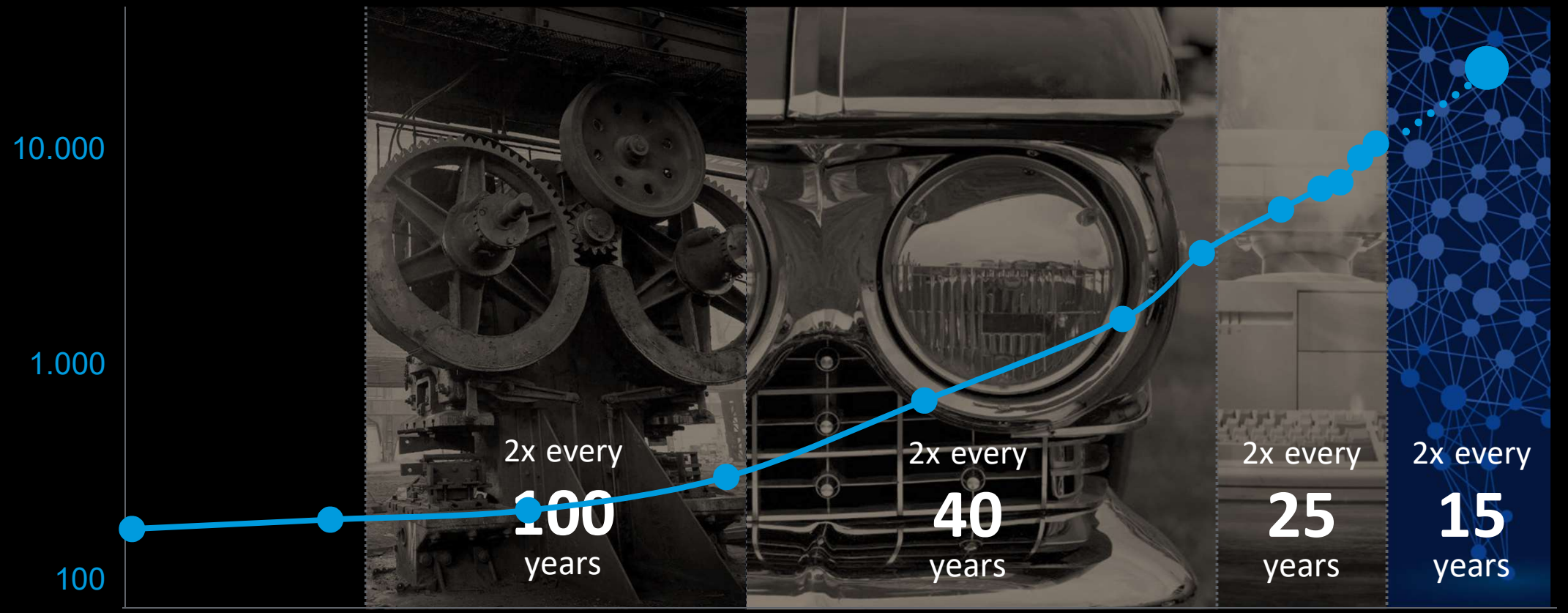
Global GDP Per Capita is Accelerating



Source: World Bank, Maddison Project, De Long- UC Berkeley

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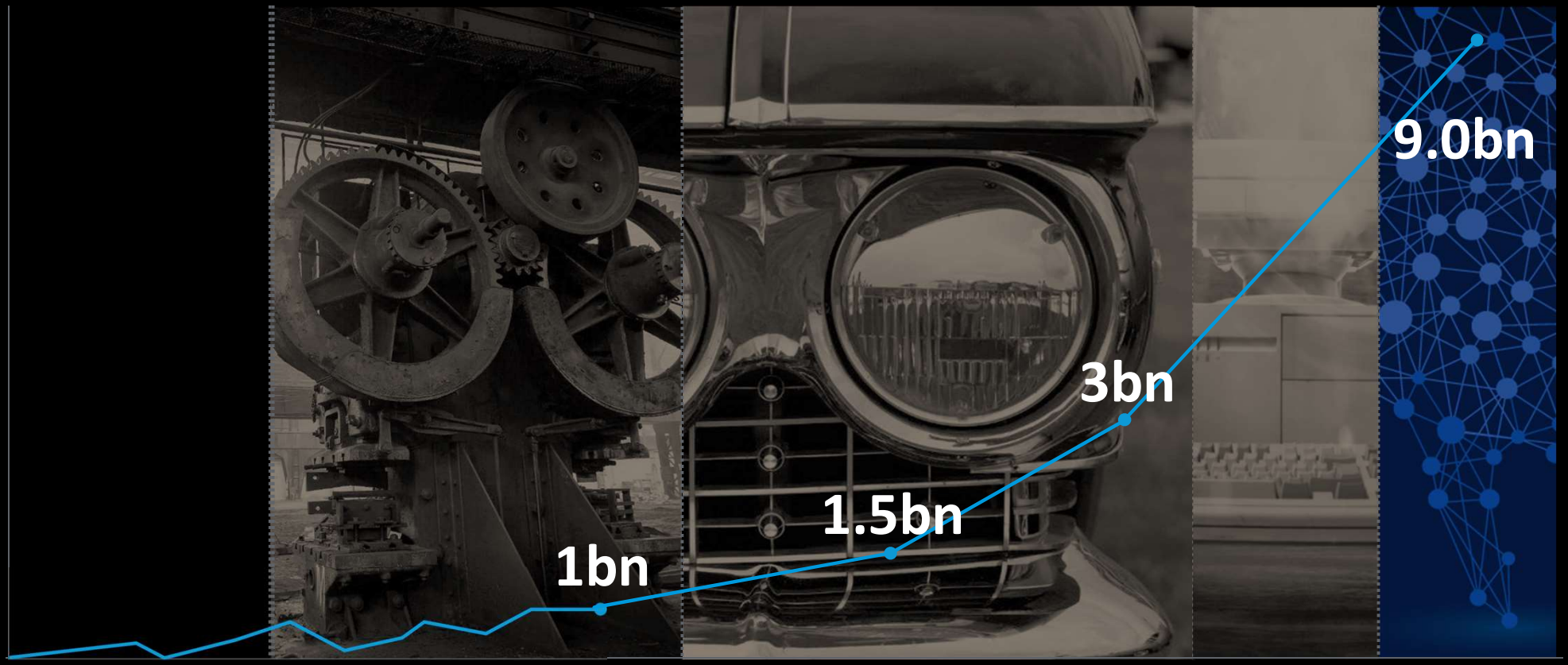
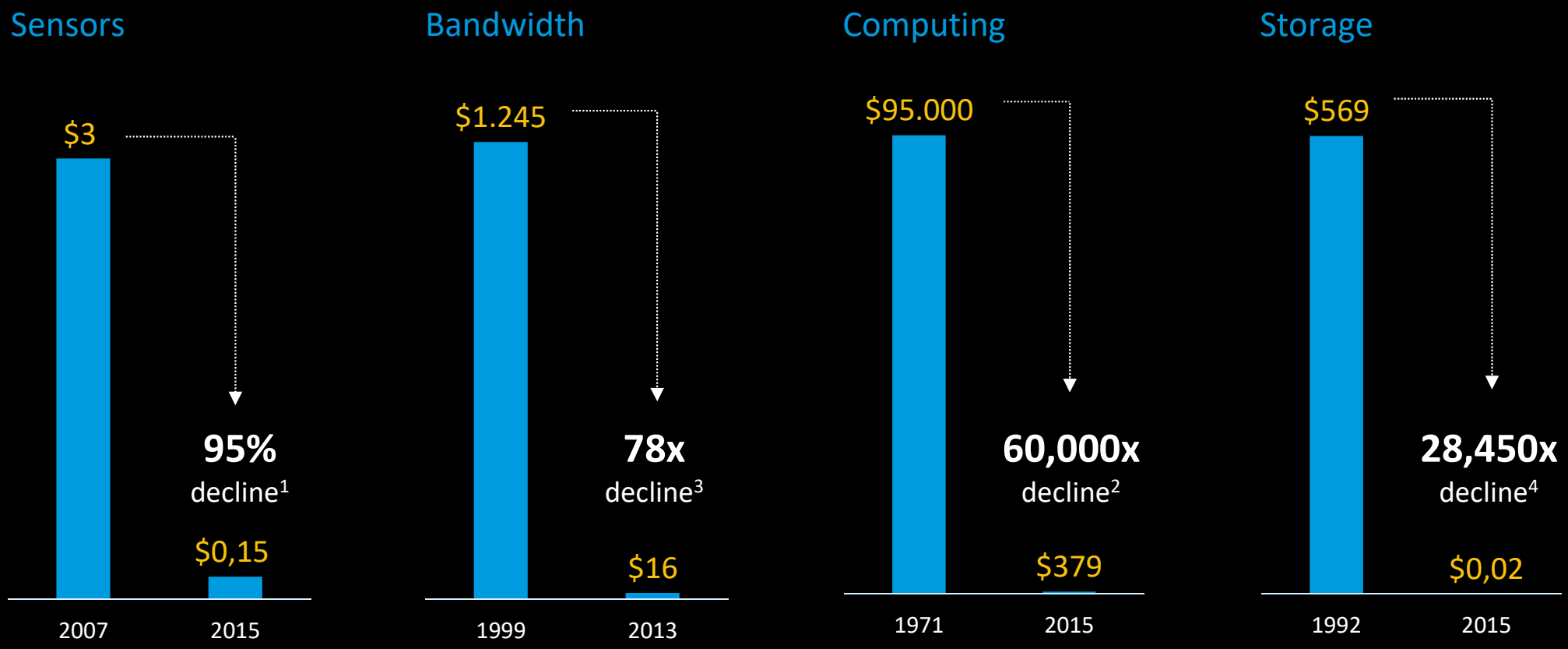
Global Population is Exploding



Cost Implosion is Enabling a Rise of Connected Devices



Source: [1]Yole Development - Cost of 3-axis accelerometer; [2]Intel- Cost of an Intel transistor; [3]Deloitte - Cost of 1,000 Mbps data transfer; [4]Deloitte - Hard drive cost per GB

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Low Component Costs Cut Prices and Boost Performance

Apple Macintosh

$2,495 ($5,834 in 2016)
128 kb RAM
No hard drive
7.83 MHz processor

Apple iMac

$1,099
8,000,000 kb RAM
1 TB hard dive
1600 MHz processor

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Miniaturization of Core Technologies Enables Mobility

iPhone

$499

4.5” x 2.4” x .46” / 4.8 oz.

Accelerometer, light and proximity sensors

Apple Watch

$349

1.52” x 1.21” x 0.41” / 1.41 oz.

Accelerometer, optical pulse, photodiode, infrared, pressure and more sensors

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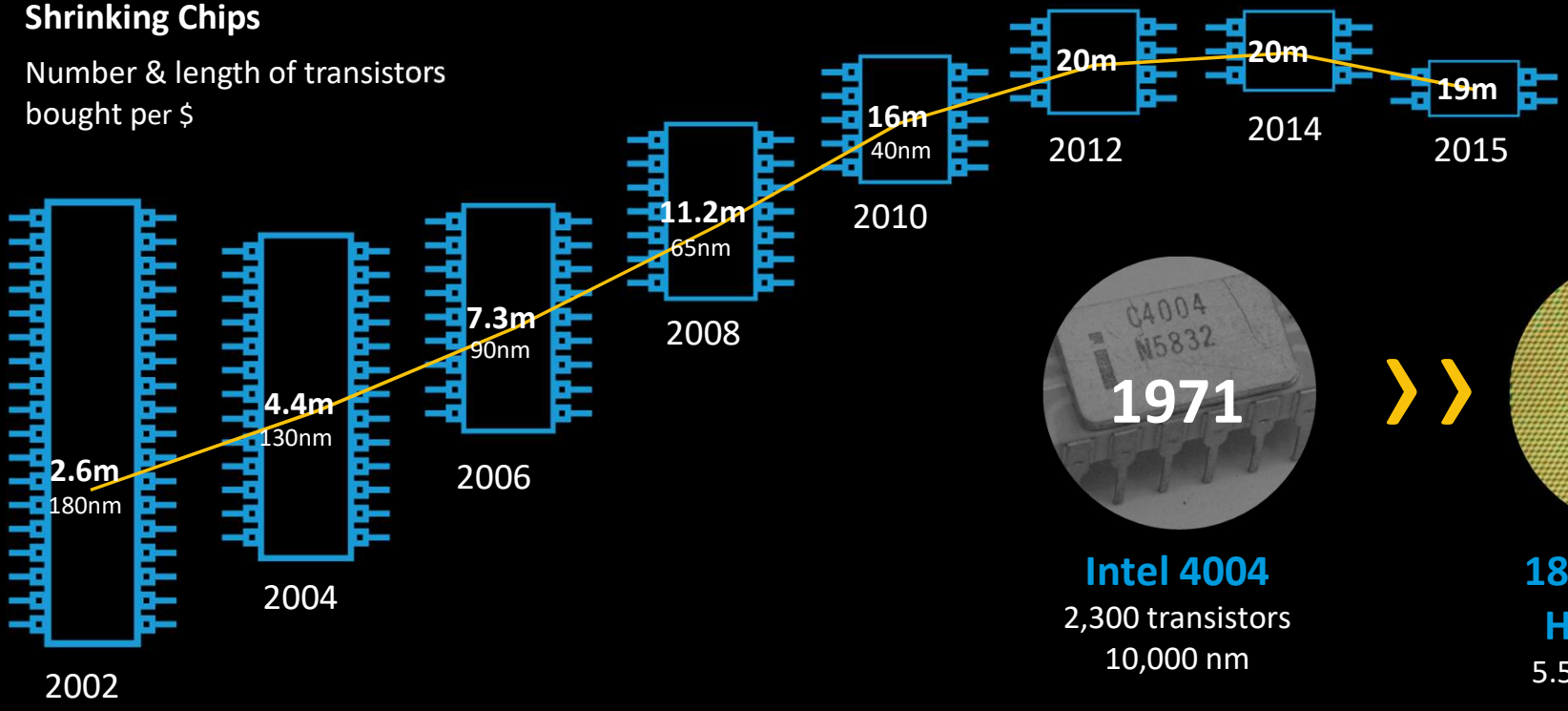
Innovation Overcomes Physical Limitations

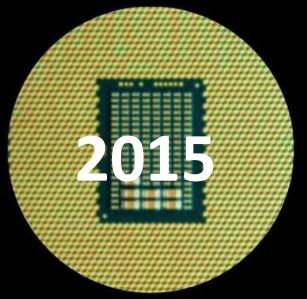
We are reaching the limits of miniaturization - the next wave will be 3D microchips, delivering 10x more power, using 40-50% less electricity

Shrinking Chips

Number & length of transistors bought per $



Intel 4004
2,300 transistors
10,000 nm

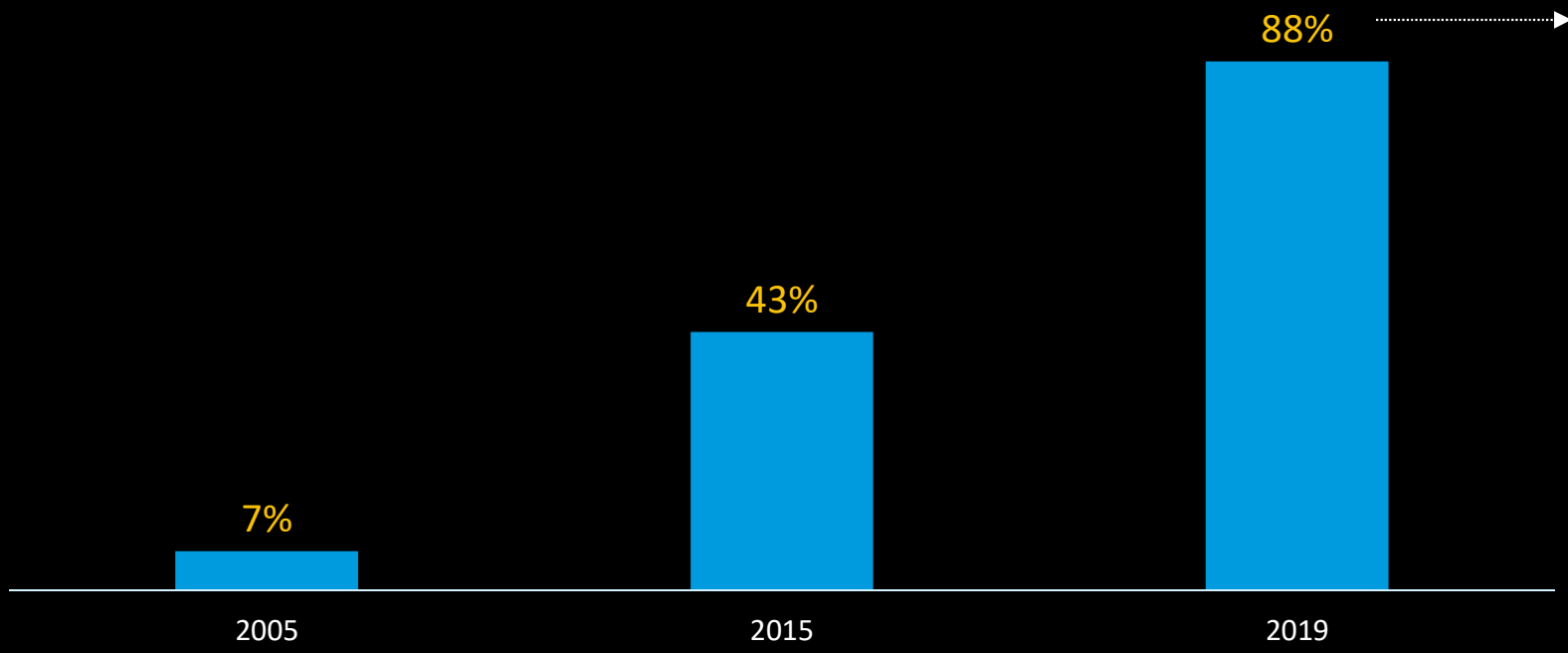


18-core Xeon Haswell-E5
5.5bn transistors
22 nm

Source: Linley Group

Ubiquitous Amount of Connections

Global internet penetration



6.7B
internet users

Source: BCG, Cisco

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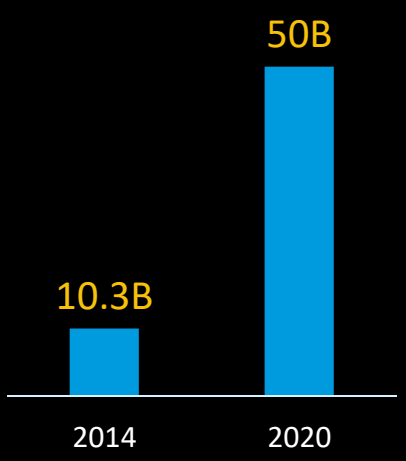
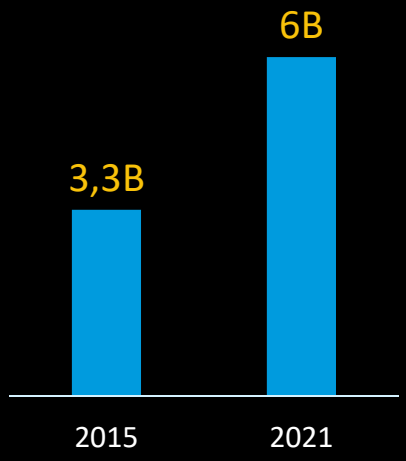
The Number of Connected Devices Continue to Increase

Today, only 1% of devices are IoT enabled, but everything that can be connected will be connected in the very near future

IoT Endpoints



Smartphone Subscription



3:1

outnumbered connected devices vs. global population by 2019

$6T

will be invested in IoT over the next five years – over $2T in hardware alone

Google

"There will be…so many devices, that you won't even sense it, it will be all around you. It will be part of your presence all the time."

Source: Ericsson, IDC, BI Intelligence, Cisco

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The Age of Intelligence™ is Already Here

Innovation

Disruption

Velocity

Agility

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How We Define IoT
An ecosystem of interactions between intelligent, connected nodes, people, process and data.
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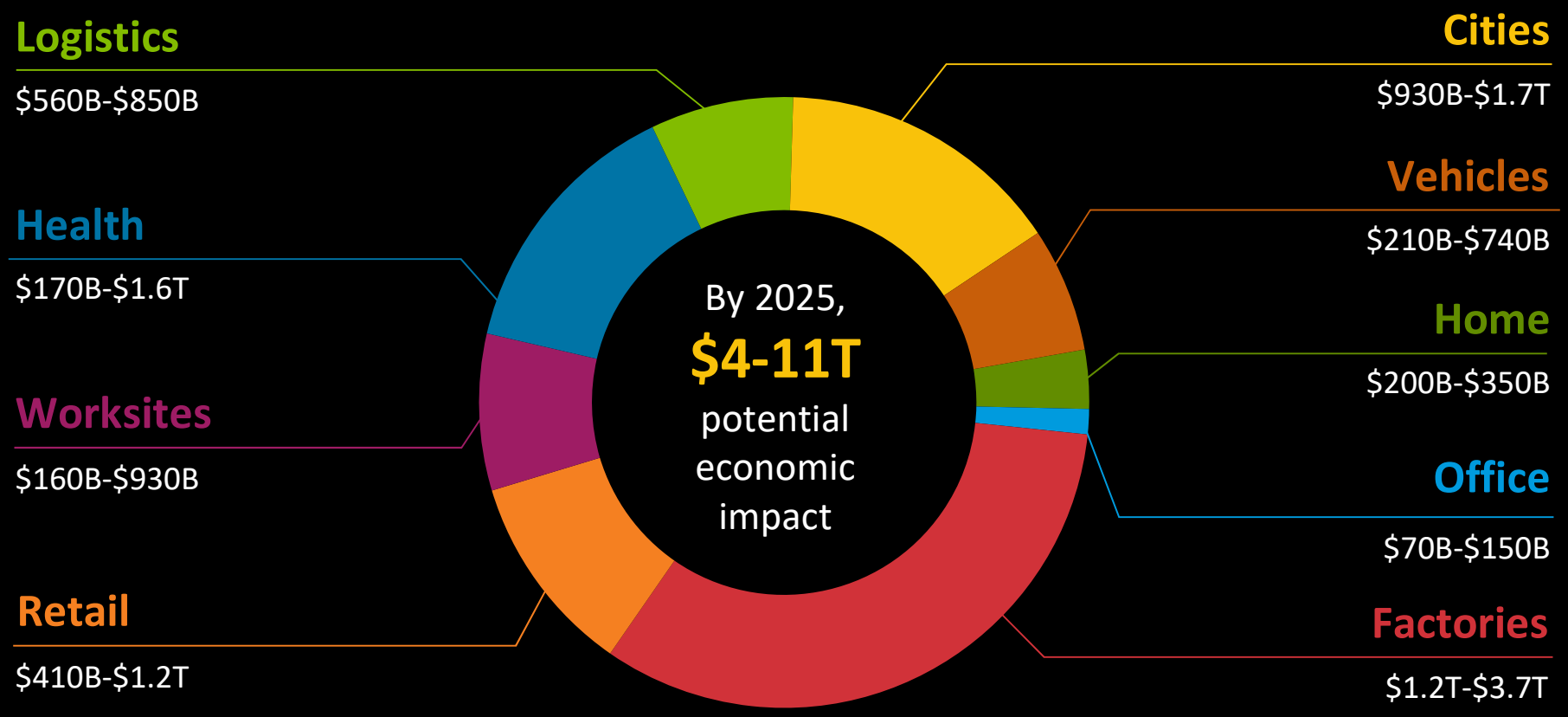
The Intelligence of Things

Combining to create a sheer explosion of smart nodes

Revolutionary Potential

IoT has the potential to fundamentally shift the way we interact



Source: McKinsey, 2015

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Companies are Capitalizing on IoT

10M connected vehicles by 2020

Strategy built around **IoT** and **big data**

Invested **$3B** in IoT business

100% connected products by 2020

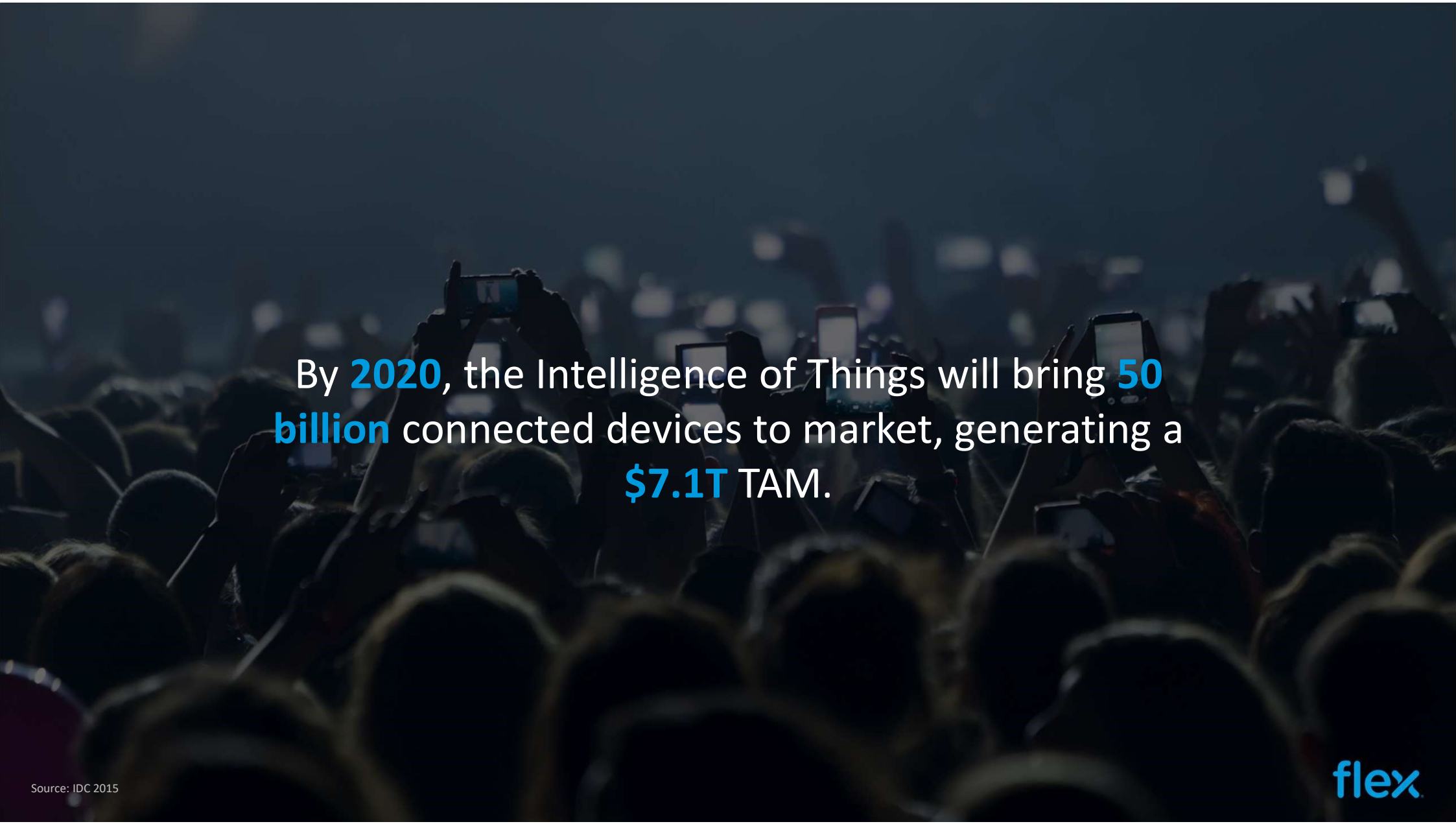
$1B in revenues from 43 "Industrial Internet" products

$2.4B in revenues from its 800 IoT offerings

Acquired Nest for **$3.2B** and Dropcam for **$555M**

$3B joint venture to develop smart devices

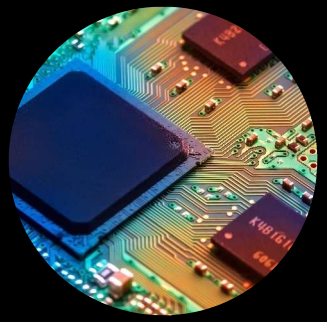
Source: Fortune, Company websites



Source: IDC 2015

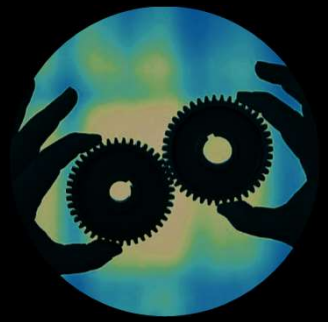
The Foundation of IoT

The Foundation of IoT



Semiconductors

Communications Infrastructure



Standards, Interoperability & Protocols

Security & Privacy

Intellectual Property

Government Support

Source: TATA Consultancy Service

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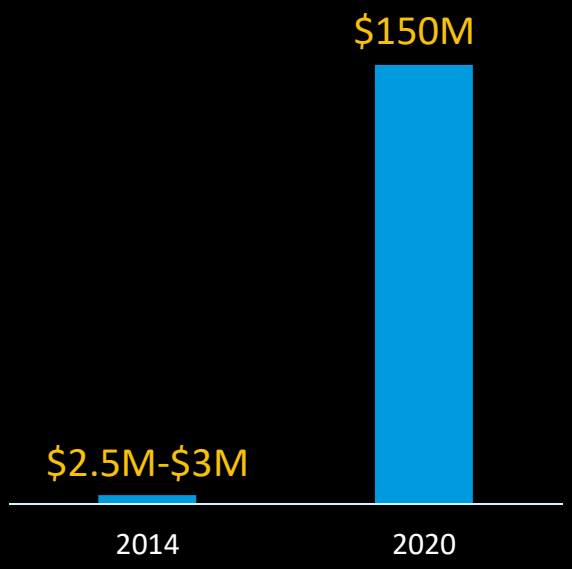
Security & Privacy

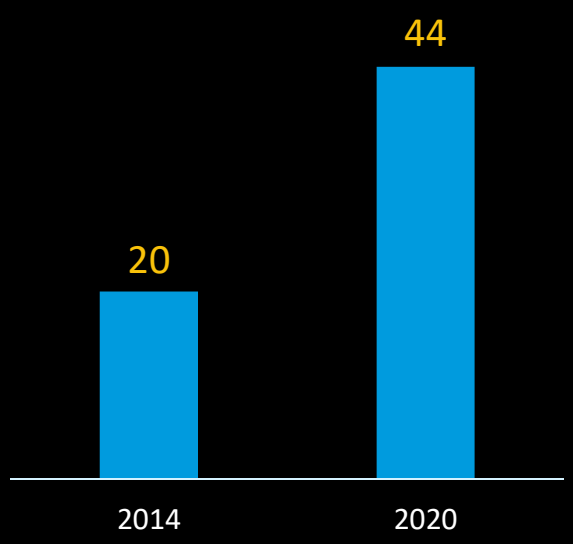
Security & privacy become key concerns

Exploding number of devices creating exploitable end points while objects not initially designed to be online are connected

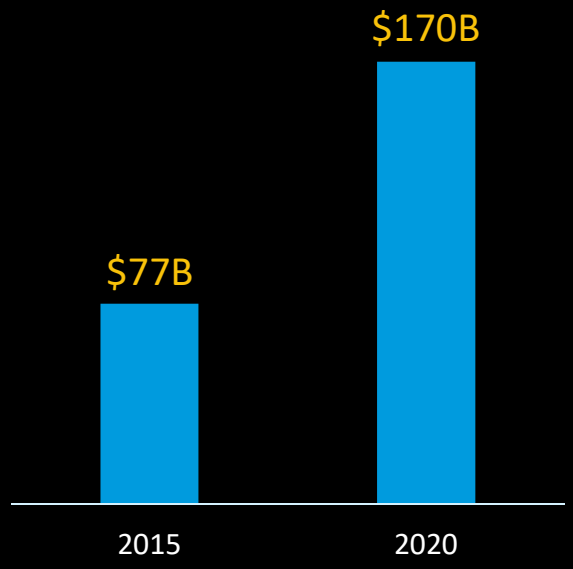
Cost from data breach



Reported data breaches



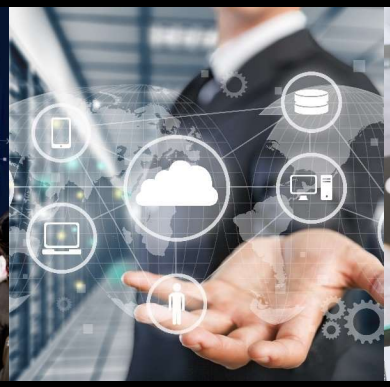
Spend on cybersecurity



Source: Cybersecurity spending, Gartner

Security & Privacy

Security recommendations

Security as part of design	Personnel security training	Service providers	Risk identification & management	Access control measures	Life cycle monitoring
					

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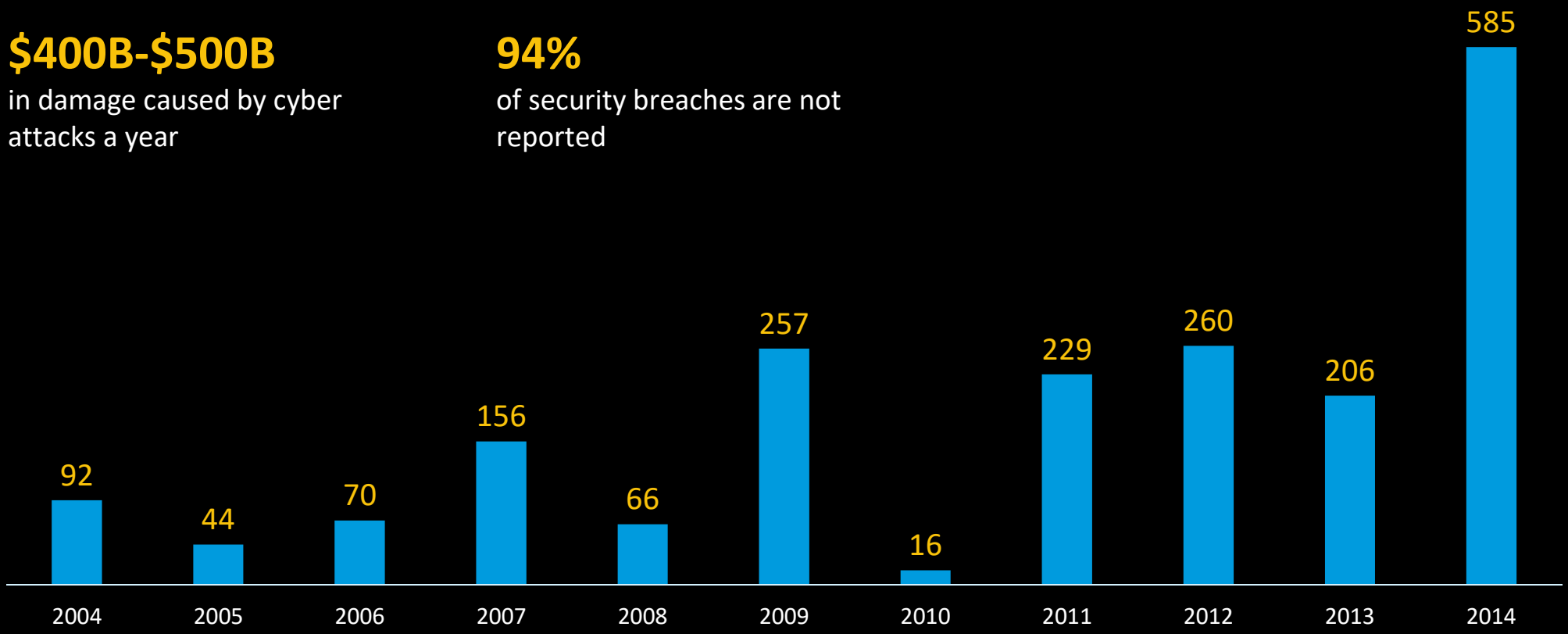
Security & Privacy

Number of data records compromised

$400B-$500B
in damage caused by cyber attacks a year

94%
of security breaches are not reported



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Intellectual Property

Protection of intellectual property rights is essential in encouraging investment in IoT

As IoT proliferates, increased number of patents will be filed for new products, services and business models, making it difficult to navigate through the chaos

Persistent Turf War

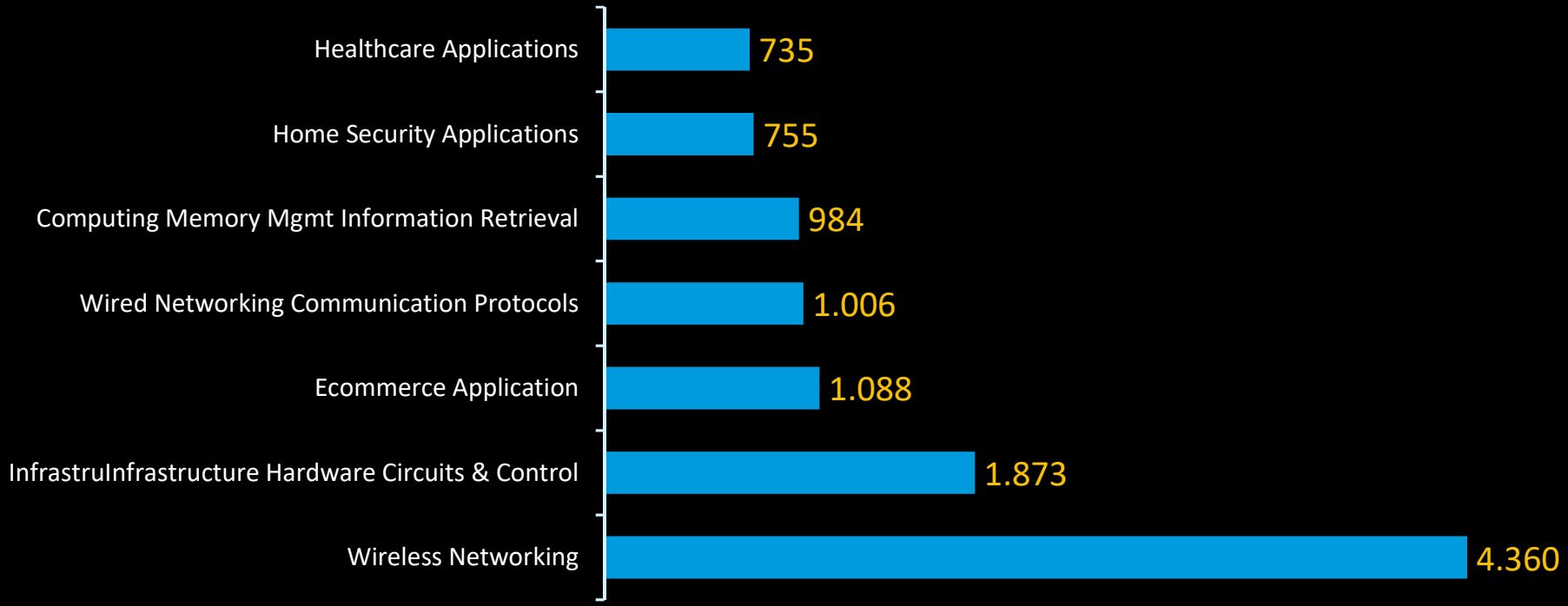
Protectionist behavior by IP owners make cooperation challenging

Need Cooperation

Agreements on a set of essential patents needs to be achieved

Intellectual Property

Top 10 class of IoT patents assigned in 2014



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How Can Flex Help?

Platforms
Innovation Workshops
Consultancy on Time to Market
Incubation / Investments

The Intelligence of Things

Smart, connected devices, machines and systems

Wearables

Connected Living

Digital Health

Smart Energy

Connected Transportation

Smart Agriculture

Mobility & Cloud

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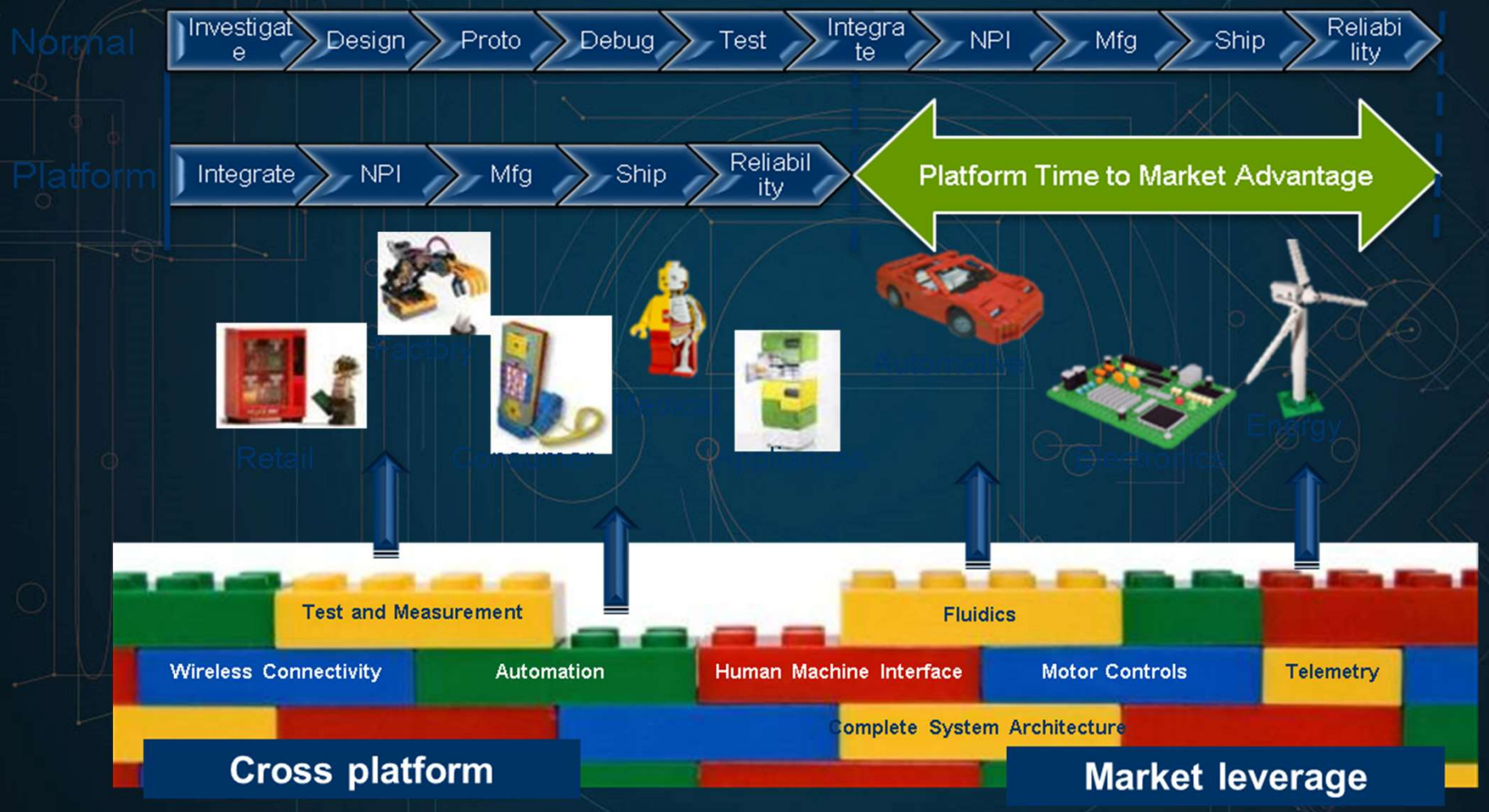
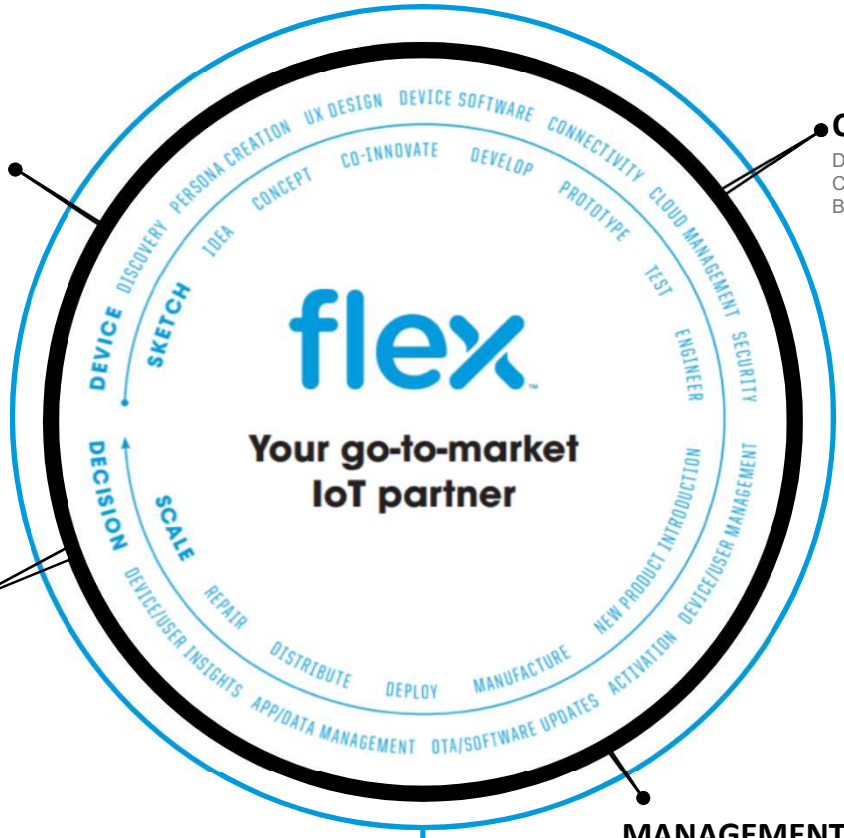
Platforming Benefits



Navigating the IoT Value Chain



INTELLIGENT PRODUCTS

Hardware Form Factor
Embedded Software
Embedded Agent
Certification
Radio Management

CONNECTIVITY

Data: MQTT, WSS, HTTPS, AMQP
Communication Protocols: Zigbee, Bluetooth Low Energy, WiFi, Cellular

APPLICATIONS

Product Administration Portal
Mobile & Web Applications
Solution Verticals
Identity Management

MANAGEMENT

Cloud Services
Platform Operations
Device Management
Security
SLAs
API/SDK
User/Data Management

SINGLE PARTNER

Software Services

Product / Device / Gateway 

Connectivity Protocols 

Cloud & Device Management 

User & Data Management 

User Applications 

Data & Analytics 

Device/Embedded Software

BSP & Radio Abstraction

Firmware development

Operating System Abstraction

(RTOS, Linux, Android)

Service and Application Layers

Embedded Agent

Device driver development

Embedded application development

Software verification

Device Identity Security

Device Emulators

Data & Communication Protocols

Cloud Software

Device Admin Portal

APIs/SDK

Micro-services Architecture

Security

Multi-tenancy

Private Platform Environments

Platform Operations

Storage

Support

User/Application Software

UI Framework

Starter applications

RESTful APIs

SDK

App Discovery

App Design

App Development

Integration support

Developer documentation

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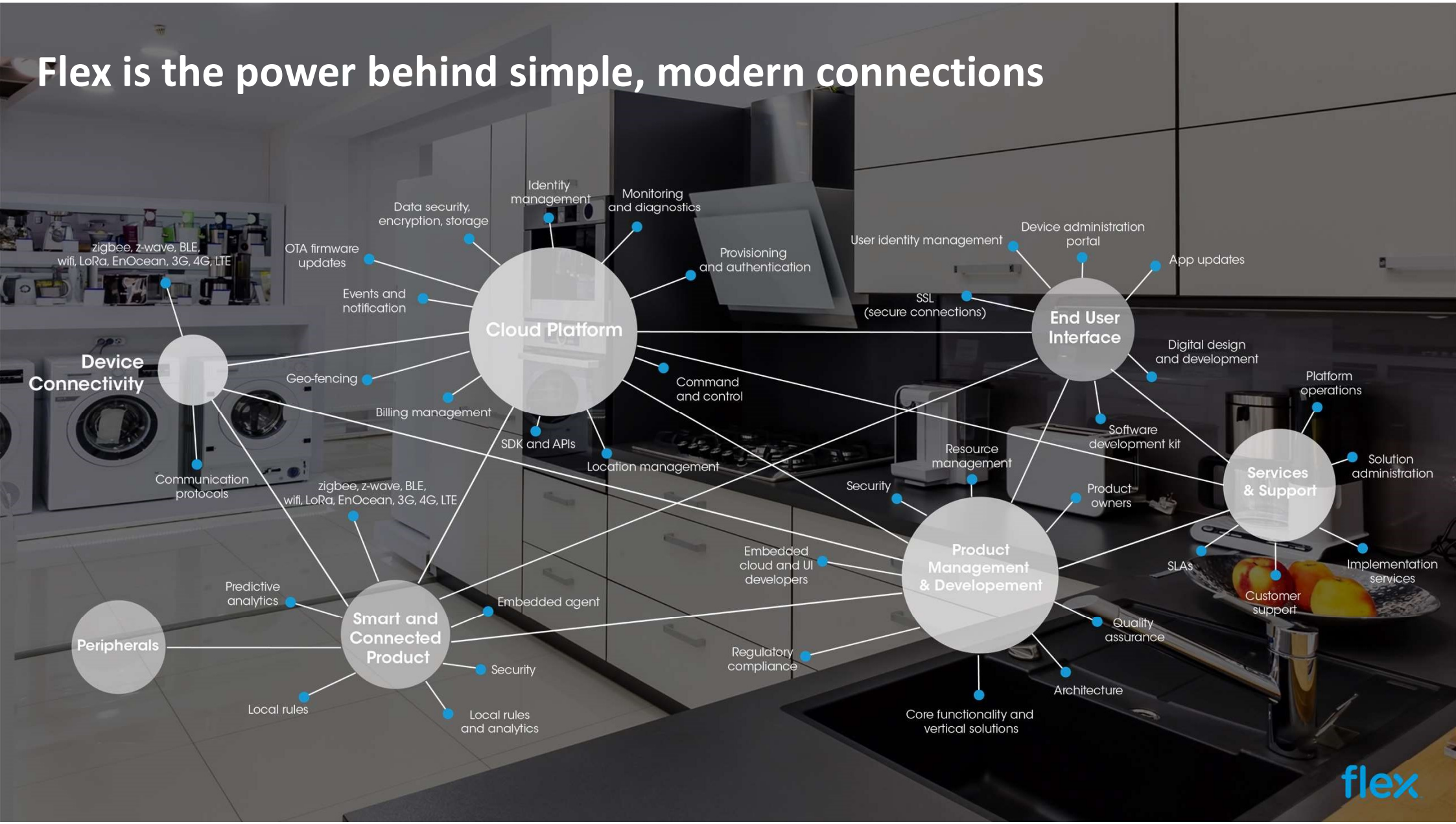
Flex is the power behind simple, modern connections



Our Connected Living Hardware Platforms Help You Innovate Today

Smart Home Gateways

Multi-Radio
Smart Home Hub

Smart Gateway &
Light Switch

Home Automation
Gateway (U.S.)
Amsterdam 1

Multi-Radio
Smart Home Hub V2

Multi-Radio
Gateway (W.W.)
Amsterdam 4

Home Automation
Gateway (W.W.)
Amsterdam 2

Application
Gateway (Water
Heater)

Application
Gateway (Lighting)

Home Automation
Gateway
(Australia)
Amsterdam 3

LoRa and LTE-M Gateway

Z-Wave to LTE-M
Gateway (AT&T)

WIFI to LoRa
Gateway (Comcast)

Dongle

LTE-M/NB-IOT
Dongle

ZigBee/Thread
Dongle

BLE/ZigBee Module
(Fashion)

Sensors

Smart Zigbee
Button

ZigBee/BLE
DW Sensor

Single piece Zigbee
DW Sensor

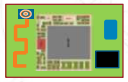
Voice Enabled Products

Smart Speaker

Voice Assistant

Voice enabled Light
Switch

Connectivity Module



ZigBee/Thread/BLE
Module
(Flex & SiLabs)

WIFI Module
(Marvell)

LTE-M/NB-IoT
Module
(Sequans & SkyWorks)
(Altair)

Examples of IoT Products Flex Designs & Builds for it's Customers

Connected POS

3G
4G LTE

Ethernet

Smart Flow Meter

3G
Wi Fi

Defibrillators
Battery Management

Wi Fi
3G
4G LTE

In-Car Connectivity

Home Gateway

Smart Lighting & Gateway

Reference Designs:
Sigfox, GSM,
Zigbee, etc

IPTV wireless STB

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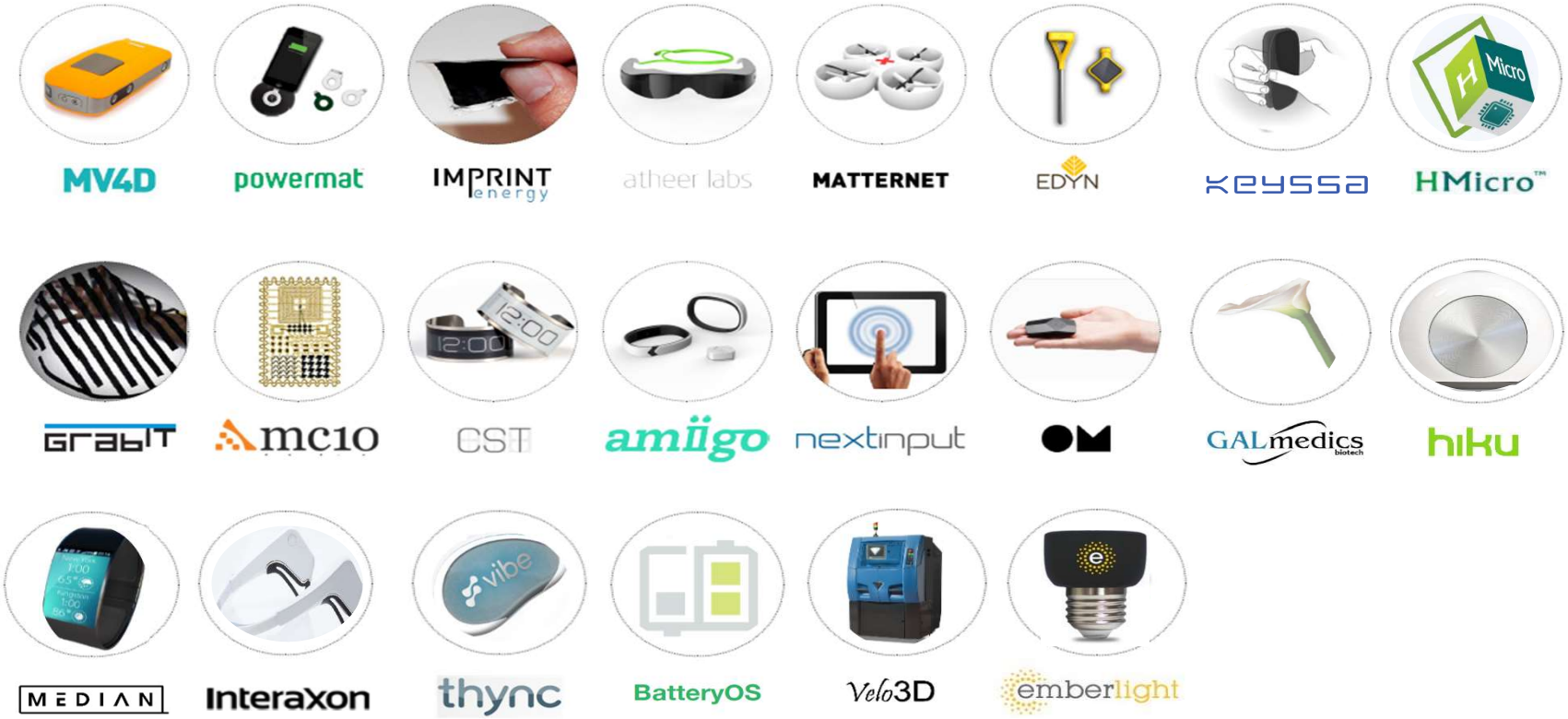
Lab IX … Ventures & Partnerships

- Provide access to early stage startups and new technologies to leverage for our customer's designs
- Focus on strategic HW technologies in areas that are aligned with Flextronics growth vision



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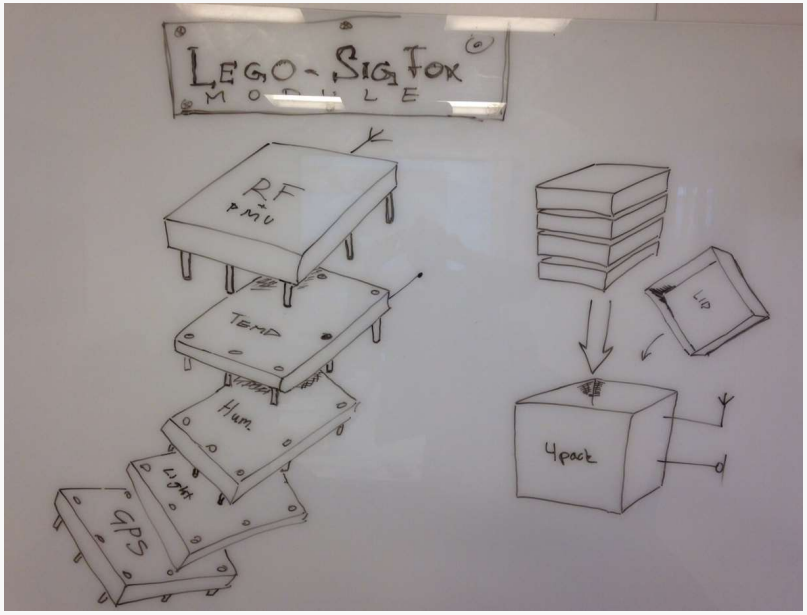
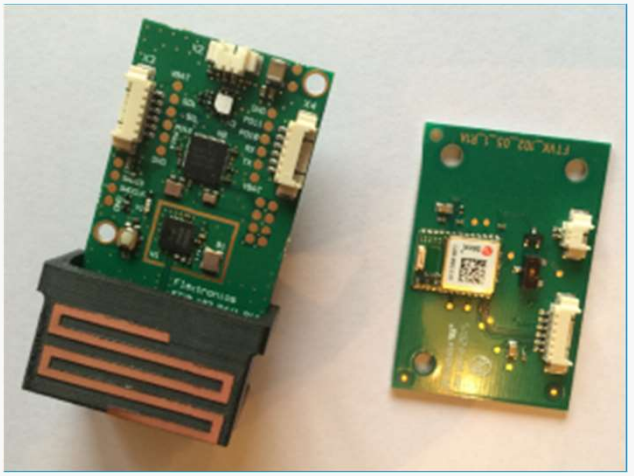
Sketch to Scale – Sigfox End-Node





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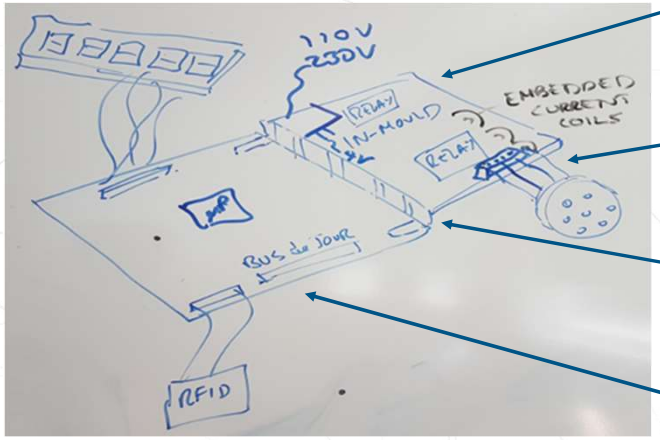
Sketch to Scale for EVC

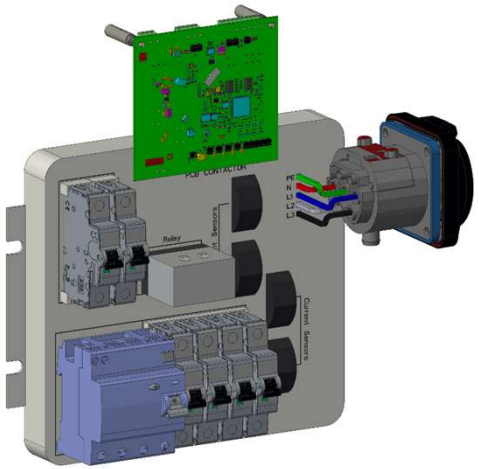


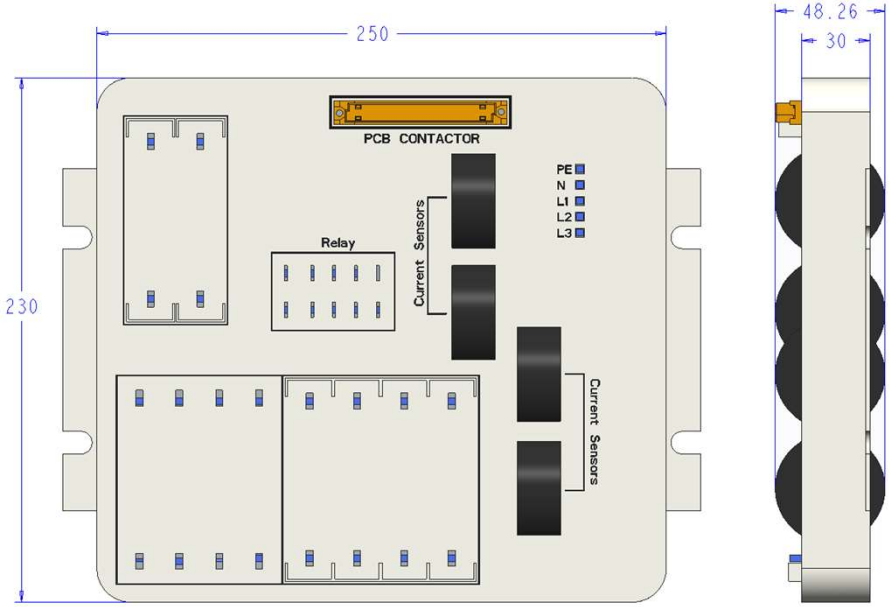
Proposed Power Train Board

Fix any connector
- CHAdeMO
- SAE-J1772
- Other

Flexi PCB

Controller Board





Mechanical & electrical design and manufacturing process developed by Flex, Industrial design & software developed by JCI

Manufacturing Site: Suzhou, China
Design Center: Ottawa, Canada
Project Details:

- Full Electrical Design (PCBA Layout, Wi-Fi/Bluetooth radio, audio & power design) & Mechanical Design (HMI, sensors, plastics)
- Utilized the Qualcomm Snapdragon chipset & provided software interface support to JCI as they led the software development and leveraged Microsoft Cortana for voice activation
- Developed the glass-attachment process which is a unique bonding process that is borderless
- Driving the manufacturing-readiness process – full DFX & test development

Johnson Controls

flex

Flex developed a Human Machine Interface for the tablet with state-of-the-art display technology

Manufacturing Site: Suzhou, China
Design Center: Shanghai, China
Project Details:

- Industrial design and concept development
- Flex designed the complete TPU (Teach Pendant Unit),end-to-end, including the PCBA, the design of the housing, all components including the design and style of the push buttons, integration, sample builds, sample testing and NPI

Manufacturing & design of Human Machine Interface (HMI) for top-load washing machine

Manufacturing Site: Guadalajara, Mexico
Design Center: Raleigh, North Carolina
Project Details:

- In-Mold-Decoration (IMD) was designed into the plastics to optimize the cosmetic finish of the front panel
- Touch sensor capability was designed into the electronics to improve the user experience
- Plastics and electronics are designed, manufactured and integrated at Flex to provide a complete HMI solution

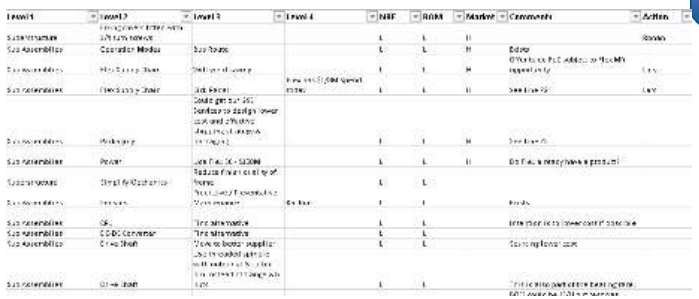
Whirlpool CORPORATION

QFD Process

Flex/Customer | Flex Internal | Flex/Customer

No Commitment | Commit

Voice of Customer → Brainstorm → QFD Creation → Create Roadmap → Prioritise & Commit to Work Plan



Quick Wins

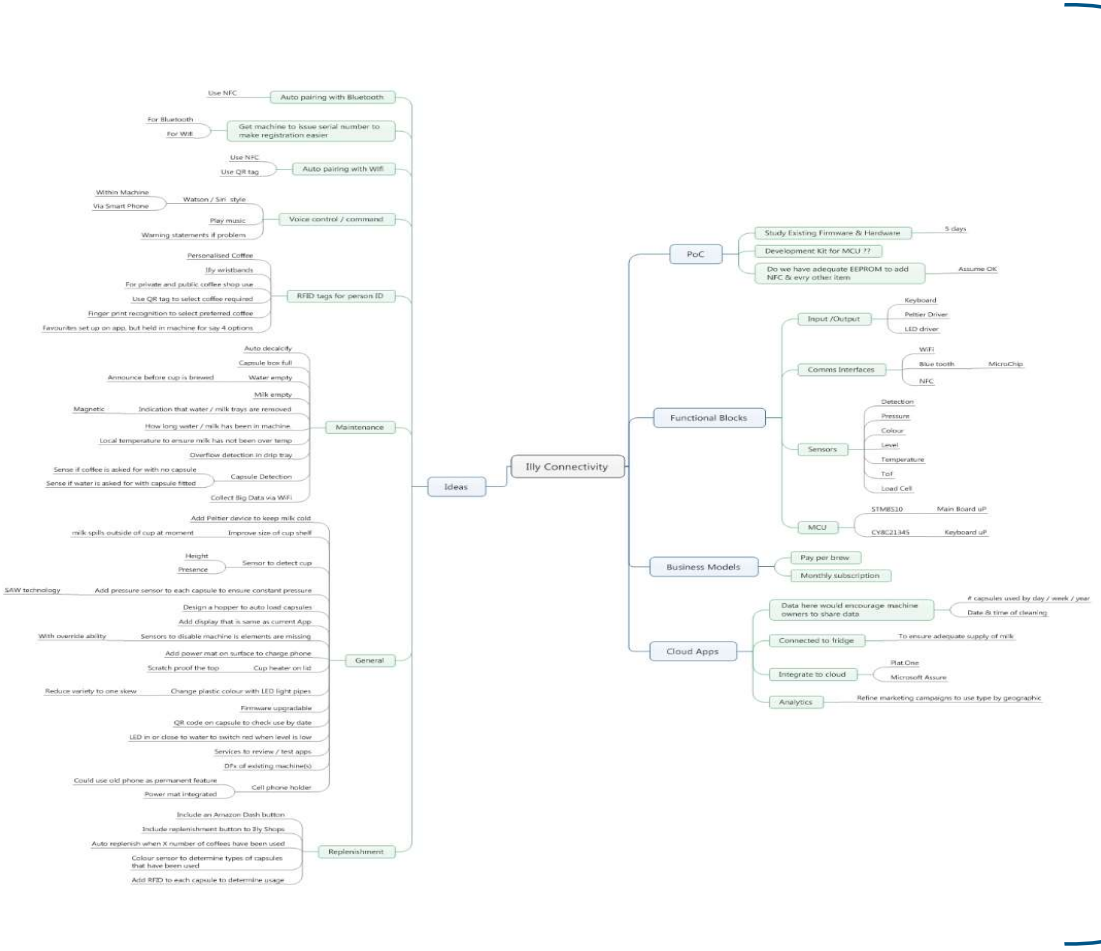
Gen 2

Gen 3

Gen 4

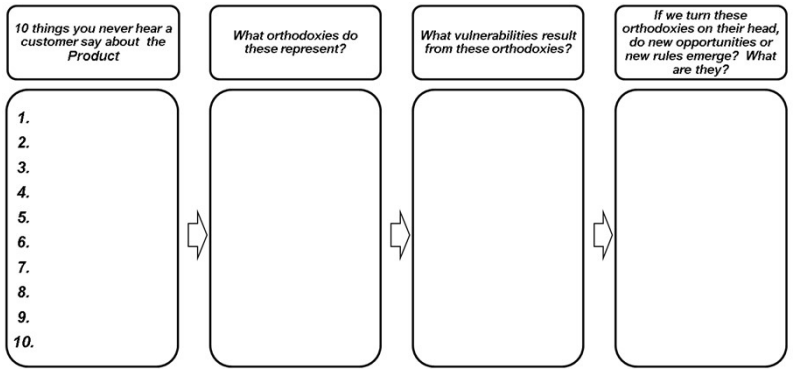
Mind Map & QFD: See hard copies, also available in soft form

Output from Simple Ideation

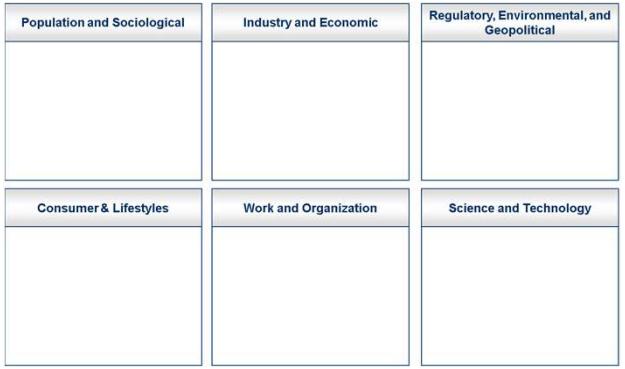


		NRE Cost	BOM Cost	Market Need	Comment
Use NFC		m m	l l	h h	Assumes Comms blocks available Use with original process as not all phones have NFC
		m	l	l	"
				l	
For Bluetooth		m	l	l	Registration and data transferred already via BlueTooth on phone
For Wifi		m	l	l	"
Use NFC		m	l	l	"
Use QR tag		m	l	l	"
Watson / Siri style					
	Within Machine	h	h	l	
	Via Smart Phone	m	l	h	
Play music		l	h	0	
Warning statements if problem		l	l	l	
Personalised Coffee		m	l	m	Assumes RFID reader installed
Illy wristbands		l	l	m	Value adding
For private and public coffee shop use					
Use QR tag to select coffee required		m	h	m	
Finger print recognition to select preferred coffee		h	h	m	
Favourites set up on app, but held in machine for say 4 option		m	l	m	
Auto decalcify		l	l	l	Set timer in App depending on how hard water is
Capsule box full		l	l	l	
Water empty		l	l	l	
	Announce before cup is brewed				
Milk empty		l	l	l	
Indication that water / milk trays are removed		l	l	l	
	Magnetic				
How long water / milk has been in machine.		l	l	l	
Local temperature to ensure milk has not been over temp		l	l	l	
Overflow detection in drip tray		l	l	l	
Capsule Detection		l	l	l	
	Sense if coffee is asked for with no capsule				
	Sense if water is asked for with capsule fitted				
Collect Big Data via WiFi		l	l	m	Meet with Plat.One
Add Peltier device to keep milk cold		l	h	m	For next gen machine 2019
Improve size of cup shelf					
	milk spills outside of cup at moment				
Sensor to detect cup	Height	l	m	l	
	Presence	l	l	l	
Add pressure sensor to each capsule to ensure constant pressure					
	SAW technology	h	h	l	Many patents in this area
Design a hopper to auto load capsules		h	m	l	Value Adding as option - Next Gen
Add display that is same as current App		m	h	l	Next Gen
Sensors to disable machine is elements are missing		m	m	l	I2C bus
	With override				
Add power mat on surface to charge phone		l	m	l	Adds €5
Cup heater on lid		l	m	l	
	Scratch proof the				
Change plastic colour with LED light pipes		h	h	l	Need deeper understanding
	Reduce variety to one skew				
Firmware upgradable		m	l	l	Will have already in X7
QR code on capsule to check use by date		h	h	l	
LED in or close to water to switch red when level is low		l	l	l	
Services to review / test apps		??	??		
DFx of existing machine(s)		??	??		
Include an Amazon Dash button		m	m	h (low for Flex)	Illy already working on this, we may be involved later
Include replenishment button to Illy Shops		h	m	h (low for Flex)	
Auto replenish when X number of coffees have been used		l	l	h (low for Flex)	
Colour sensor to determine types of capsules that have been used		m	m	l	
Add RFID to each capsule to determine usage		l	h	0	Makes capsule non-recyclable
Data here would encourage machine owners to share data		l	l	h	Involve Plat.One
	# capsules used by day / week / year				
	Date & time of cleaning				
Modularity - Design		h	l	l	Illy considering modularity internally

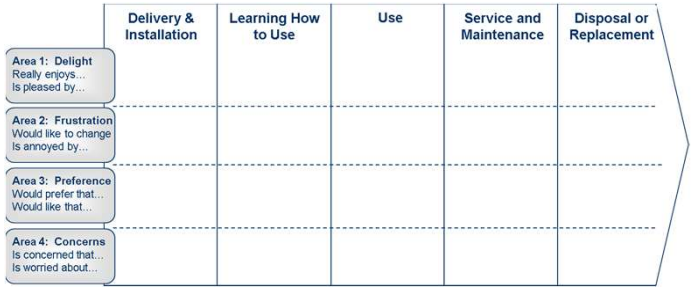
Ideation Tools



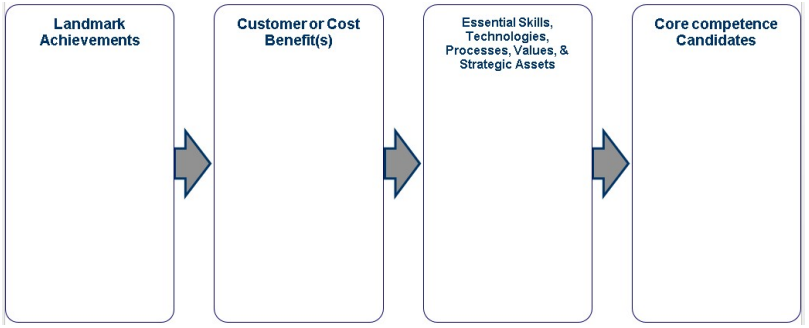
Orthodoxies Tool



Discontinuities Tool



Customer insights Tool



Core Competency tool

Thank You