From Sensors to Supercomputers Big Data Begins with Little Data

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SYSTEMS RESEARCH & DEVELOPMENT

The Architecture for the Digital World® **ARM**®

ARM Primer

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Terminology

Architecture "ARMv8"

ARM® Architecture Reference Manual

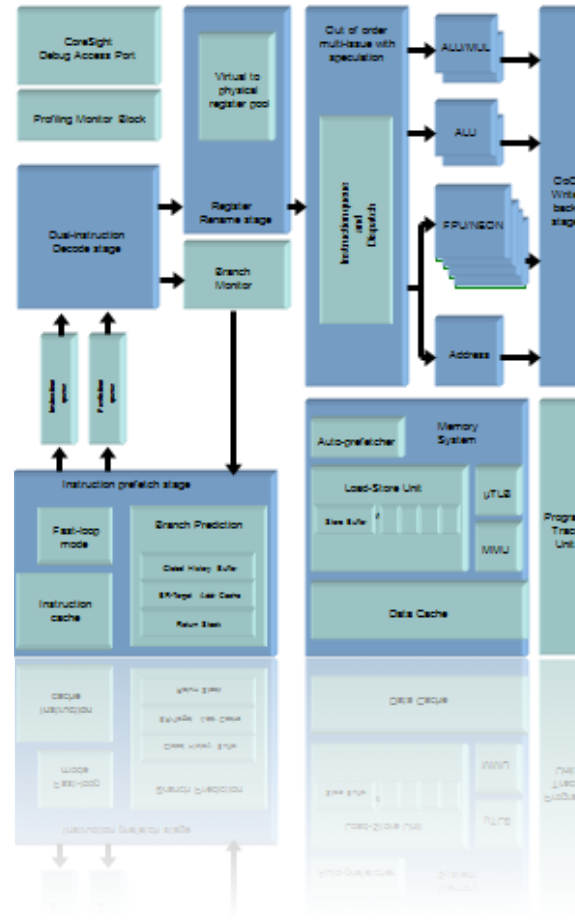**ARM®**

Copyright © 1996-1998, 2000, 2004-2010 ARM Limited. All rights reserved.
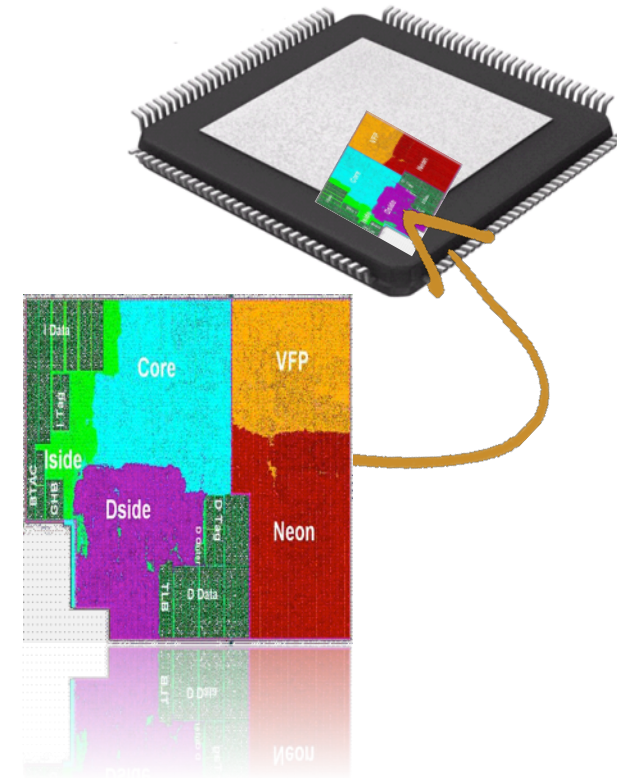ARM DDI 0406B_errata_2010_Q3 (ID100710)

Processor Micro-Architecture "Cortex-A57"

Processor Hard-Macro Implementation

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ARM Business Model

Processors

GPUs

Physical IP

Interconnect

ARM

IP

licence

Semi Partner

OEM

ARM invests in ecosystem

Silicon Partners

Design Support Partners

Software, Training and Consortia Partners

Customer

Ecosystem provides value chain with support & products based on ARM technology

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Wide Choice of Partners

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ARM®

Linaro – Distributed Software Organization

Technical Steering Committee (TSC)

Office of the CTO (OCTO)

Working Groups
- Kernel Consolidation
- Toolchain
- Graphics
- Power Management

Segment Groups
- LEG (15 companies)
- LNG (12 companies)

Platform Engineering

LAVA
Validation & Benchmarking

Builds & Baselines
OE/Yocto, Android, Fedora, Ubuntu

QA
Continuous Integration for Linaro output

Landing Teams
working under NDA

ARM
BROADCOM
FUJITSU
HISILICON
LG Electronics
ST ERICSSON
SAMSUNG

Optimization, consolidation and innovation

Validation, benchmarking and release management

**SoC support and optimization**

ARM: 21st Century Design

- Focuses on Design & Licensing of IP Building Blocks for SoCs (=LEGO's)

- Fosters an eco-system of standard pieces, acting as COTS-on-Silicon

- COTS-on-Silicon encourages multi-suppliers through the eco-system

- Allowing the eco-system the ability to deliver cost effective solutions
  - Enforcing localized optimized end designs

- Enabling circuit-boards to be miniaturized onto a single chip

- While retaining the technology DNA of Energy-Efficiency

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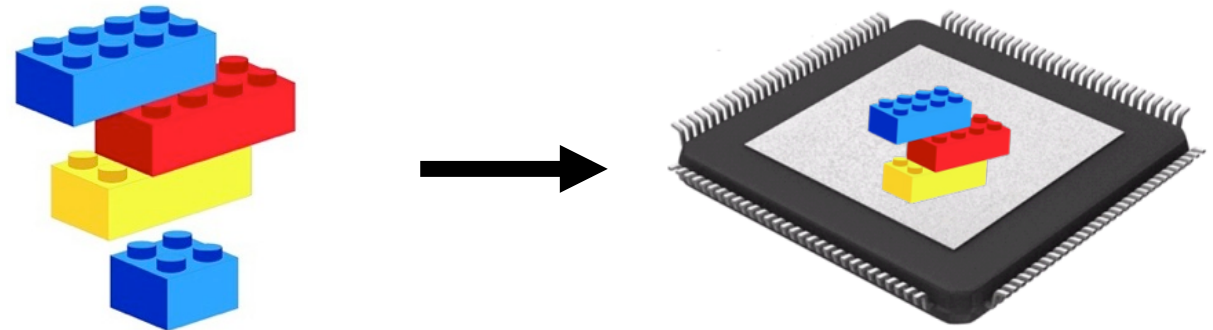
Evolution

13

Wearable Intelligence

PC

82   89   93   07   10

Mobile Computing

Embedded

77

97

IOT

Consumer

Smart Appliances

Computing

Cloud Server

1960   1970   1980   1990   2000   2010   2020

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What is IOT? according to the Internet…

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internet of things / smartphone / university of illinois at urbana-champaign

MoboSens, a Square-like tool for eco warriors, lets y... crowdsource ...

by Stac...

**Sensors
Smartphones
Analytics
Crowdsourcing**

Clear water doesn't always equal clean wate... arsenic can reside in water that looks perfect... research project at the University of Illinois at... sensors, smartphones and supercomputers v... monitoring project that can tell you if your wa... a community's water over time.

belkin / ces 2013 / internet of things

Belkin's WeMo builds an internet of thing...

by Stacey Higginbotham   JAN. 7, 2...

2 Comments

SUMMARY: *Connected home junkies should pay attention t... deal signed b... consumer ... Jarden ... appli... space ... positio... gateway fo...*

**Conn...
appli...**

Wi-Fi and was simple to implement.

data / ibm / podcast

Podcast: How IBM uses chaos theory, data and th... things to fix traffic...

by Stacey Higginbotham   MAR. ...

No Comments

SUMMARY: *IB... of things is abo... changing the c... bulbs, in large-... implementations ... traffic jams, save lives a... costs for cities.*

**City-sca...
Crowds...
Analytics**

tweet this

While the internet of things is invading people... industrial world has seen the promise of conr... years. IBM has been actively pulling together... internet" with acquisitions of data analytics c... sensors to create its Smarter Cities program.

digital health / fitbit / internet of things

Amiigo and its exercise database want to make you... look dumb

by Derrick Harris   FEB. 4, 2013 - 3:35 PM

3 Comments

SUMMARY: *intelligent... collec... referen... inform... activities. ... it, the smarter it gets.*

**Quantified
Analytics**

tweet this

The fitness-tracking incumbents might want... based Amiigo. The personal fitness startup'... available, but it has generated a lot of buzz... Indiegogo and an undisclosed amount of ve... make the Fitbit *(see disclosure)*, Jawbone U... device look quaint by comparison. The key... to deliver a personal experience the others...

digital health / startups / venture capital

Following the money in health tech: sensor techn... personalized medi... boost in March

by Ki Mae Heussner   APR. 3, 2013 - 10:4...

1 Comment

SUMMARY: *in heal... mone...*

**Outpatient
Monitoring
Data qualit...
Quick resp...**

The $1,000 genome isn't here qu... in using genetics, data and deep analysis t... patients. Although it wasn't the sector to at... personalized medicine had one of its best r... Health Academy's monthly insights report.

digital health / fitbit / internet of things

'Facebook for things' company Evrythng teams up with ARM on internet of things

by David Meyer   FEB. 22, 2013 - 9:31 AM PDT

1 Comment

SUMMARY: *The internet of things isn't all about infrastructure. Evrythng wants to provide the ide... enable smart... that infra... with the...*

**Interoperability
Aggregation**

tweet...

Much of the talk around the "internet of things" is centered on sensors and the networking or connectivity part of the puzzle — the IP addresses that everyday objects will need to have, or the machine-to-machine (M2M) networks needed to connect all those sensors. But infrastructure isn't the end of the story.

There's another element to this new wave of technology, namely the software ecosystem that will emerge on top of that infrastructure. And a fundamental building block for that will be identity management — not for the users' identities, but for the things themselves.

Diversity + Choice ➡ Partnership and Standards

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The Long Tail Drives Big Data Value

Smart meters, Wellness …

Value per Application

Turn on my lights when I arrive home

Value of Big Data

Number of IOT Applications
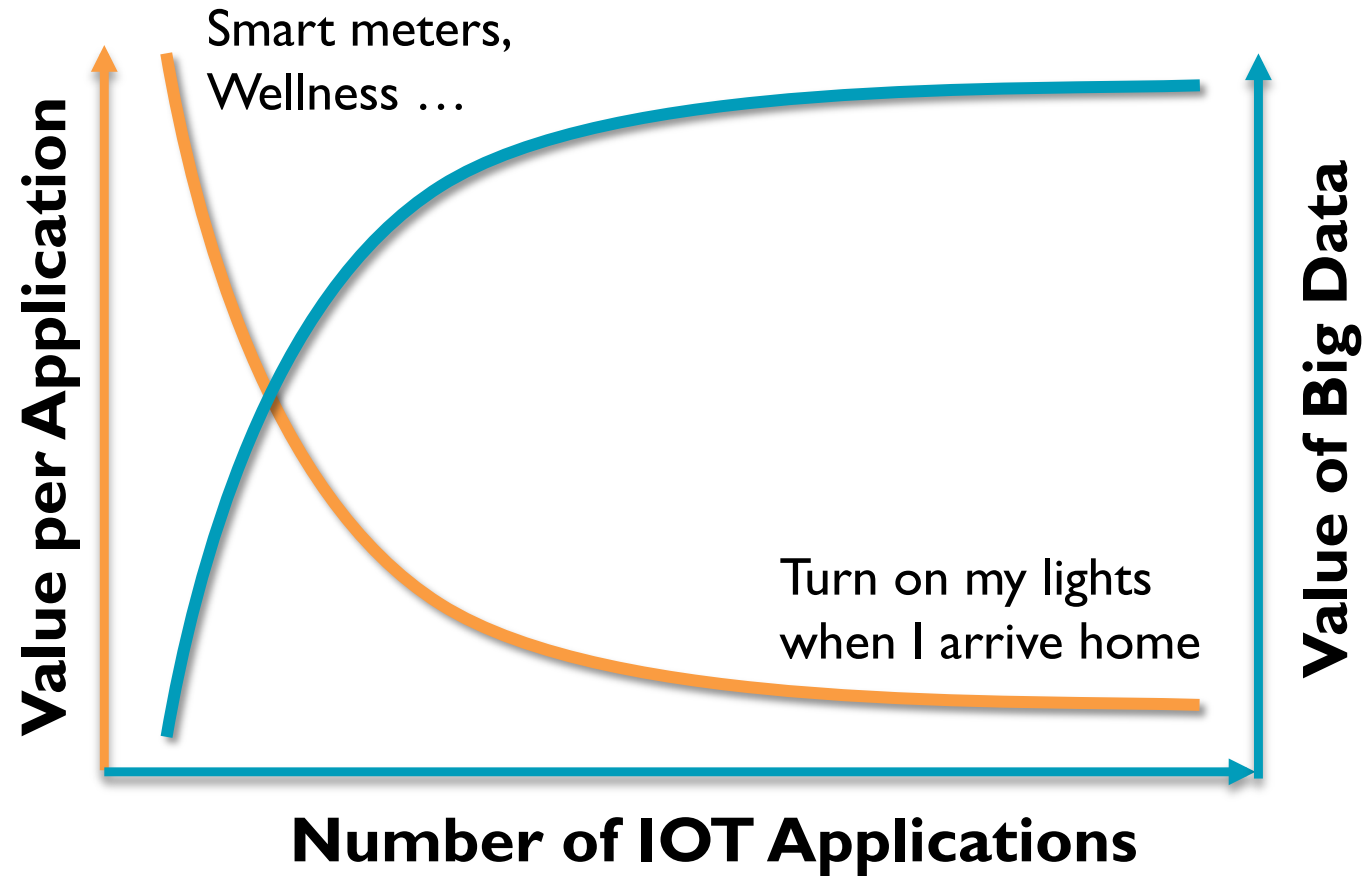
When   did I buy it?
Where   did I buy it?

When   do I use it?
Where   do I use it?

What do I do with it?

Who do I use it with?

Who did I tell about it?

Big Data begins with Little Data

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IR

Bluetooth

Bluetooth

Bluetooth

dlna CERTIFIED™

dlna CERTIFIED™

AirPlay

Google

IFTTT

IPv4

IPv4

Imagine that there were a 1000 of these connected devices....

nest 72

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Control your world

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Scale Needs Standards and Automation

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Universal Standards for IOT

- ARM is dedicated to a standards-based IOT with billions of IP and Web based devices

I E T F	**ZigBee** Member	**oma** Open Mobile Alliance	**ipso** Alliance	**one M2M**
IP, 6LoWPAN HTTP, CoAP, TLS	*ZigBee IP*	*Device Management, Lightweight M2M*	*Marketing, Interop, Web Objects*	*Integration*

- To accelerate the Internet of Things, ARM has acquired Sensinode to complement mbed
  - Sensinode was a pioneer in creating and deploying these key IoT open standards
  - Sensinode software enables efficient and secure communication from device to cloud
    - 6LoWPAN Stack and end-to-end CoAP and Lightweight M2M Platform

ARM®MBED™ + **ARM®SENSINODE**
IoT Development Platform   IoT Technology
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From Web Applications to IoT Nodes

1000s of bytes

Web Object
HTTP
TLS / TCP
IP

Web Application

Proxy

Sensinode
NanoService
Platform

~100 bytes

Binary Web Object
CoAP
DTLS / UDP
IP

IoT over Backhaul

Router

Sensinode
NanoRouter

10s of bytes

Binary Web Object
CoAP
DTLS / UDP
6LoWPAN

IoT Node Network

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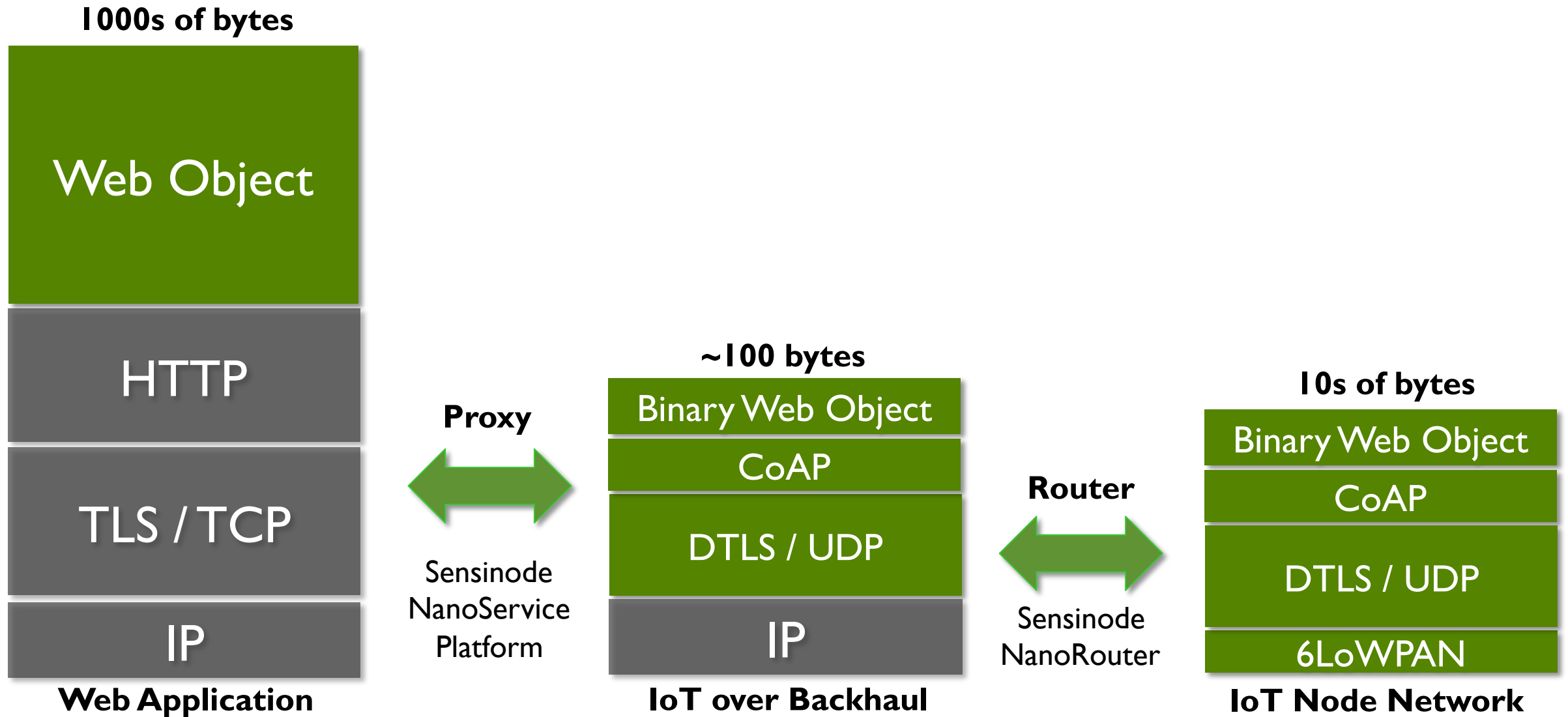
Functional Becomes IOT Little Data & Service

Functional

Little Data

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Sharing Needs Trust

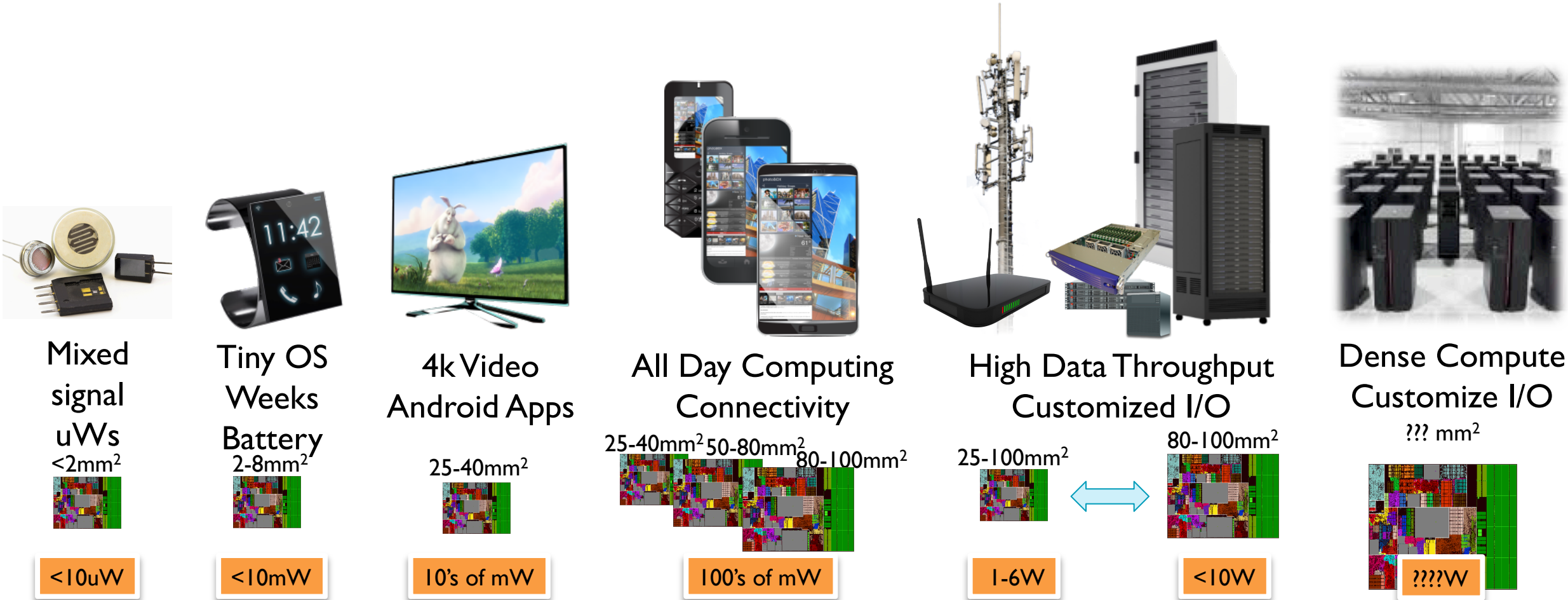The Architecture for the Digital World® **ARM**®
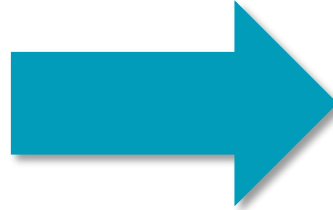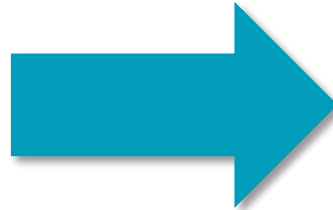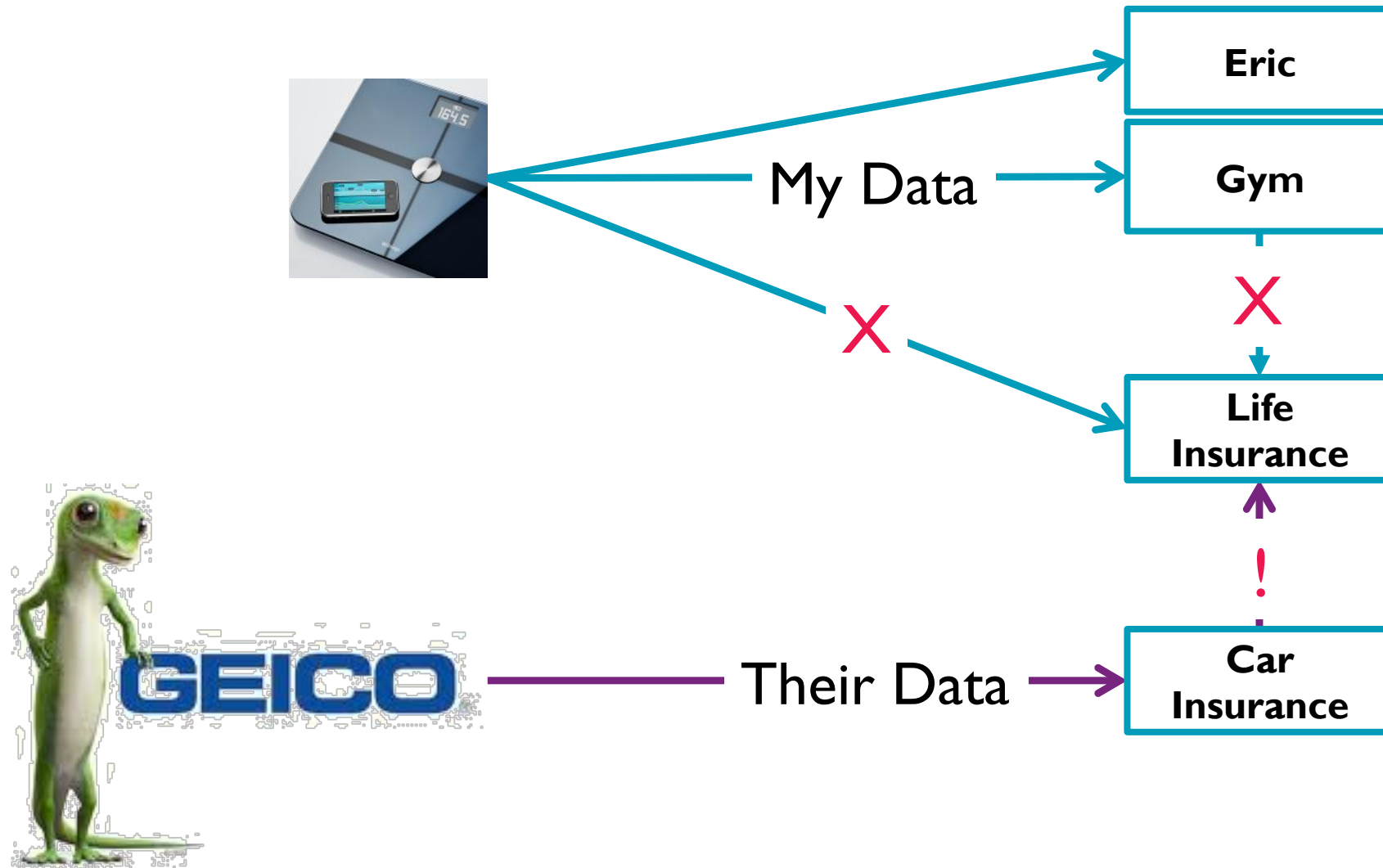
Trust Needs Security

- First implantable Pacemaker 1958

- Can a pacemaker be hacked to kill?
  - Or just a plot line in US TV series

- RF interface for adjusting settings

- First hacked in 2008
  - "Sustained effort by a team of specialists" – The New York Times
  - Range a few cm

- Today
  - MIT grad students
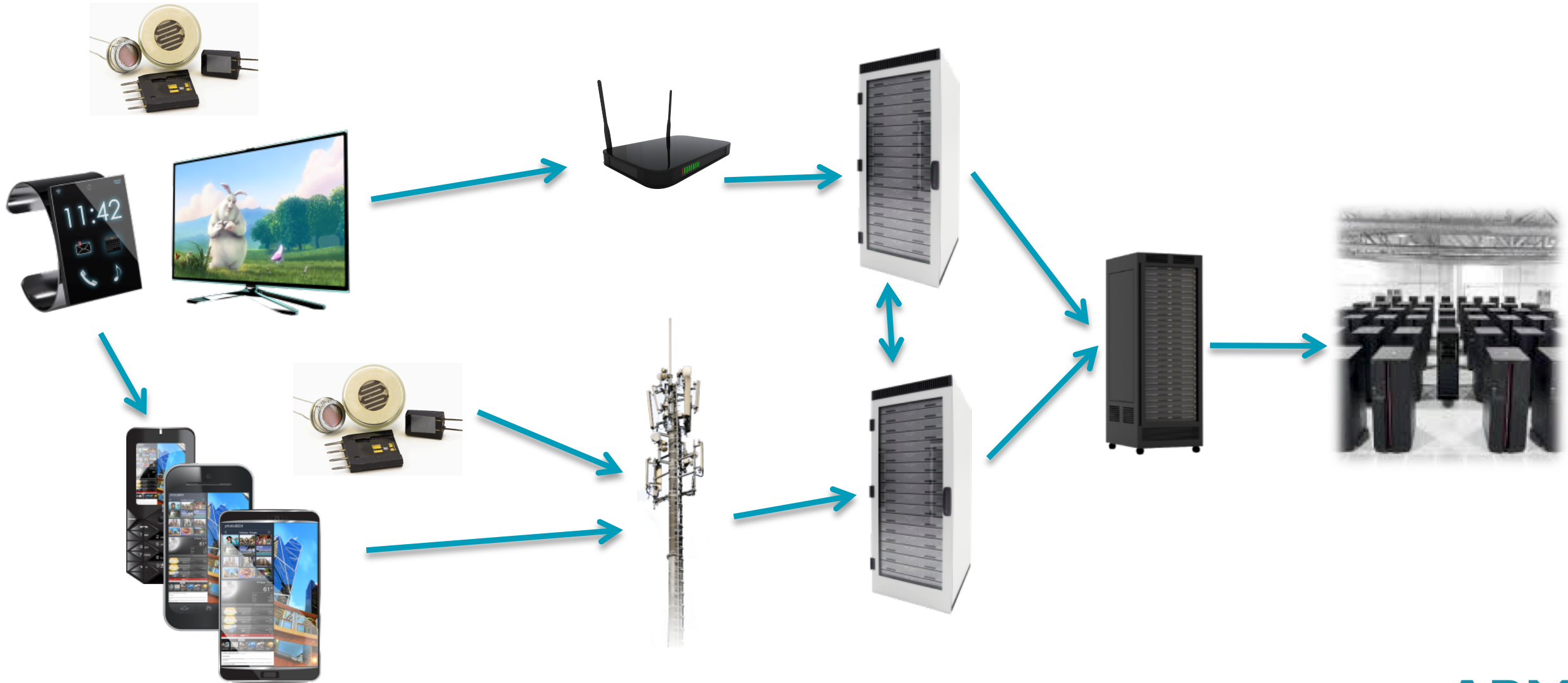 - One weekend
  - Range 50 feet

SIEMENS-ELEMA
1958

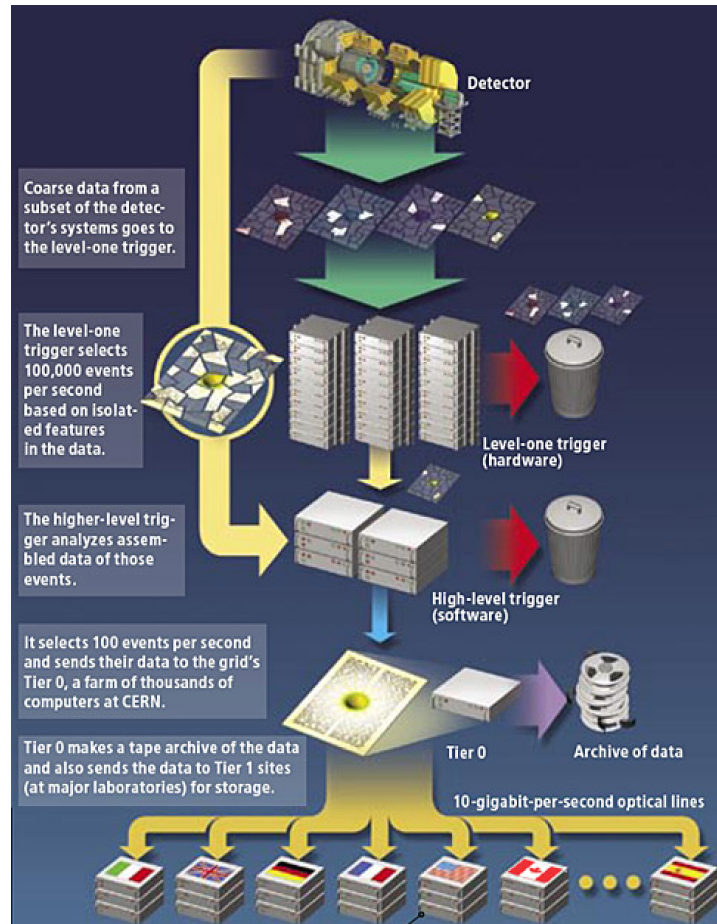The Architecture for the Digital World® **ARM**®
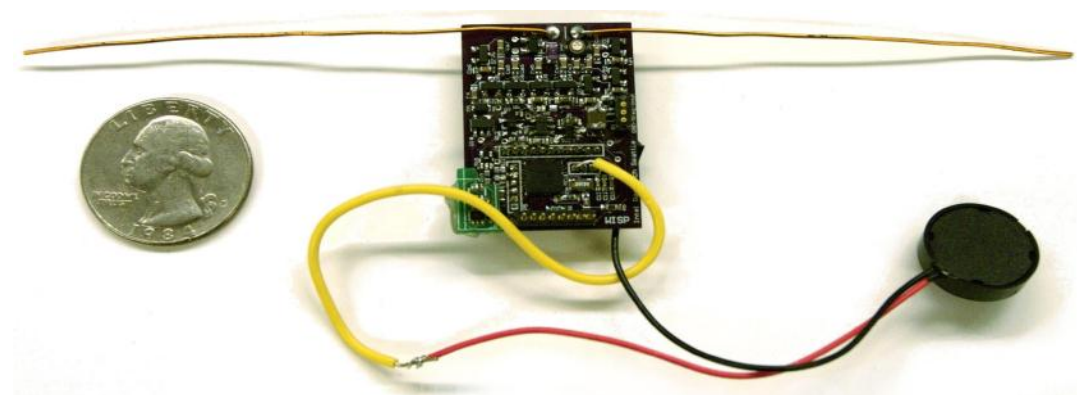
Computing Now Requires the Right SoC

Mixed signal uWs	Tiny OS Weeks Battery	4k Video Android Apps	All Day Computing Connectivity	High Data Throughput Customized I/O	Dense Compute Customize I/O
<2mm²	2-8mm²	25-40mm²	25-40mm² 50-80mm² 80-100mm²	25-100mm² 80-100mm²	??? mm²
<10uW	<10mW	10's of mW	100's of mW	1-6W <10W	????W

Scalable architecture and hundreds of ARM partners

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Little Data to Big Data as a Workflow Problem

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Big Science Starts With Little Data Too

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IoT as a Platform

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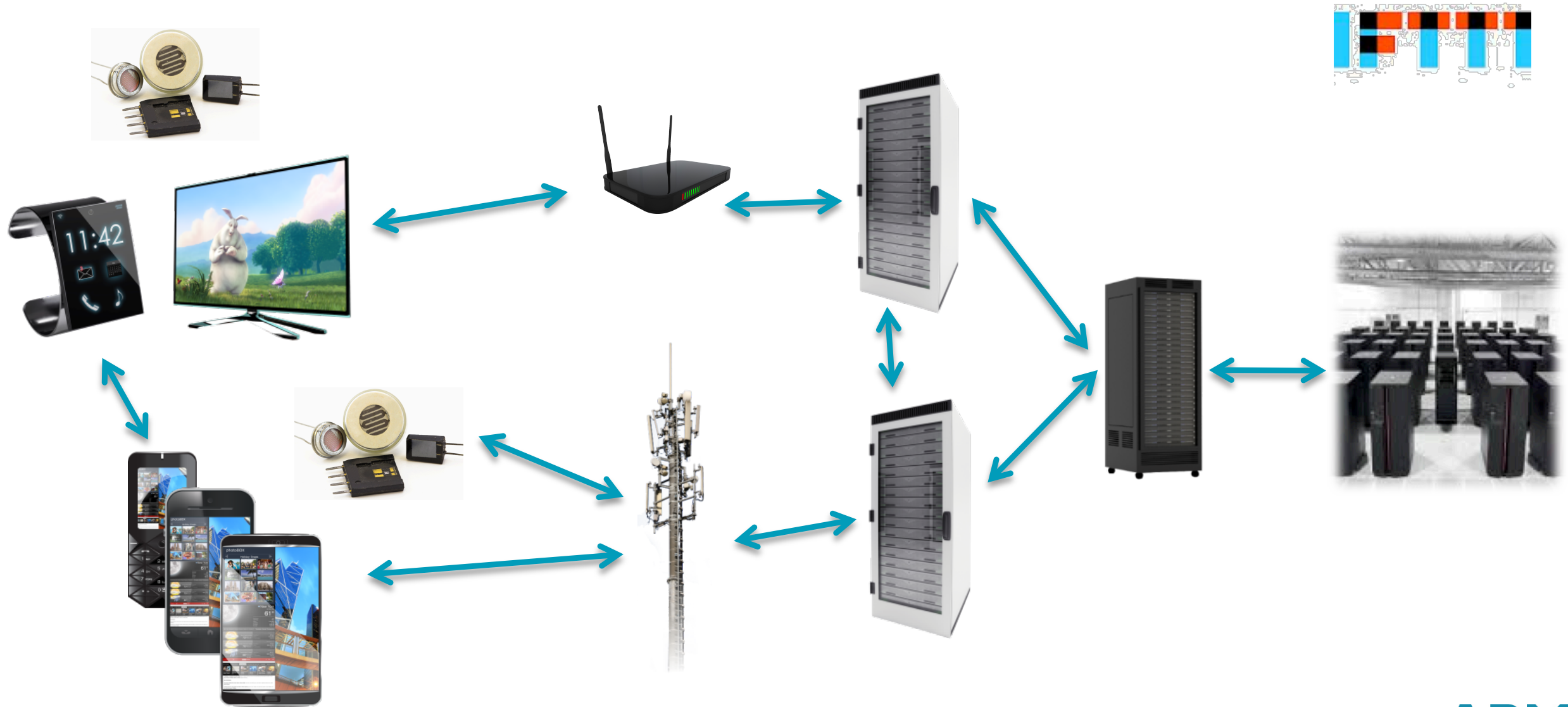
Challenges

- Trust
  - Trust today, trust for the future
- Security
  - Secure who can place agents on your devices and when
- Integrity
  - Trust that IoT 'apps' won't brick devices
- Incentive
  - Why do I want to allow others to run on my infrastructure?
- Productivity
  - How do we unlock the distributed systems model (and get it right this time)
  - What is the model for making this available to the consumer to aggregate and process their own little data?

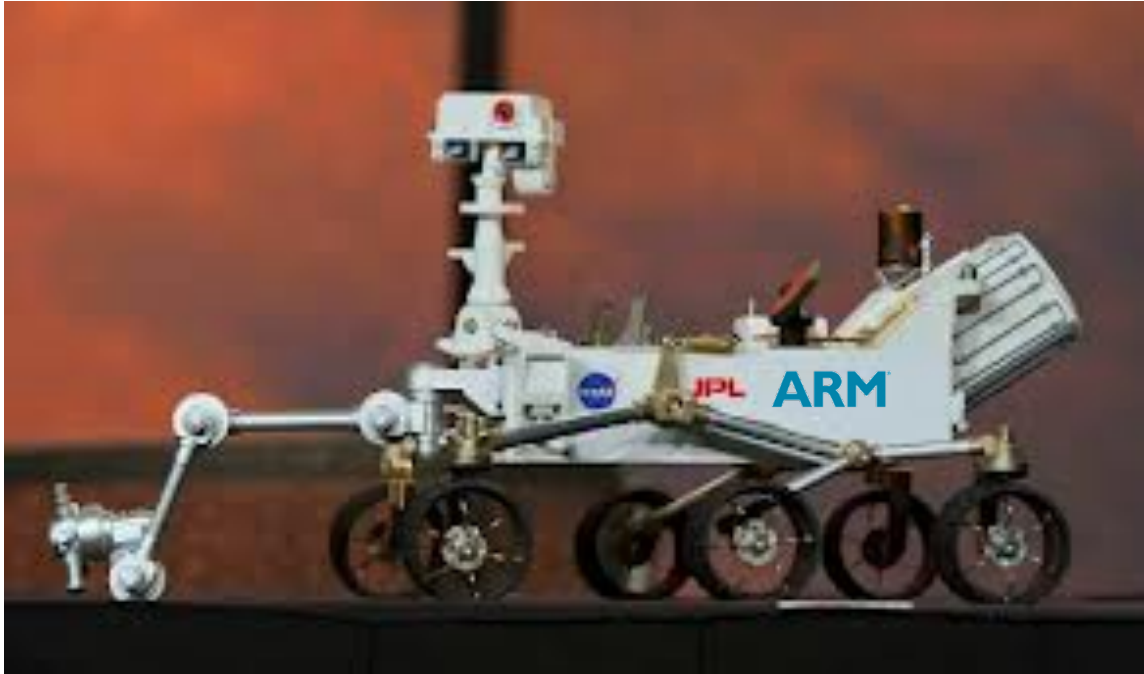The Architecture for the Digital World® **ARM**®
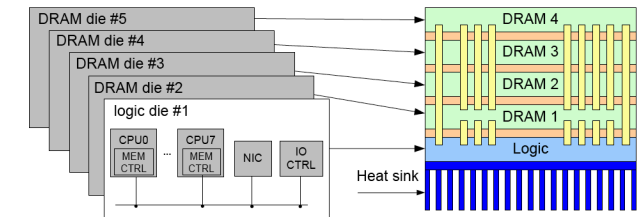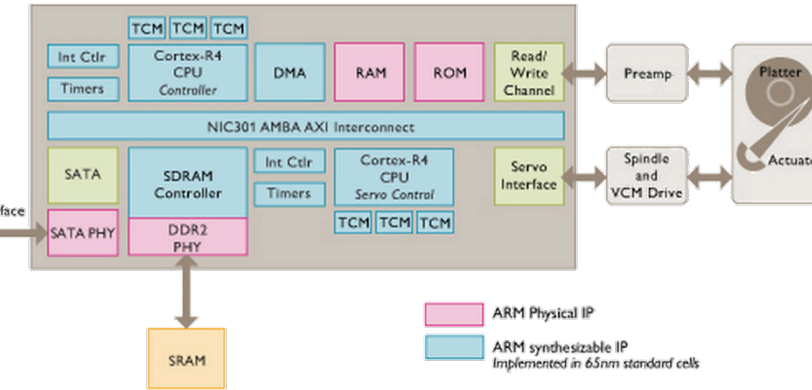
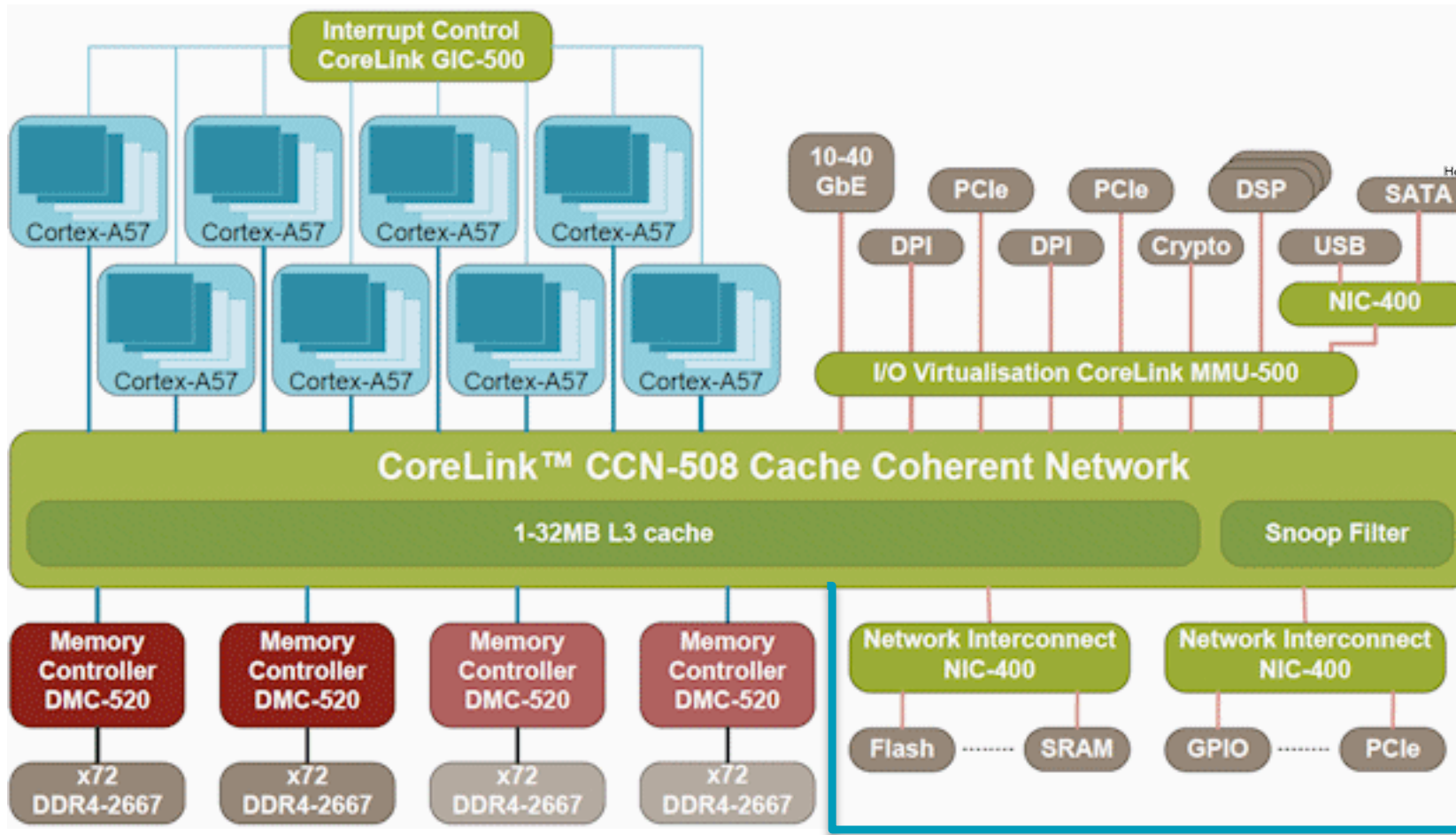# Non-blocking Event-Driven Execution Model
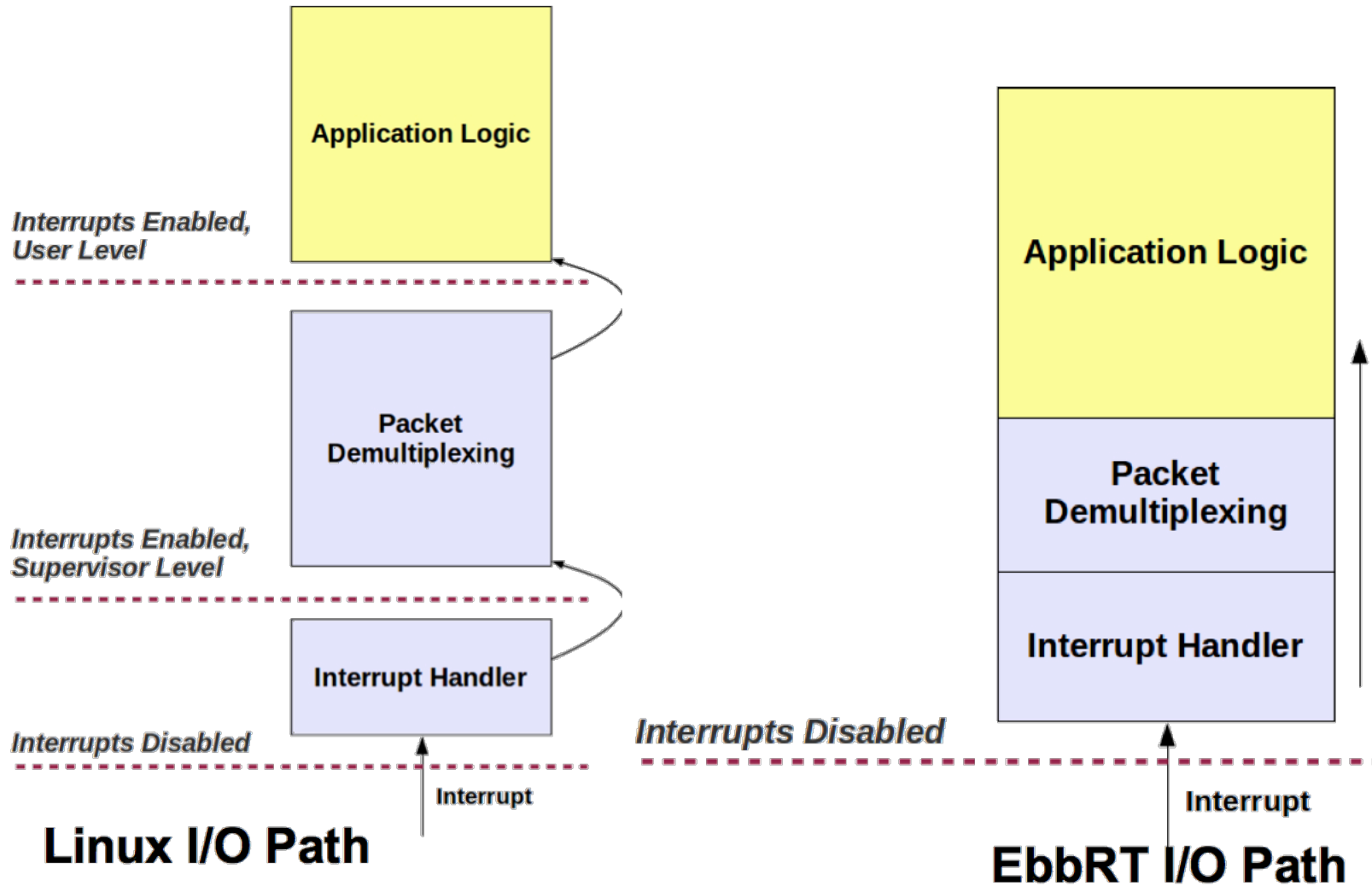
- Avoids costly context switches on I/O path

- Improves communication latencies for high-speed networks

- Directly map h/w interrupt to function call

* D. Schatzberg, J. Appavoo, et.al. Boston University

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NGSP & PERFECT

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Peripheral Intelligence

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Big Data Starts with Little Data

Internet of Things

Scale   Needs Standards
Sharing   Needs Trust
Trust   Needs Security

The future

Open Data and Objects

Smart Everything

Sensors & Actuators Networks

Reach

Applications
Mobile internet
Internet / broadband
M2M
SaaS
Fixed Telephony Networks   Mobile Telephony

Today

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Questions?

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