



How upcoming IoT trends will affect development and automation

Anton Semenchenko

About ☺



COMAQA.BY community activist, hardcore development community CoreHard.by, founder of DPI.Solutions, Manager at EPAM. More than 15 years of experience in IT, main specialization: automated testing, low-level development on C++ and lower, Management, Sales.

Agenda

- Business trends in mobile
- Business trends in internet of things
- Enumerating trends
- Main trends in QA
- Main “difficulties” in QA
- QA “difficulties” division by levels
- Main testing types
- Main tools for testing
- Conclusions about “that bright future”
- Sources of information
- What’s next
- List of potentially useful sources of information

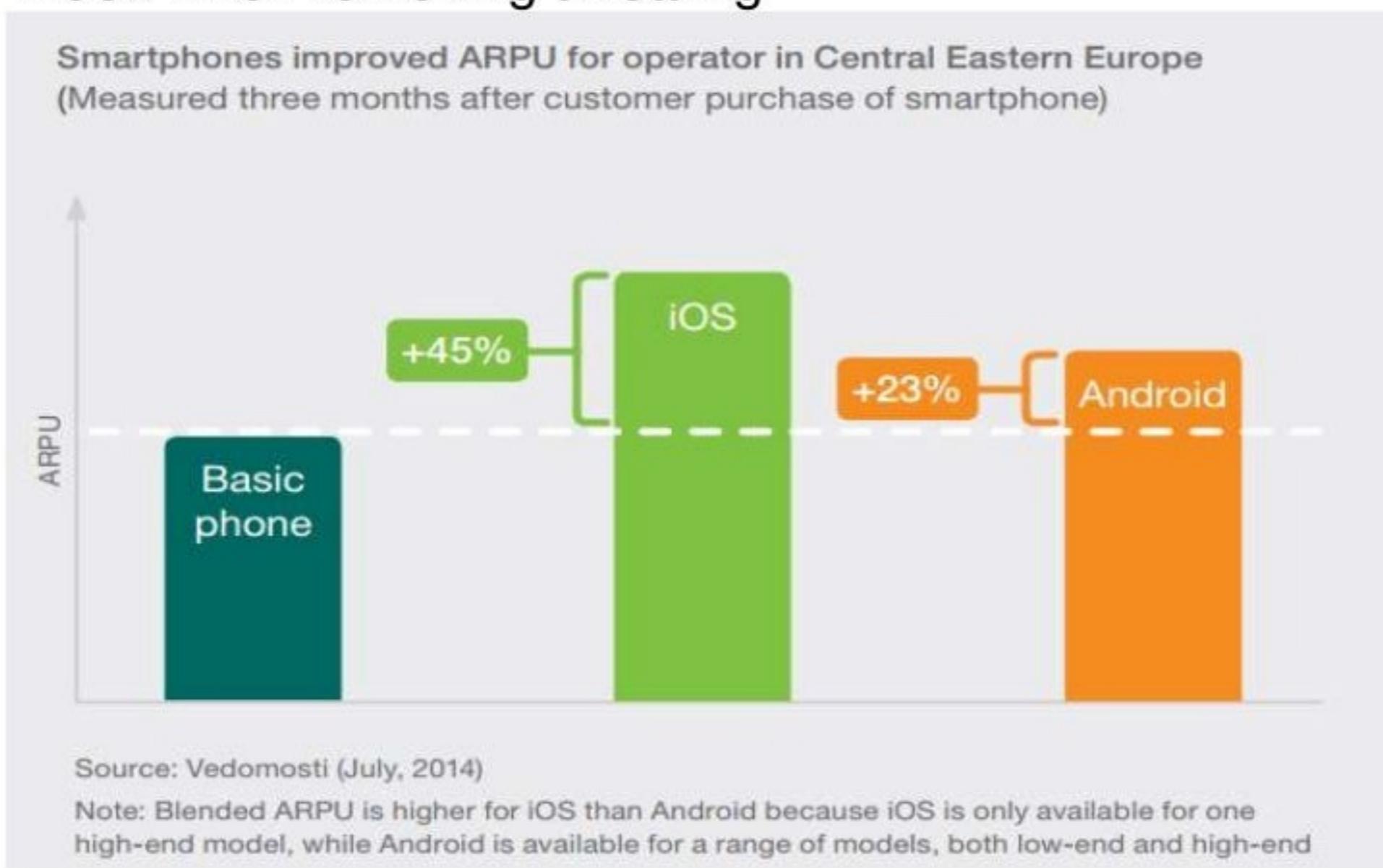


Business trends in mobile

- Phase 0
 - Migration to smartphones
 - Data-centric subscriptions
- Phase 1
 - Increasing data usage
 - Connecting more devices
- Phase 2 (2016)
 - Monetizing content, apps and services
 - Targeting adjacent industries
 - Two-sided business models
 - Opening up network capabilities
- Phase 3 (~2018)
 - IoT

Business trends in mobile - phase 0

- Migration to smartphones
- Data-centric subscriptions
 - One operator experienced 29 percent improvement in quality index when removing throttling

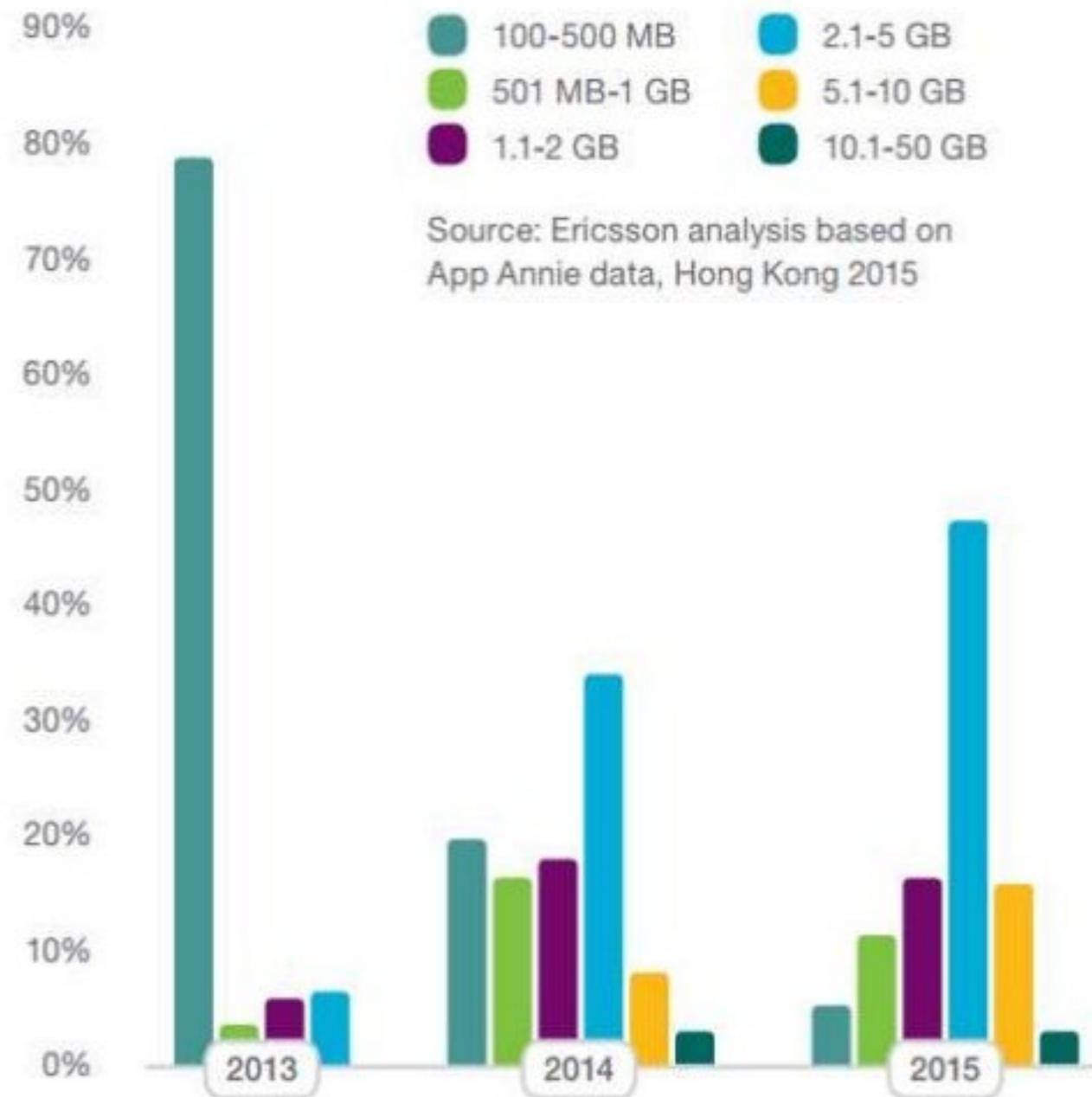


Phase 1 - increasing data usage

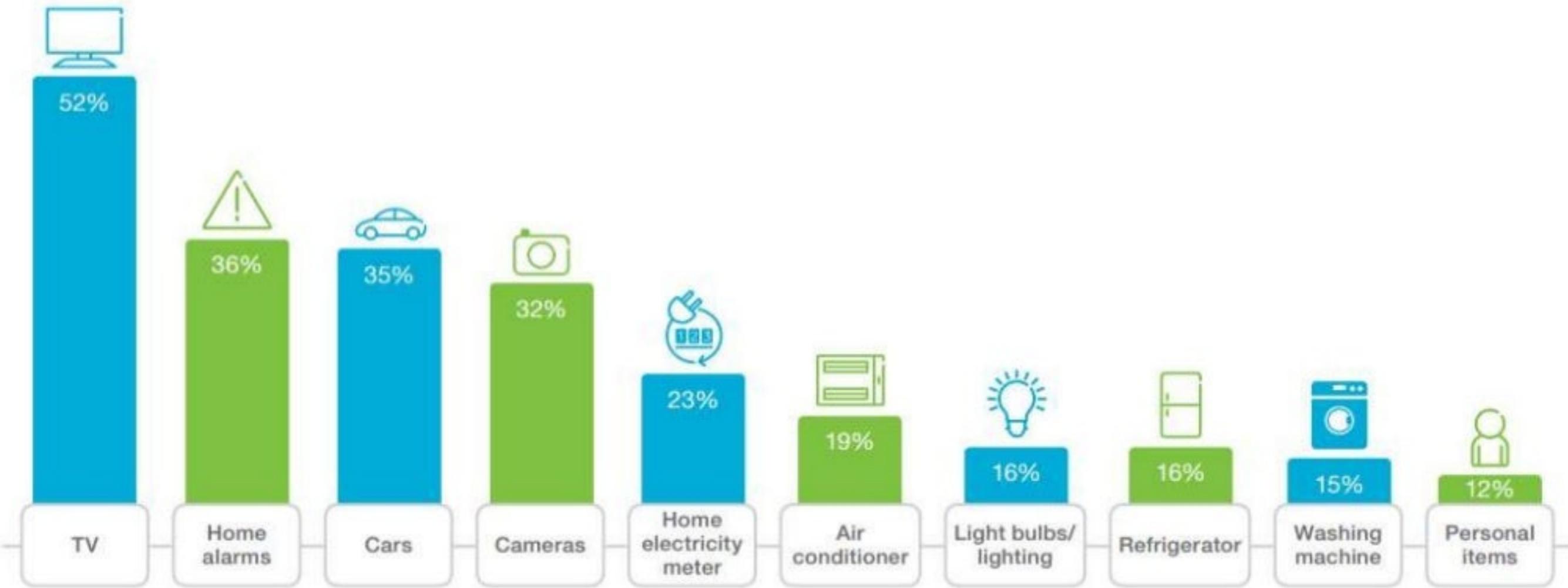
High speed networks increased average monthly data consumption and ARPU in South Korea



Most common data plan changed from 500 MB/month to 5 GB/month with LTE



Phase 1 - connecting more devices

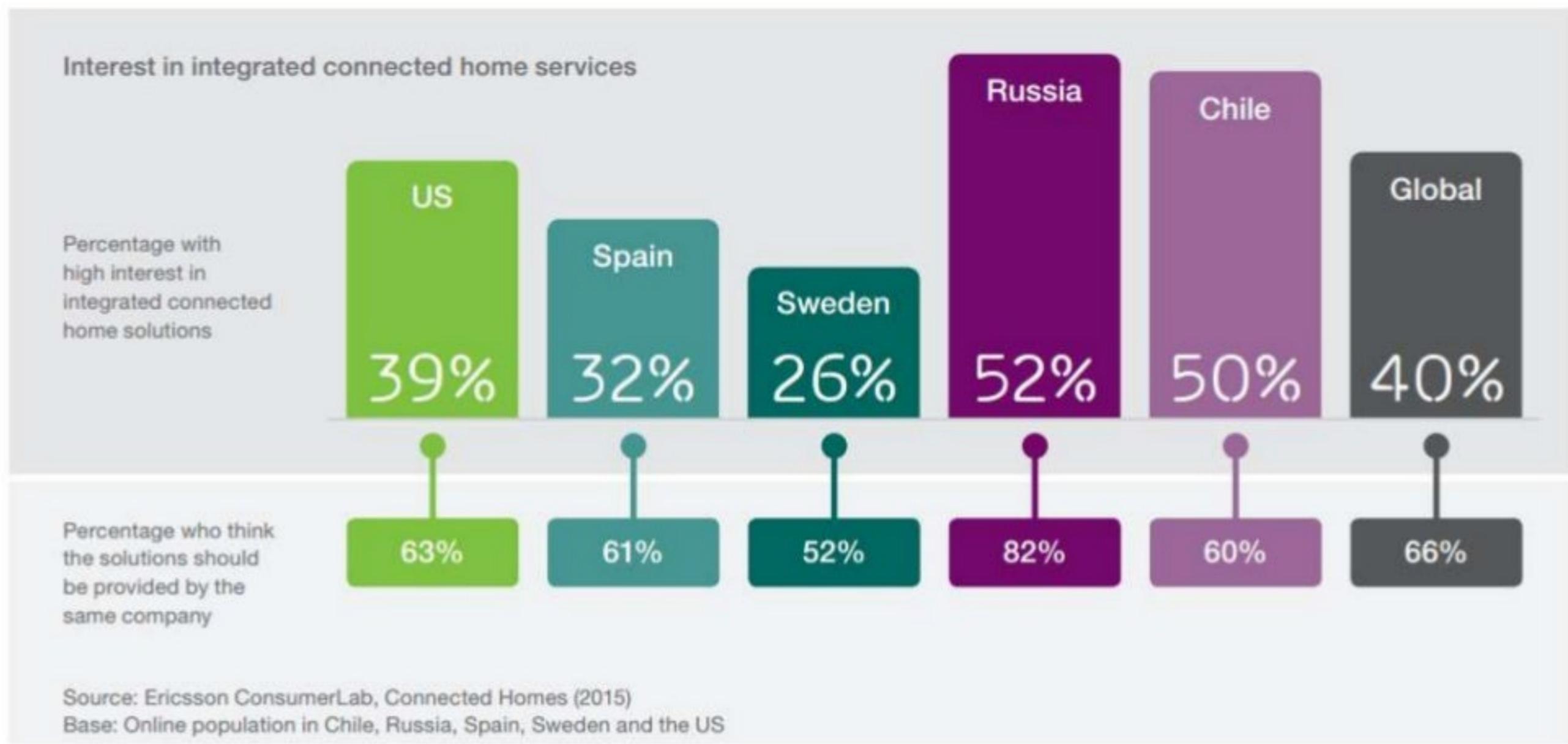


Source: Ericsson ConsumerLab Analytical Platform 2015

Base: Internet users in 24 countries

Phase 2 (2016)

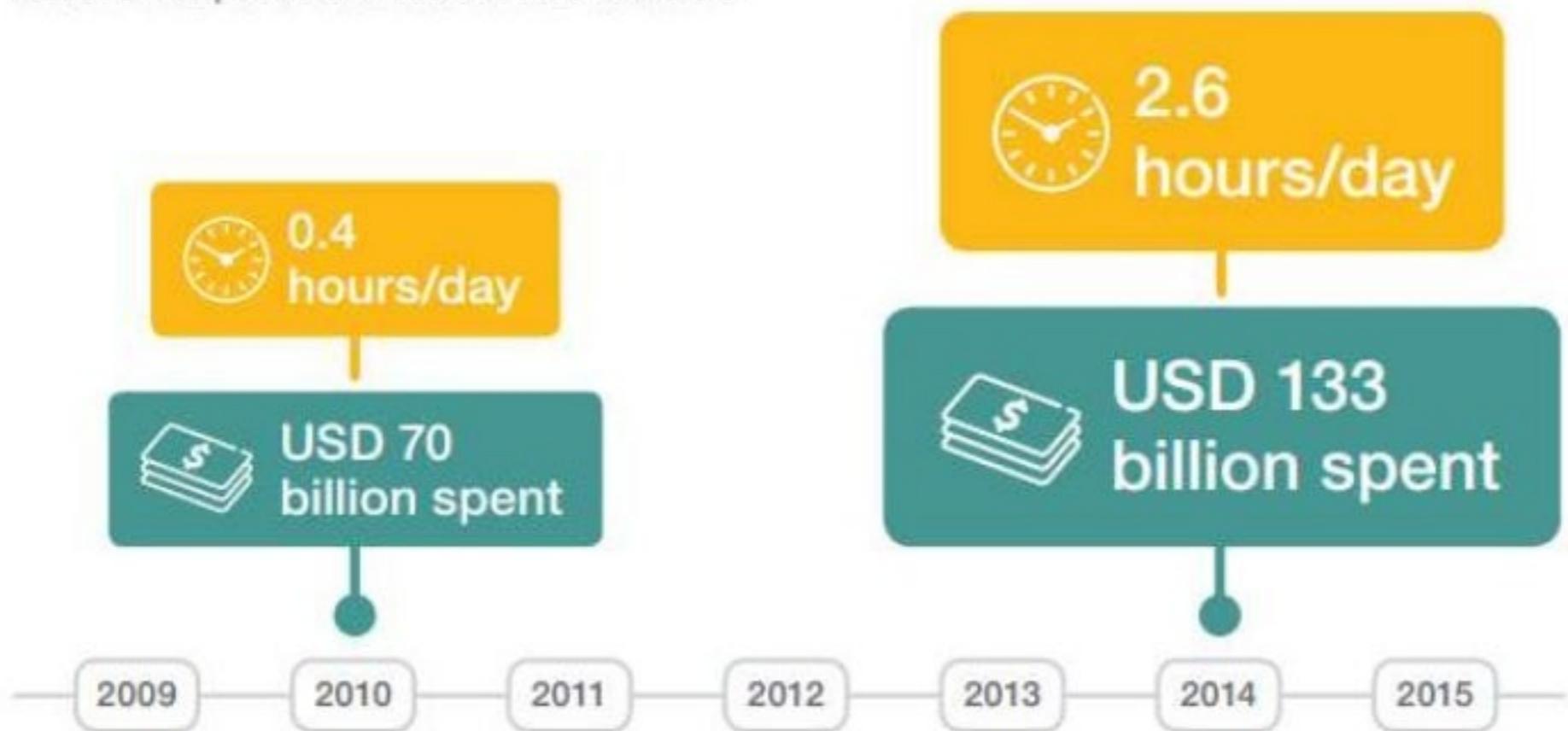
- Monetizing content, apps and services
- Targeting adjacent industries



Phase 2 (2016)

- Two-sided business models

Source: Ericsson analysis based on KPCB/eMarketer (April, 2015)
and PWC Global Entertainment & Media Outlook
Base: Smartphone and tablet users in the US

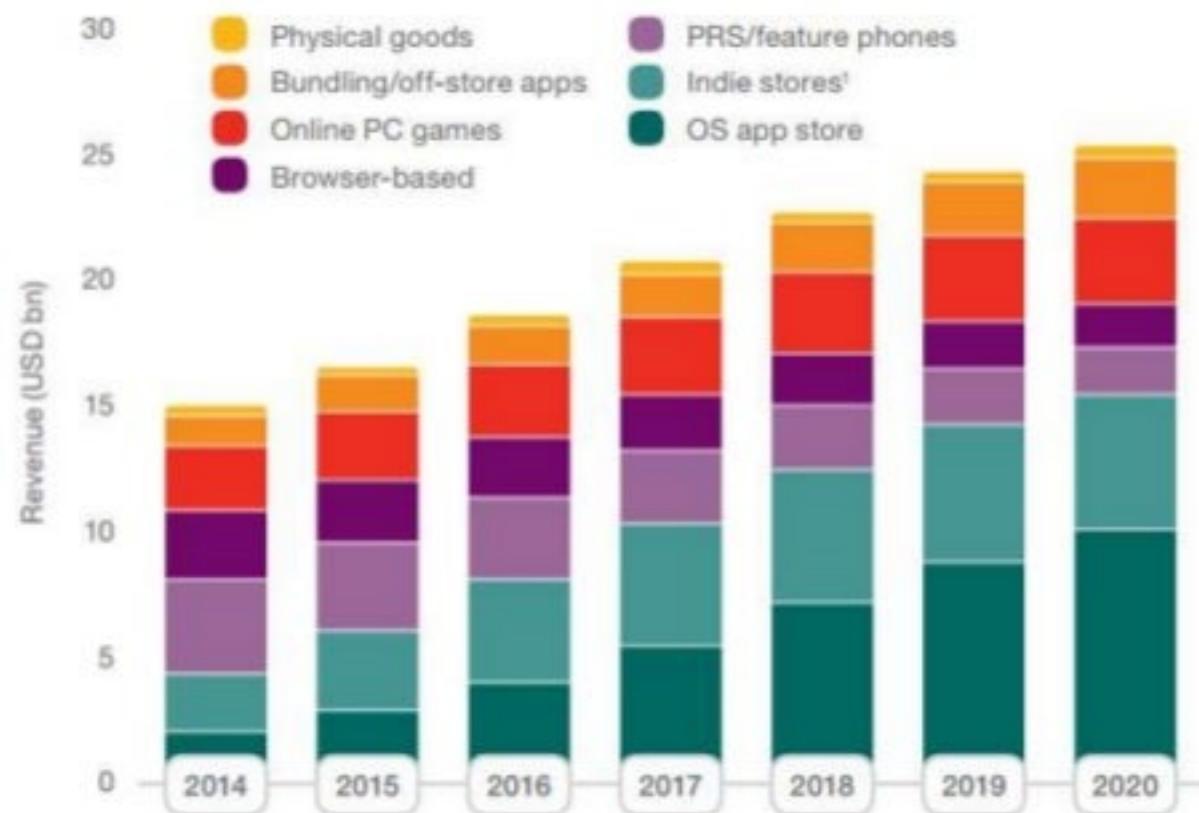


Increased time spent on smartphones and tablets has prompted significant growth in mobile advertising spend

Phase 2 (2016)

- Opening up network capabilities

Estimated total transactional value
of the global carrier billing market

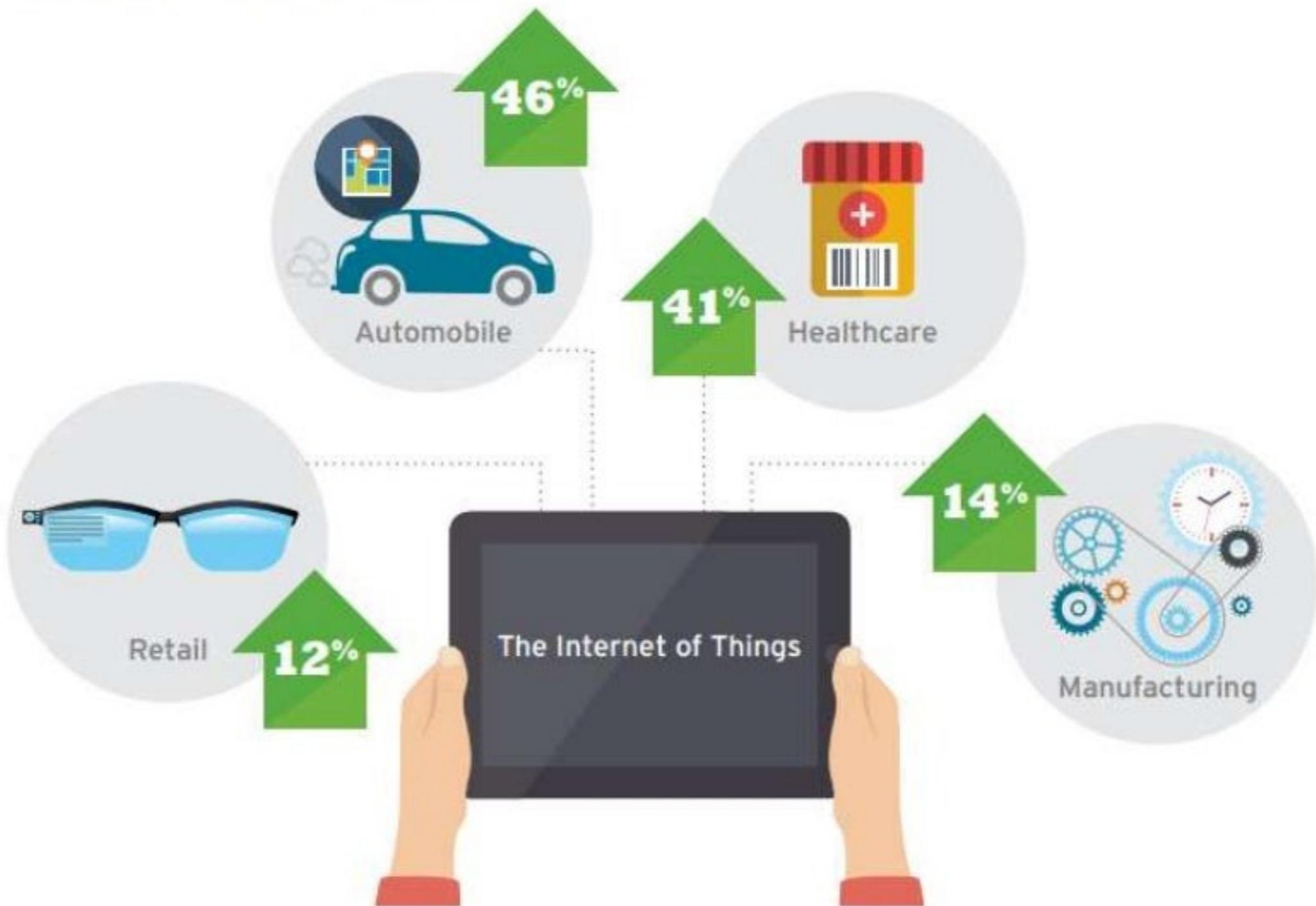


Source: OVUM Knowledge Center
Carrier Billing: Forecast Analysis, by segment, 2014-20



Phase 3 – IoT (2018 ☺)

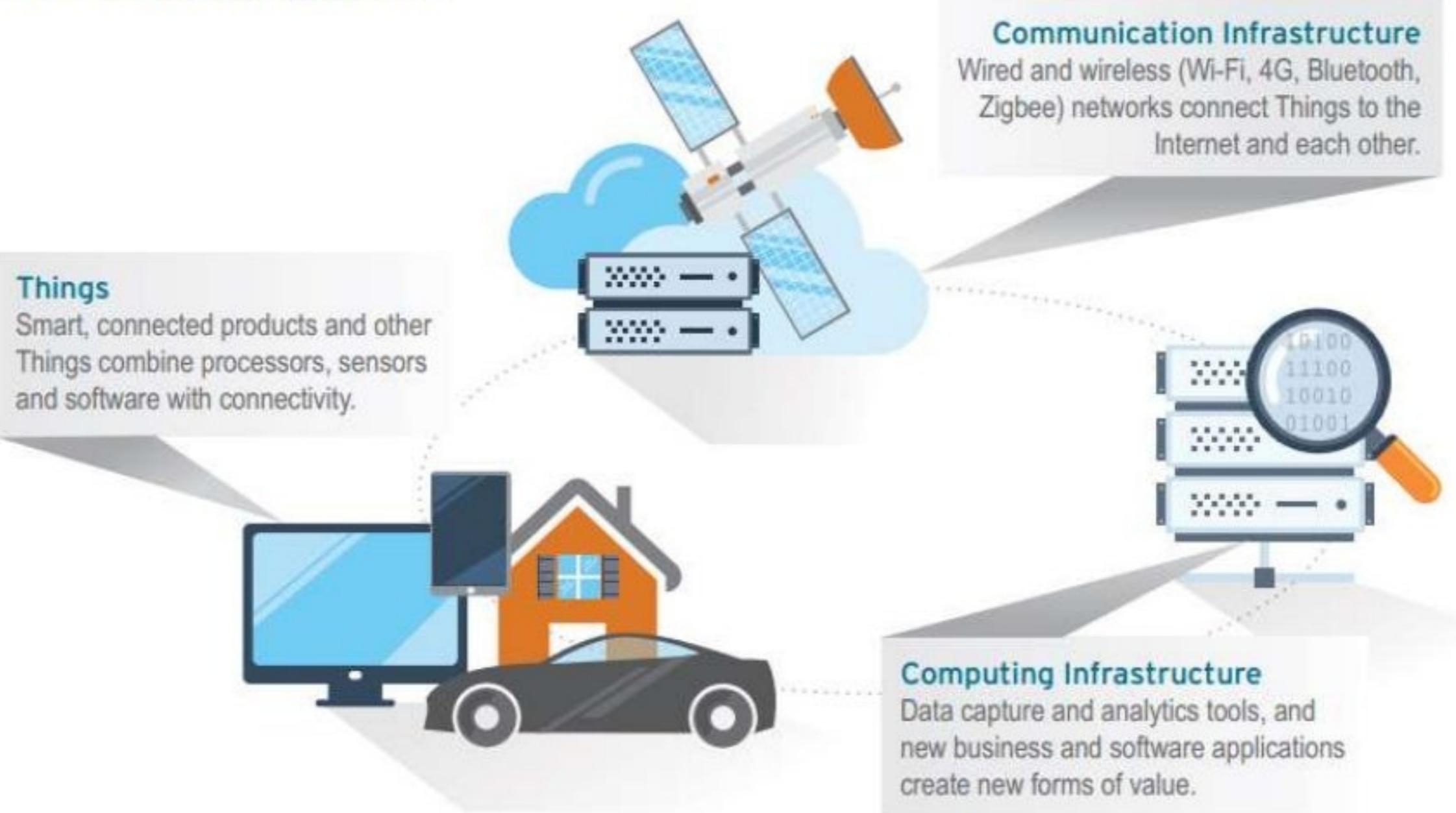
The Many Manifestations of IoT



IoT's key components

- Things
- Communication infrastructure
- Computing infrastructure

IoT's Key Components



IoT – a set of bright facts / prognoses

What's Your Projection for 2020?

Many companies have their own predictions on the number of objects to be connected to the internet in 2020.



Planetech USA likes Cisco's prediction the best!

<http://www.siemens.com/innovation/en/home/pictures-of-the-future/digitalization-and-software/internet-of-things-facts-and-forecasts.html>
<http://share.cisco.com/internet-of-things.html>

IoT – a set of bright facts / prognoses

According to IDTechEx

Here is the RFID's (Radio Frequency Identification) market total volume:

2013



7.77 Billion

2014



8.89 Billion

2024



27.31 Billion

*That's a lot
of dough!*

<http://www.siemens.com/innovation/en/home/pictures-of-the-future/digitalization-and-software/internet-of-things-facts-and-forecasts.html>

IoT – a set of bright facts / prognoses

Top 3 Industries to Profit the Most From IoT

Gartner Prediction



- » Manufacturing
- » Healthcare
- » Insurance

According to a new report from MarketResearch.com, the healthcare Internet of Things market segment is poised to hit \$117 billion by 2020. <http://iotworm.com/internet-of-things-healthcare-devices/>

<http://www.siemens.com/innovation/en/home/pictures-of-the-future/digitalization-and-software/internet-of-things-facts-and-forecasts.html>

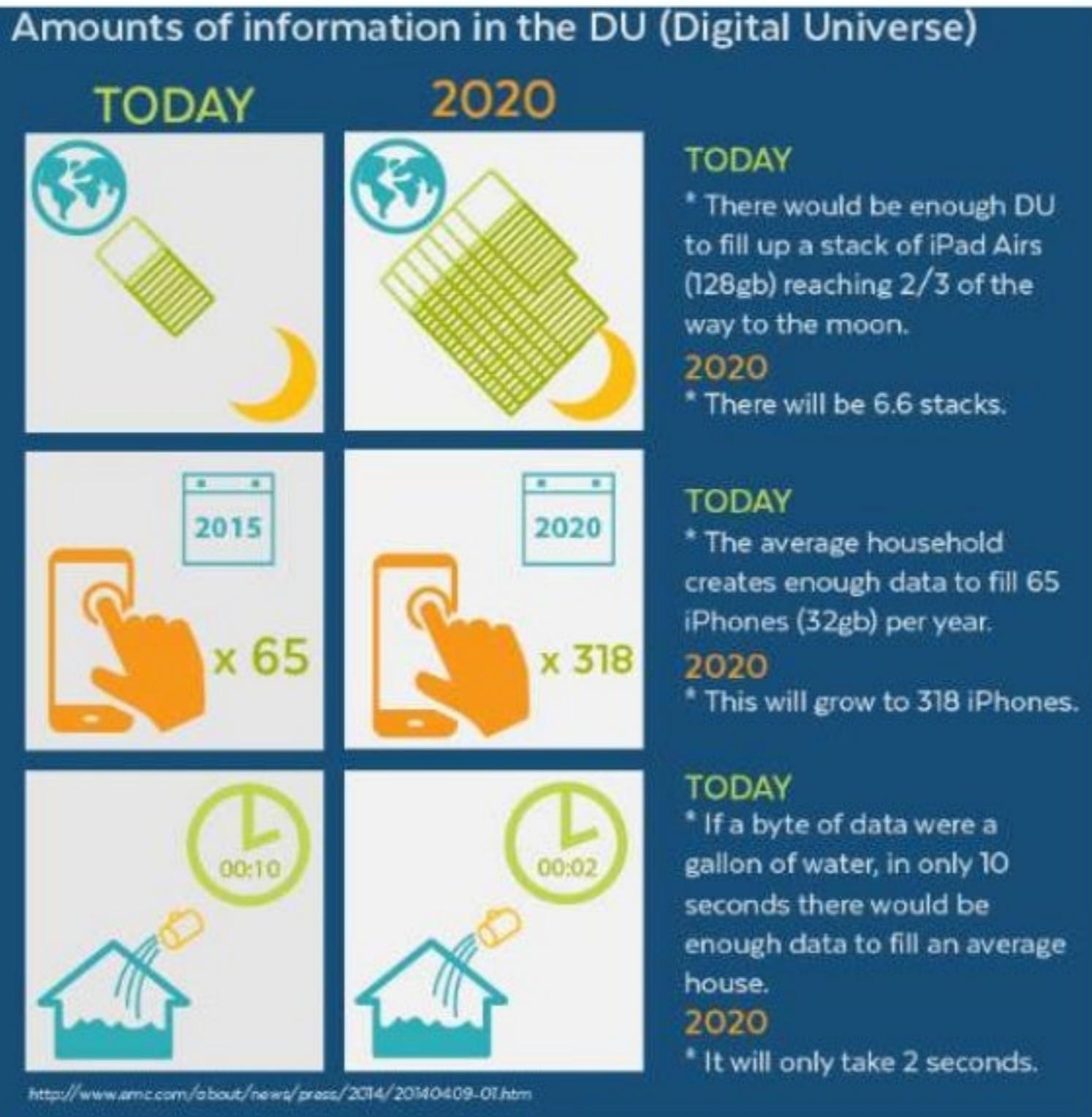
IoT – a set of bright facts / prognoses

Exploring the IoT



<http://www.baselinemag.com/innovation/slideshows/fascinating-facts-about-the-intemet-of-things.html>

IoT – a set of bright facts / prognoses



IoT – a set of bright facts / prognoses (citations from reports)

- “The IoT installed base will grow to **26 billion units by 2020**”
- “IoT product and service suppliers will **generate incremental revenue exceeding \$300 billion**, mostly in services, in 2020.”
- “IoT will result in **\$1.9 trillion in global economic value-add** through sales into diverse end markets.”

IoT – a set of bright facts (citations from reports)

- By **2018**, it is forecast that **36M connected cars will be on the road**, and by **2025 every new car** will be connected to the Internet in a variety ways.“
- "The explosion of connected appliances and smart home solutions has created a dynamic environment filled with many opportunities and risks for object makers and IoT service providers. Gartner predicts that the **average family home will contain more than 500 connected devices by 2022.**"
- "**Industries have a large number of connected machines** generating huge volumes and variety of sensor data. Something as seemingly small as a 1% change in pump performance can have an immediate impact on the global oil supply.“

IoT – a set of bright facts (citations from reports)

- Despite the harsh growing conditions – water shortages, a limited availability of land and increasing costs – the **agriculture industry must increase food production by 70% by the year 2050.**
- “Emerging IoT solutions are increasing the quality, quantity, sustainability and cost effectiveness of agricultural production. Sensors allow producers to remotely monitor and control soil moisture, crop growth and livestock activities (feed levels, health scoring, etc). **IoT analytics analyze and augment data in real-time to empower producers with data-driven business insights.**”
- “**IoT to generate 400 zettabytes of data by 2018 (Cisco)**”

IoT \ Mobile - QA general trends

- Devices, sensors and applications form the ecosystem
- Shift of testing of applications in a defined environment to testing the experience in a dynamic environment
- *Very robust QA validation process*
- *Not trivial application intelligence*
- *The use cases could be extremely complex in real time*
- *The variety of real-time scenarios can become a challenge for QA*
- Device's real-time complexity



IoT \ Mobile - QA main general challenges

- Validation of real-time env
- Big Data or even “Huge” Data 😊



10 of the biggest IoT data generators

- Air travel
 - Boeing 787 aircraft could generate 40 TBs per hour of flight
- Mining
 - mining operations can generate up to 2.4TBs of data every minute
 - IoT system on “Rio Tinto” mining trucks (savings summing up to \$300 million)
- Cars
 - according to “Machina Research”, data generated by smart cars could crash mobile networks with data surges by 2024.
 - connected vehicles are expected to total 2.3 billion, which will increase data traffic up to 97% during rush hour traffic at some cell points

10 of the biggest IoT data generators

- Utilities
 - “SAP” estimates that the worldwide revenue opportunity presented by the IoT for the utilities industry by 2018 is \$201 billion. Smart meters are just an example.
 - by the end of 2014 there were a total of 20.8 million gas meters and 25.3 million electricity meters operated by the larger energy suppliers in British domestic properties
 - Smart meters collect data on how much energy is being used every 30 minutes, 24/7, 365. This sends to the cloud several TBs of information every year.

10 of the biggest IoT data generators

- Cities
 - Westminster City Council has installed solar-powered bins that can communicate with council workers and tell them how full they are. The system uses telemetry and infrared sensors, and led to a 60% reduction in bins collection.
- Wearables
 - “Cisco” estimates that by 2019 more than 578 million wearables will be in use around the world. These solutions are constantly collecting data on health, fitness and wellness.
 - in less than 3 years time mobile data traffic will reach 292 EBs per year (~ 10 times)
- Sports
 - as sports adopt more wearables and intelligent clothing to improve performances, clubs are also looking at new ways to read the field and polish tactics using predictive analysis
 - create a database that records every single move players execute, players' stats, and so on

10 of the biggest IoT data generators

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10 of the biggest IoT data generators

- Logistics
 - Most of this data will be [RFID](#), giving logistic companies the ability to analyse it in real time and tackle any eventual problems that might happen in the chain.
- Healthcare
 - The health sector will see huge benefits from IoT, with sensors being deployed across all areas in a medical unit.
- Smart homes
 - “Splunk” predicted that one smart connected home today can produce as much as 1GB of information a week. Times that by all the UK households and that is over 26 million GBs of data every week.

Examples

- real-time analytics for stock exchange
- controllers programming
- user experience (shopping)
- iBeacon and co
- sports
- and others

example

Data centers infrastructure diversity

- **Big data centers:** Also known as “motherships,” they will act as repositories of applications and data.
- **Distribution data centers:** Large regional hubs, they will move data from the motherships down to a retail-oriented level.
- **Micro data centers:** Comprising one or two racks, they will be located close to population centers so they can receive and transmit data to IoT sensors instantly.



Examples

- a set of data-protection (backup\restore) solutions

example

IoT - QA challenges by layers

- **The device interaction layer**
 - Conformance with standards
 - Interoperability
 - Security
- **The user interaction layer**
 - Network capability and device level tests
 - Usability and user experience
- **Services \ back-end with a tricky env**
 - Exhaustive White Box testing



IoT – main types of testing

- QA Automation
- White-box testing
- Performance testing
- Security testing
- Compatibility testing
- Exploratory testing



IoT – QA and co tools

- IoT platforms (Cloud based)
- Protocol simulators
- Data recorders
- Data generators
- Mockup frameworks
- Performance profilers
- Security testing tools
- Tools for visual QA Automation
- Tools for complicated visualization Automation
- Focus on white box testing tools
- Virtualization
- Cloud
- And many others
- **Special tools for IoT QA ☺**



IoT – QA and co tools

- <http://mnubo.com/>
- <http://buglabs.net/products/swarm>
- <https://www.iobridge.com/>
- <http://go.sap.com/solution/internet-of-things.html>
- <http://www.friendly-tech.com/products>
- <https://exosite.com/>



IoT – QA and co tools

- <http://open.sen.se/>
- <http://www.thingworx.com/>
- <http://www.arrayent.com/>
- <http://www.sine-wave.com/platform>
- <https://www/aylanetworks.com/products/iot-platform>
- <http://www.echelon.com/izot-platform>



IoT – QA and co tools

- <https://evrythng.com/>
-
- <https://exosite.com/>
-
- <https://xively.com/>
-
- <https://www.carriots.com/>
-
- <http://www.marvell.com/solutions/internet-of-things/>
- **Plus dozens and dozens and dozens of platforms**



IoT platforms – tech details

For example:

- <https://thingspeak.com/>
- https://thingspeak.com/pages/how_to
- C, Python, Matlab

Very popular solutions:

- plus Rest API
- sometimes plus CLI “API”



Protocol simulators

General information:

- https://en.wikipedia.org/wiki/Network_simulation

ns (free):

- Release - March 24, 2016
- C++ and Python
 - [https://en.wikipedia.org/wiki/Ns_\(simulator\)](https://en.wikipedia.org/wiki/Ns_(simulator))
 - <https://www.nsnam.org/documentation/>
 - <https://www.nsnam.org/docs/release/3.25/tutorial/ns-3-tutorial.pdf>

Protocol simulators

Riverbed / OpenNet (proprietary):

- A family of products
- Release – up to date
- Rest / Python API
- <http://www.riverbed.com/gb/products/steelcentral/opnet.html?redirect=opnet> - family of tools
- <http://www.riverbed.com/gb/training/technical-training/online-training.html> - all trainings are 5 day long
- <https://support.riverbed.com/apis/steelscript/> - Python scripting
- <https://support.riverbed.com/apis/index.html> - Rest API scripting

NetSim (proprietary):

- Release - 1 March, 2016
- C and CLI
- <https://en.wikipedia.org/wiki/NetSim> - general information
- <http://tetcos.com/blog/> - scripting

Data recorders

For example:

<http://www.dataloggerinc.com/> - data logger (hardware + software, specific for the domain)



Data generators

- [General information](#)
- [A list of data generators](#)
- [A list of DB data generators](#)
- [Tool example](#)



Performance profilers

Tools:

- Specific for IoT:
 - <https://smartbear.com/solutions/internet-of-things/>
 - <http://www.applause.com/internet-of-things>
- Specific for exact IoT platform tools (as a part of platform)
- General purpose performance profiling tools



Security testing tools

Security areas:

- Insecure Web Interface
- Insufficient Authentication/Authorization
- Insecure Network Services
- Lack of Transport Encryption
- Privacy Concerns
- Insecure Cloud Interface
- Insecure Mobile Interface
- Insufficient Security Configurability
- Insecure Software/Firmware
- Poor Physical Security

Security testing tools

Tools:

- Specific for IoT tools
 - <https://www.praetorian.com/internet-of-things>
- Specific for exact IoT platform tools (as a part of platform)
- General purpose security testing tools



Tools for visual QA Automation

[Applitools Eyes](#) (proprietary, you can try to play with a trial version)



Cloud service



Easy integration



Intuitive reports

[Galen Framework](#) (free)



Tools for complicated visualization Automation

www.COMAQA.by ☺



Focus on white box testing tools, Mockup frameworks

It depends on technology stack



Virtualization

- MS Hyper-V
- VMware family
- And dozens of others



IoT - Cloud

- <https://azure.microsoft.com/en-us/solutions/iot-suite/>
- <https://aws.amazon.com/iot/>
- <http://www.sensorcloud.com/>
- <http://www.ptc.com/axeda>
- <http://www.digi.com/>
- <http://www.zatar.com/>
- **Plus dozens and dozens and dozens of Clouds**



IoT – other tools

Just an example:

- <http://www.openremote.com/> - an open-source middleware solution for the IoT.
- **OpenRemote** allows you to integrate any device — regardless of brand or protocol — and design any user interface for iOS, Android or web browsers



Special tools for IoT QA

Just examples (good or not so good ☺):

- <https://smartbear.com/solutions/internet-of-things/>
- <http://www.applause.com/internet-of-things>



Today's or even yesterday's “challenges”

- Video streaming
- Audio streaming
- Visual QA Automation
- And many others



IoT – “special cases” \ challenges

- **Different equipment \ technics simulators**
 - Aviation
 - Manipulating hard-technics (tractor and company)
 - Military manufacture
 - Number and quality of military aviation simulators, is one of the most significant rating parameters of army's possibilities
- Challenge: **How to prove \ test behavioral identity and usability of simulator and real device?**



IoT – “special cases” \ challenges

- Virtual Reality
 - Visual
 - Challenge: **How to test the whole world?**
 - Challenge: **Tactile feelings** – Virtual Reality gloves
 - What's next...?
 - Ideal final result – fully automated system, “Matrix” in fact, dropper, Virtual Reality Engine and plug into her brains.
- Challenge: **How to test smells?**
- Challenge: **How to test taste?**
- Challenge: **How to test tactile feelings all over the body?**



Conclusions 2016

- Complex domain
- Completely new bunch of fields, testing approaches.
Serious technical background for successful career – is a bare necessity for QA specialist.
- Exponential growth of number of “support” tools during the whole IoT project lifecycle
- Lack of standard approaches



“Scientific” technical prove of conclusions

- Hegel's dialectics
- Bifurcation mathematical apparatus (Bifurcation Theory)
- Sedov's law of hierarchical compensation
- Pannov-Snuks Vertical
- Big History



Why so?

Non-technical scientific prove of conclusions

- Peter Drucker “Management. Challenges for the 21st Century”

Note: It's a topic of the whole big conversation, and I'm sure we're going to get back to it, but not today...



“Sources” of information

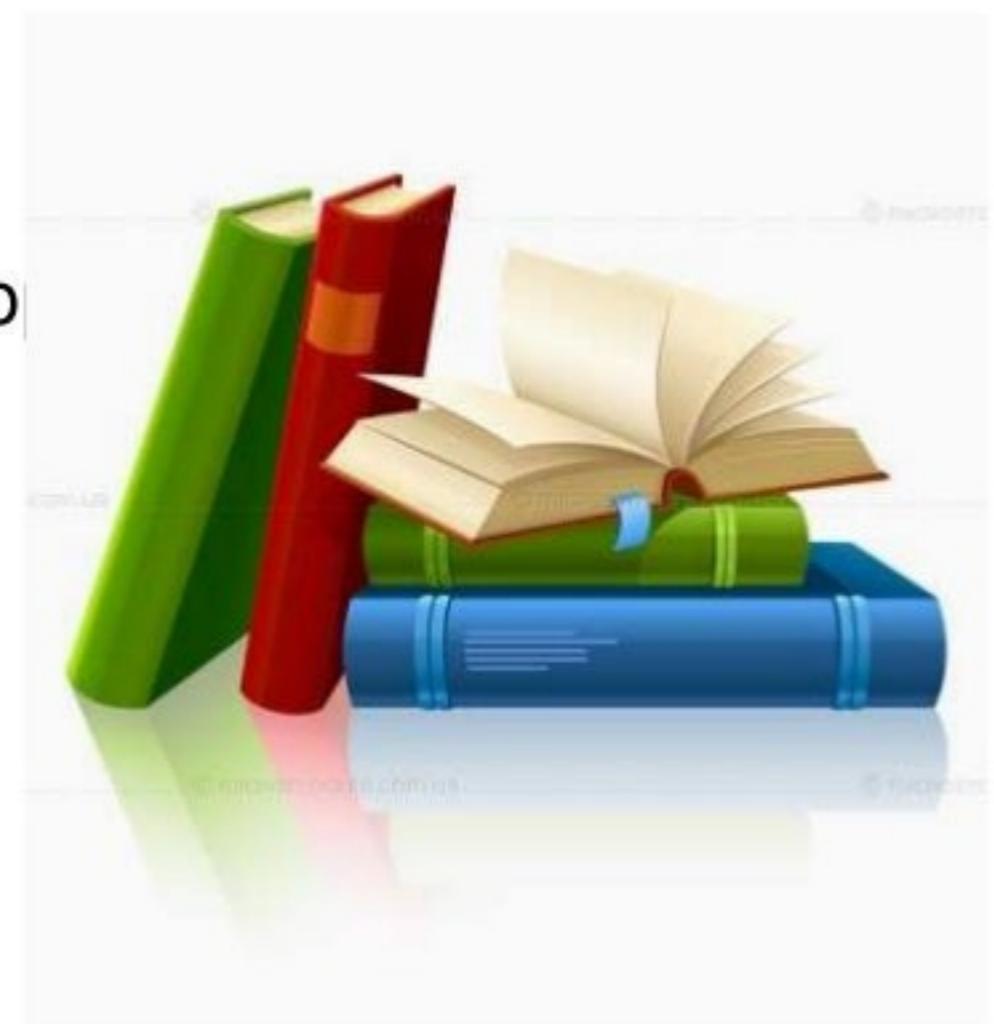
- Experience
 - Controllers programming (Assembler first of all)
 - Real-time analytics for stock exchange
 - IoT development consulting (just several projects)
 - IoT testing consulting (just several projects)
- Mobile business trends

...



“Sources” of information

- [The Internet of Things: QA Unleashed](#)
- [Internet of Things will require data centers of all sizes](#)
- [IoT – list of platforms](#)
- [Codefest conference](#) (most of topics – RU only)
 - IoT
 - Virtual Reality
 - Robot programming
 - Visual Testing Automation
- [NaStachku conference](#) (most of to
 - IoT
 - Software-testing.ru “forum”
 - COMAQA.by “forum”
- ...



What's next?

Automation is a trend. Mobile development – is a trend too. IoT – as the evolution of Mobile development – is trend of trends. We're trying to predict what testing is going to be like, first of all as automation engineers in 2018. I don't know to what extent do we need to put the word trend for illustration complexity-actuality of the task. I hope I showed you the **necessity of monitoring trends market for updating IT/QA coordinate system.**

...



What's next?

- The most important, in my opinion, is not to advise the listeners to learn this or that exact tool or approach that is going to be on demand tomorrow, but **show and prove the necessity of serious technical background for successful career in future**, at least in the areas of the most fast-growing IT branch.
- To prove to the listeners, the **necessity of systematical renewing and updating their technical background**.

...



“Mobile” trends

- [Mobile business trends](#)
- [The Internet of Things: QA Unleashed](#)
- [IoT – list of platforms](#)
- [Internet of Things will require data centers of all sizes](#)
- [10 of the biggest IoT data generators](#)
- [The stress of streaming delays](#)
- [Social networking traffic](#)
- [All the worlds a screen](#)
- [Advanced Visual Testing with Selenium](#)

...



Что бы понимать «почему.?»

- Универсальная история
- Акоп Назаретян. Цивилизационные кризисы в контексте Универсальной истории
- Евгений Седов. Информационно-энтропийные свойства социальных систем
- Вертикаль Панова-Снукса



Что бы понимать «почему.?»

- Питер Друкер. Менеджмент. Вызовы XXI века
- Виген Геодакян. Эволюционная теория пола
- Франс де Вааль. Политика у шимпанзе. Власть и секс у приматов
- Михаил Веллер. Испытатели счастья
- Герберт Спенсер. Основные начала



Что бы понимать «почему.?»

- Конференция Global Future 2045
- GF2045. Акоп Назаретян. Проблема середины XXI века
- GF2045. Михаил Веллер. Человек в системе энергоэволюционизма
- GF2045. Александр Панов. Сингularity эволюции и будущее фундаментальной науки



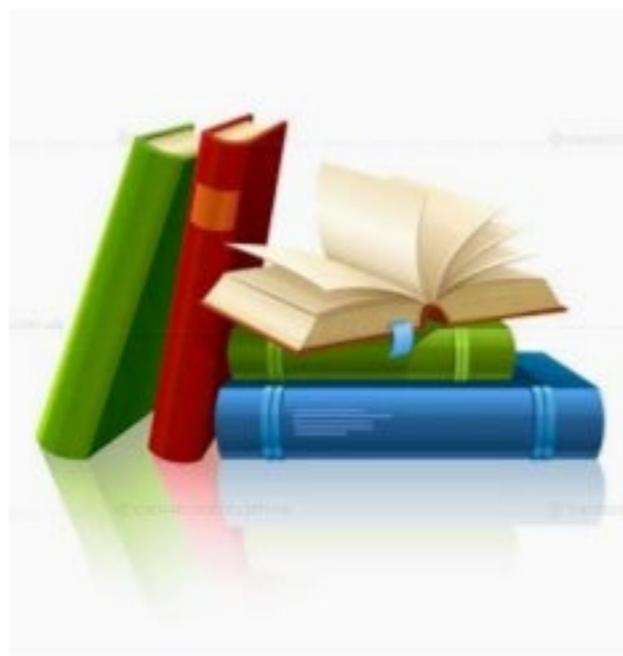
IT overview

- **Фредерик Брукс «Мифический человеко-месяц или Как создаются программные системы»**

Notes: «Мировоззренческая» книга ... очень легко читается, около художественная литература ... рекомендую прочитать дважды.

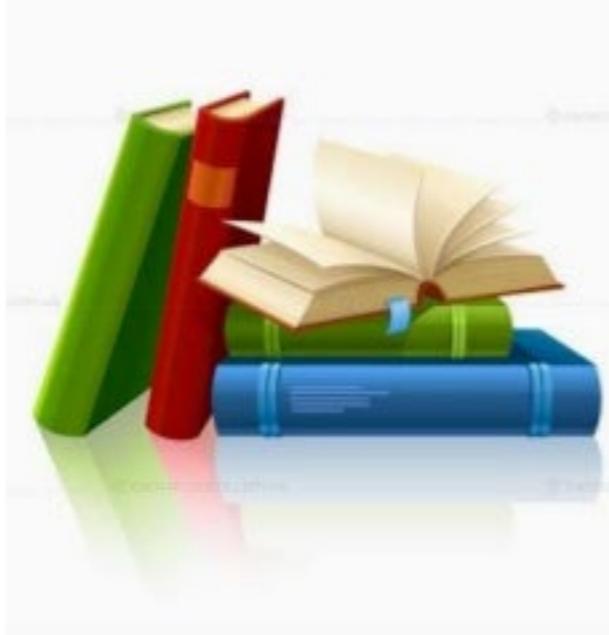
- Том де Марко «**Peopleware: Productive Projects and Teams.**»

Notes: «Мировоззренческая» книга ... очень легко читается, около художественная литература ... рекомендую прочитать дважды.



IT overview

- Том де Марко «The Deadline: A Novel About Project Management»
Notes: «Мировоззренческая» книга ... очень легко читается, около художественная литература ... рекомендую прочитать дважды.
- Кент Бек «Экстремальное программирование. Разработка через тестирование»
Notes: IMHO Легкая для прочтения, концептуально целостная книга, с полезными примерами



Tech overview

- Гради Буч «**Объектно Ориентированный Анализ и проектирование** с примерами приложений на С++»
Notes: Не стоит пугаться примеров на С++, 95% материала концептуального, не зависящего от конкретного языка программирования.
На мой взгляд это одна из лучших книг для настоящего, а не шапочного, знакомства с ООП.
- Стив Макконнелл «**Совершенный код**»
Notes: Не стоит бояться размера книги ... ее стоит или читать перед сном с любого места ... или выборочные главы, что бы освежить свои знания в конкретной проблемной области.



Tech overview

- Мартин Фаулер «Рефакторинг»

Notes: IMHO категорически рекомендую прочитать от корки до корки, 2 раза подряд, что бы содержание книги стало вашим активным профессиональным багажом.

- Gang of four “Design patterns”

Notes: IMHO категорически рекомендую прочитать от корки до корки, как минимум, 2 раза подряд, что бы содержание книги стало вашим активным профессиональным багажом.

- Д. Томас, Эндрю Хант «Программист-прагматик. Путь от подмастерья к мастеру»

Notes: Замечательная книга, состоящая из множества атомарных советов. IMHO стоит прочитать от корки до корки 2 раза, а затем пролистывать выборочные главы при подготовке к обсуждению с заказчиком или интервью.



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<https://www.linkedin.com/in/anton-semenchenko-612a926b>



<https://www.facebook.com/semenchenko.anton.v>



<https://twitter.com/comaqqa>

Аудитория сообщества

Специалисты по тестированию (как ручному, так и автоматизированному)

Разработчики средств автоматизации

Менеджеры и специалисты по продажам в ИТ

ИТ-специалисты, думающие о переходе в автоматизацию

Студенты в поиске перспективной профессии

Цель сообщества

Создать единую площадку для эффективного общения всех ИТ-специалистов в контексте автоматизированного тестирования

Ваша выгода

Возможность услышать доклады ведущих ИТ-профессионалов и поделиться своим опытом

Бесплатно участвовать в “промо” - версиях топовых ИТ-конференций стран СНГ

Регулярно встречаться лично, на тематическом форуме, в “филиалах” сообщества в социальных сетях и мессенджерах



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Аудитория сообщества

«Суровые» разработчики на C++ & со, IoT, BigData, High Load, Parallel Computing

Разработчики средств автоматизации

Менеджеры и специалисты по продажам в ИТ

Студенты в поиске перспективной профессии

Цель сообщества

Создать единую площадку для эффективного общения всех ИТ-специалистов в контексте “суровой” разработки

Ваша выгода

Возможность услышать доклады ведущих ИТ-профессионалов и поделиться своим опытом

Бесплатно участвовать в “промо” - версиях топовых ИТ-конференций стран СНГ

Регулярно встречаться лично, на тематическом форуме, в “филиалах” сообщества в социальных сетях и мессенджерах



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