Anand Chandrasekher
Chief Marketing Officer, Qualcomm Incorporated

How mobile is redefining computing

QUALCOMM®

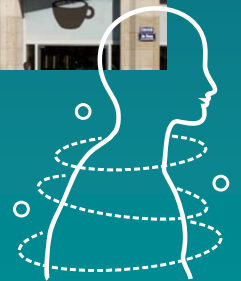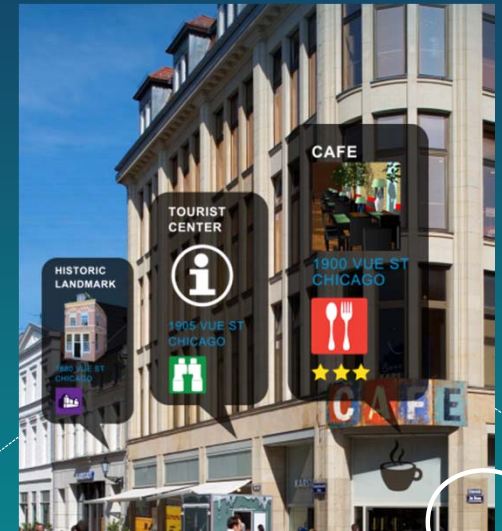@achandrasekher
#nextinmobile
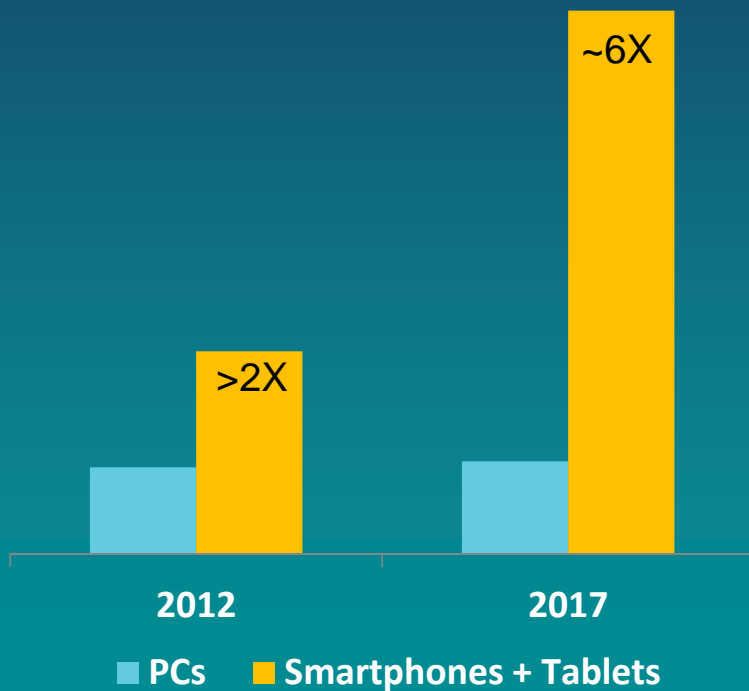
Key industry trends driving innovation

Redefining computing

The 1000x data challenge

Digital 6th sense

A new era: mobile drives growth and innovation

**Device shipments
(in billions)**

~6X

>2X

2012   2017

■ PCs   ■ Smartphones + Tablets

Semiconductor revenues

$68B ——— 2012 ——— $51B

$90B — 2016 — $56B

Mobile devices   PCs

Expanding areas for smartphone innovation

CPU

2MB L2 (8064 only)
aSMP
Custom krait
Web Tech innovations
High performance floating point
Custom system interconnect

GPU

FlexRender™ technology
GPGPU compute for imaging/video
(Renderscript, OpenCL, LLVM)
Unified shader architecture
Low power innovations
Stereoscopic rendering
Accelerated WebGL
Profiling tools

DSP/Multimedia

21 MPix	Stereo 3D video
20x digital zoom	1080p HD video
Zero shutter lag	Browser with HTML5 and 1080p
Ultrasound	flash
7.1 surround playback	Computational camera
5.1 surround camcorder	Noise cancellation

Modems

Coexistence with connectivity	LTE world mode
VoLTE/SRVCC	LTE broadcast
Advanced receivers	LTE TDD
Power optimization	RF multi-band
	TD-SCDMA

Connectivity

Coexistence with WWAN	BT
Indoor location	Miracast
GPS/GNSS	Multiband
.11ac	FM

Sensors

Accelerometer	Temperature
Proximity	Gyroscope
Pressure	IR sensing
Ambient light	Humidity
Gestures	Magnetometer

Displays

Color correction	3D
Content adaptive	Wireless
backlight	display
Frame buffer	MEMS
compression	

Strategy
Drive smartphone leadership into adjacent opportunities
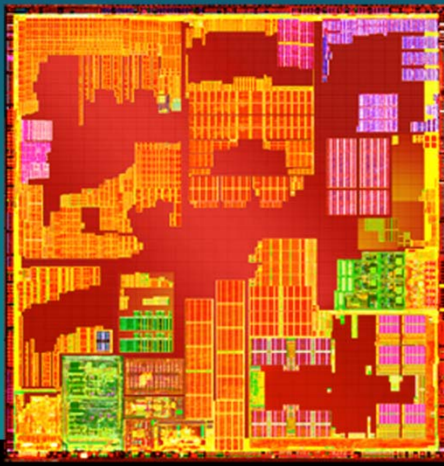
Set the design point

Own the key technology blocks

Integration

Scale – deployment and ability to invest

A full platform solution for the new era of computing

Leading hardware

Drivers & optional advanced features software

High level operating system

Qualcomm® reference designs

Enabling technologies

HW & SW development tools & customer support
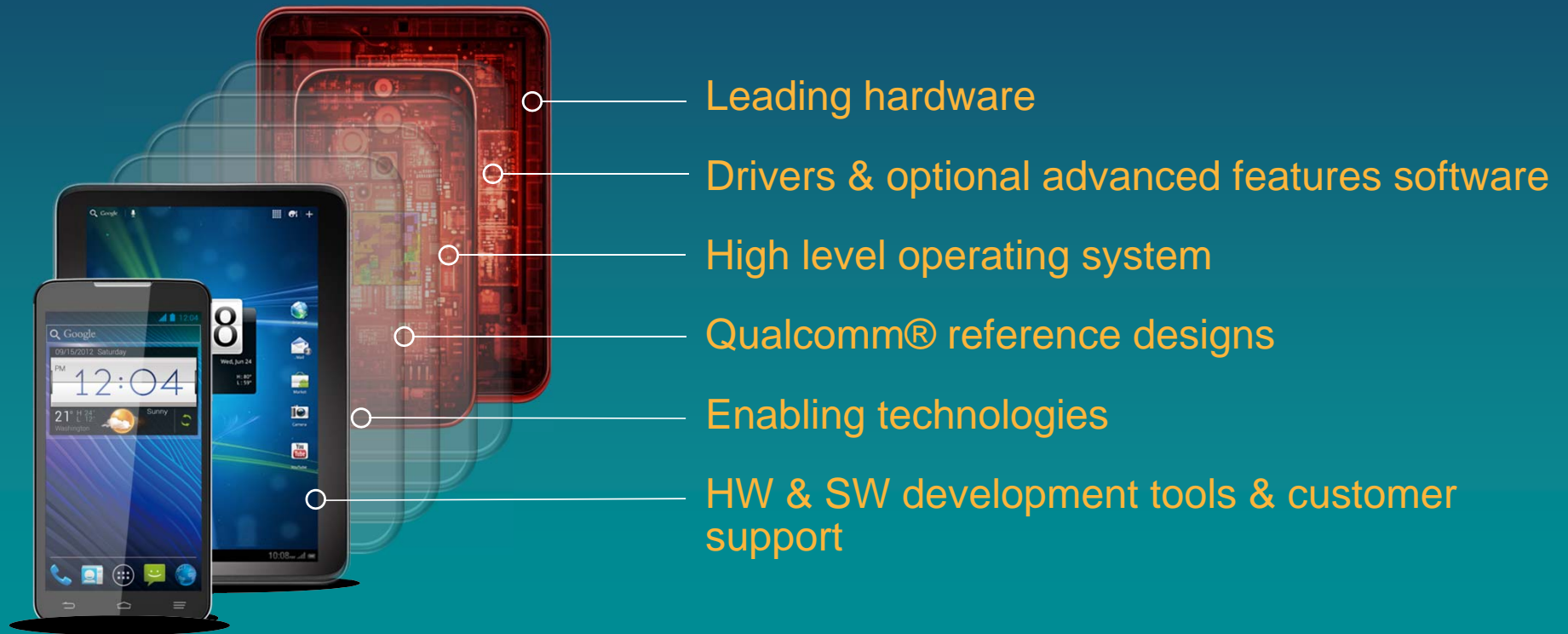
Qualcomm is a mobile native
We lead the industry we co-created after decades of investment and experience

#1
3G/4G/LTE

RF

AP

GPU

DSP

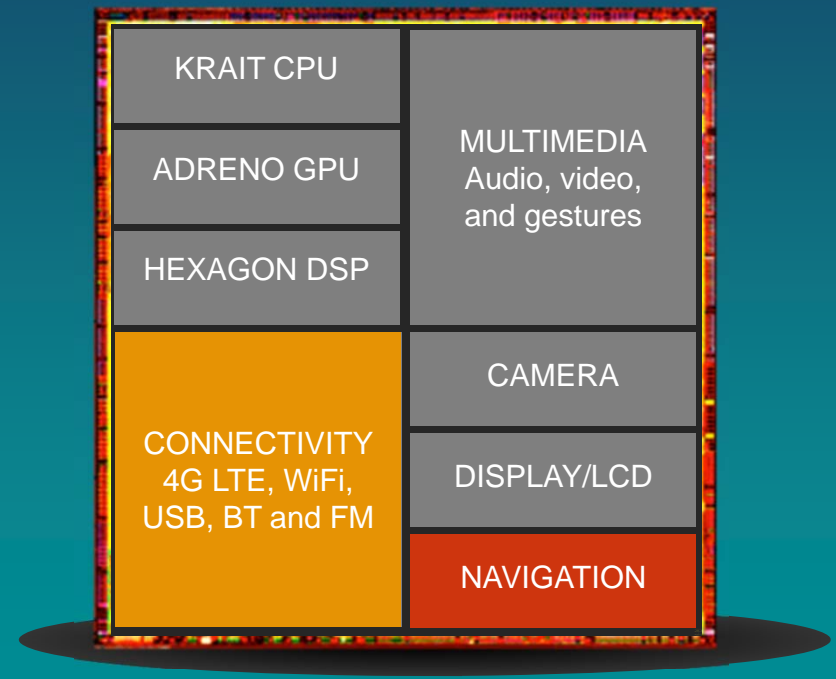# 3G / 4G LTE
Years ahead in LTE

3rd generation LTE

World-mode: supporting 7 cellular modes

Qualcomm® RF360 Front End Solution
for global LTE designs

KRAIT CPU	MULTIMEDIA Audio, video, and gestures
ADRENO GPU	
HEXAGON DSP	
CONNECTIVITY 4G LTE, WiFi, USB, BT and FM	CAMERA
	DISPLAY/LCD
	NAVIGATION

The unique Qualcomm advantage
Hiding the complexity underneath the most seamless mobile connectivity

Connectivity

(Wi-Fi) (BT) (GPS)

Radio Frequency Bands

19	23	24	26	27	28
21	22	33	35	36	37	38	7	10	11	12

| 2 | 3 | 5 | 6 | 4 | 8 | 9 | 1 | 18 | 25 | 20 | 34 | 39 | 40 | 41 | 42 | 43 | 13 | 14 | 17 | 44 |

EV-DO	GERAN	CDMA 1x	UMTS	TD-SCDMA	LTE TDD/FDD
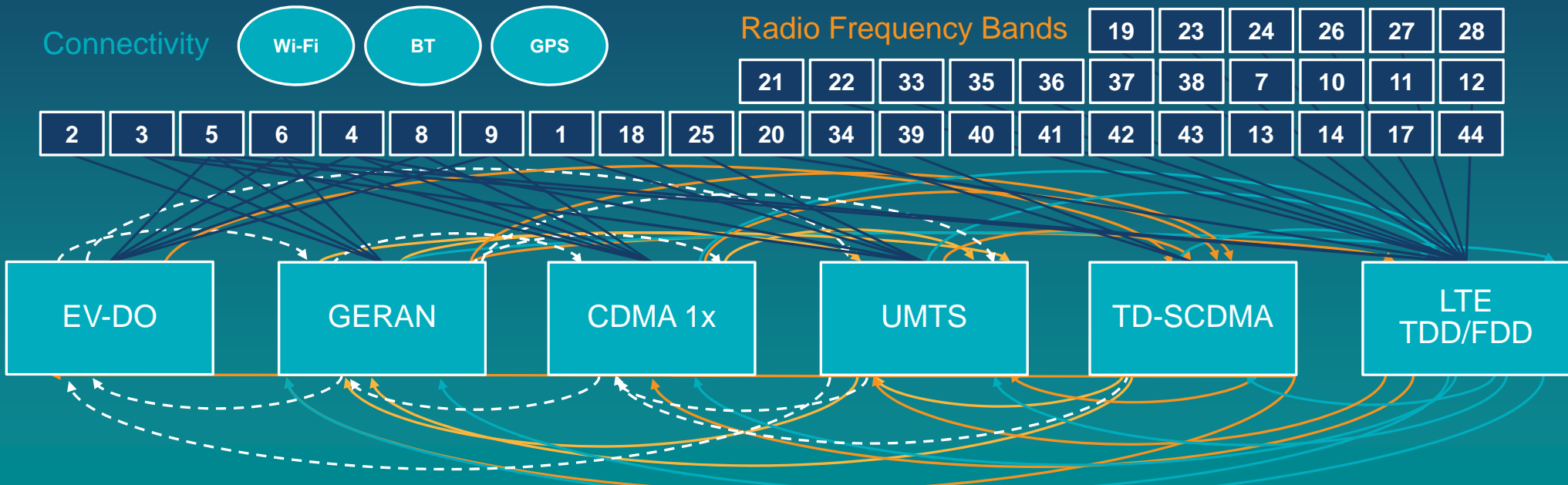
Handover Techniques (Multiple Can Apply in Each Case)

System Selection
Blind Redirection
Redirection w/ Measurements
Reselection

PS Handover
CS Fallback
CSFB w/ SI Tunneling
Single Radio VCC

Qualcomm Gobi is a product of Qualcomm Technologies Inc.

Handover Combinations (Hypothetical Examples)

LTE ⟶

2G/3G ⟶

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Qualcomm RF360 Front End Solution
The First Truly Global Solution for 4G LTE Devices

Advantages

Single SKU

Power

Performance

Size

Time to market

Band Band Band
Band Band Band

Antenna Matching Tuner

Envelope Power Tracker

Power Amp & Antenna Switch

RF POP™
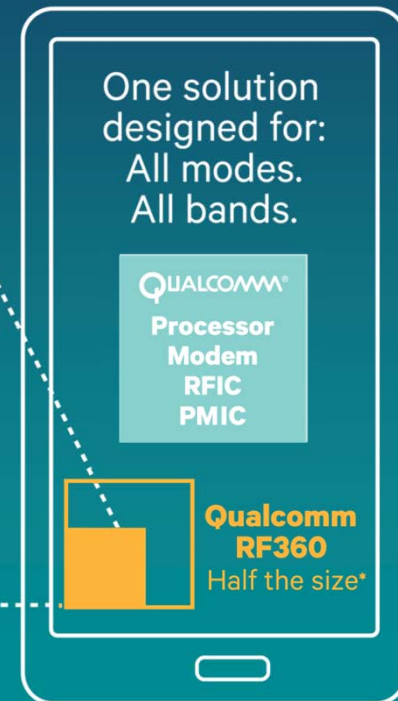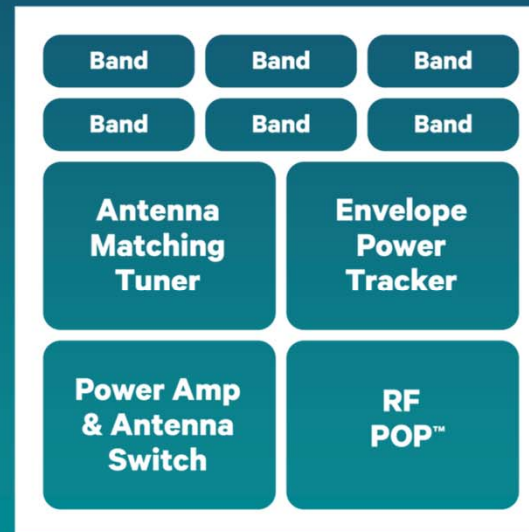
*As compared to the previous Qualcomm RF solution.

One solution designed for: All modes. All bands.

QUALCOMM®
Processor
Modem
RFIC
PMIC

Qualcomm RF360
Half the size*

Unmatched scale of global deployment
Qualcomm® Snapdragon™ S4 MSM8x60 launch

- Commercial sample to first carrier acceptance in 52 days
- 30 OEMs, 30+ operators
- 150+ launches worldwide
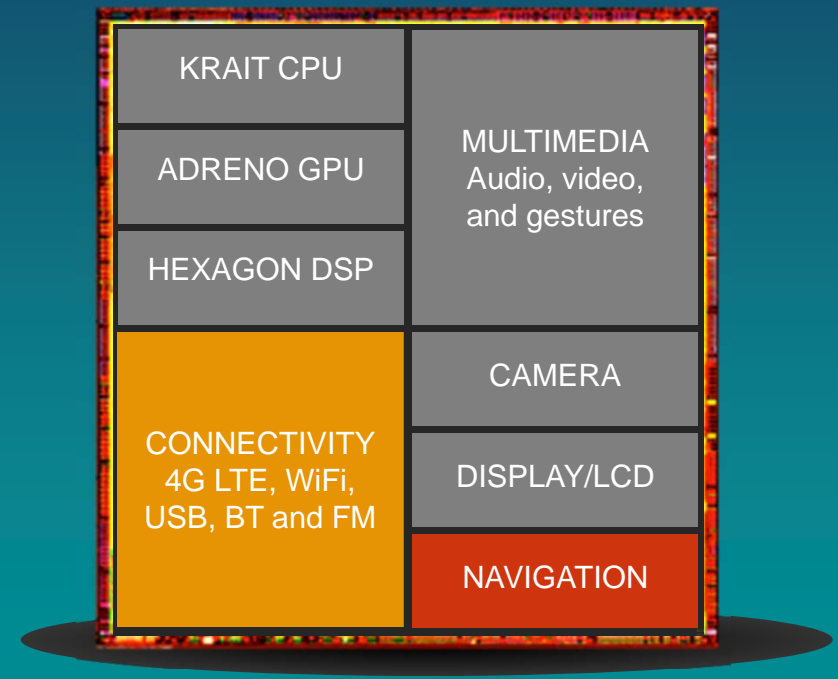- Our fastest integrated chip to ship 10M units

150+

# of carrier acceptances

Commercial sample

First carrier acceptance

Day 0   Day 52

TIME
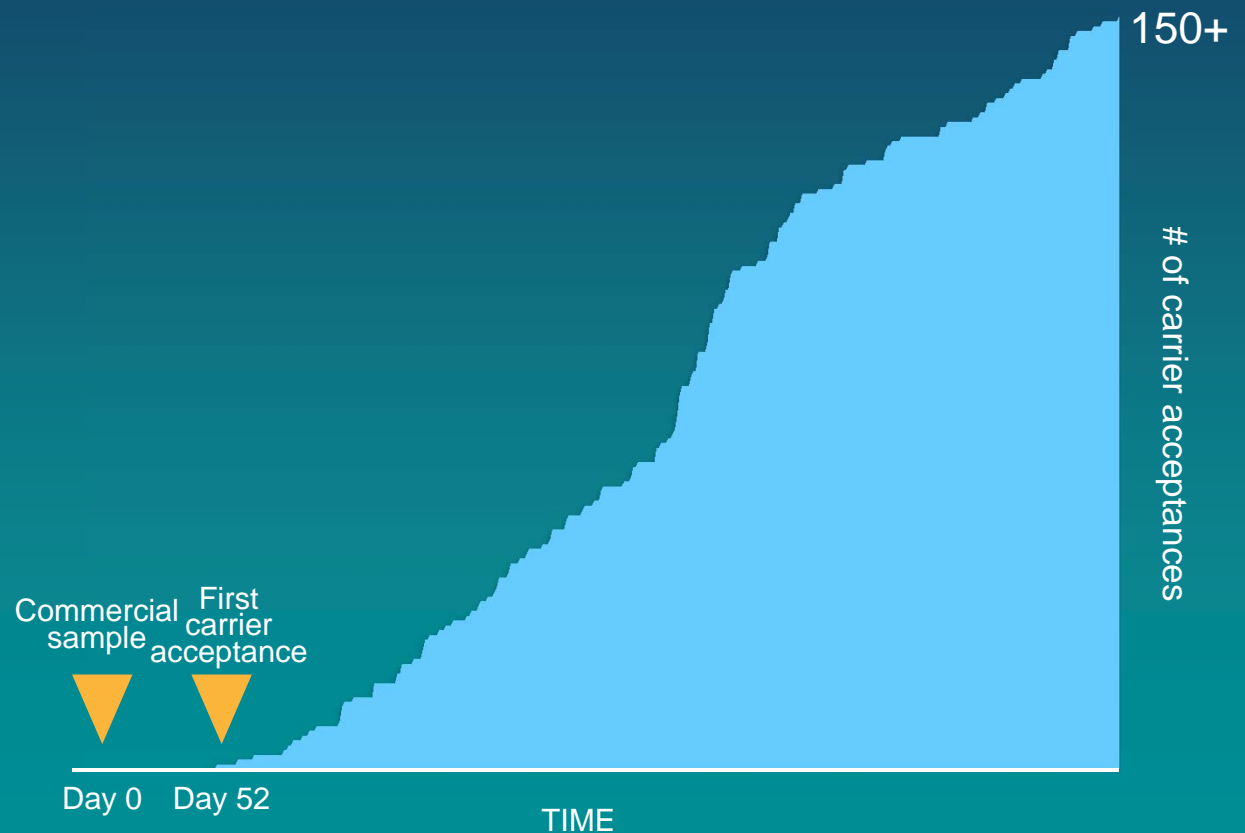
Connectivity
Leadership in Wi-Fi and location technology

Integrated Qualcomm VIVE™ 802.11ac / 11n

Qualcomm IZat™ location

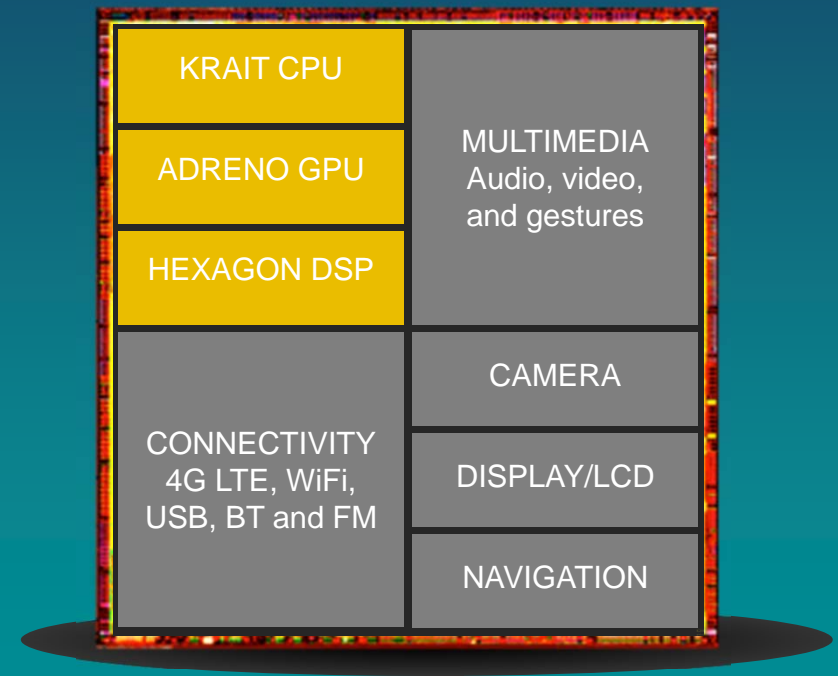| KRAIT CPU | MULTIMEDIA Audio, video, and gestures |
ADRENO GPU	
HEXAGON DSP	
CONNECTIVITY 4G LTE, WiFi, USB, BT and FM	CAMERA
	DISPLAY/LCD
	NAVIGATION

Navigation performance video
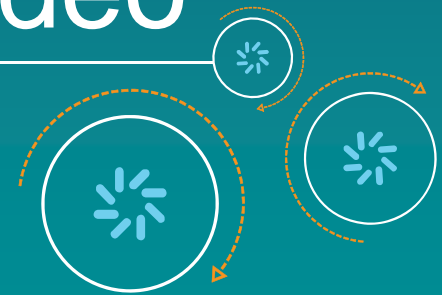
Applications SoC
Ahead of standard, off-the-shelf solutions

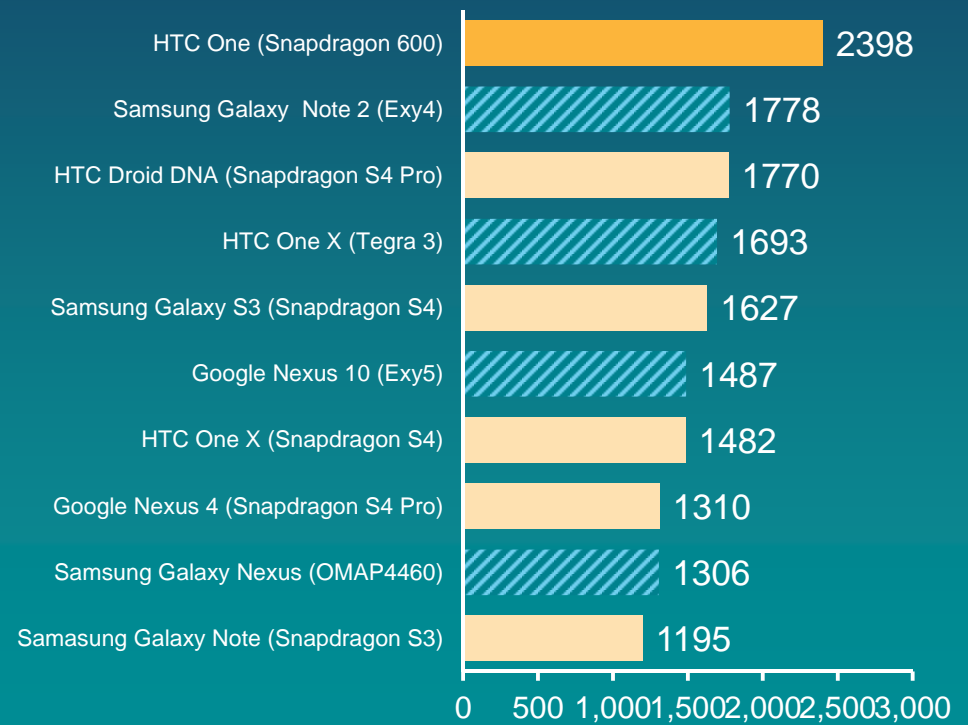Custom design from the ground up

Integrated architecture (CPU, GPU, DSP)

KRAIT CPU	MULTIMEDIA Audio, video, and gestures
ADRENO GPU	
HEXAGON DSP	
CONNECTIVITY 4G LTE, WiFi, USB, BT and FM	CAMERA
	DISPLAY/LCD
	NAVIGATION

CPU performance

"Our two Vellamo benchmarks both show the One doing very well. In the HTML5 test, the One puts everything else to shame—including the old APQ8064 based Droid DNA and the Galaxy Note 2. The Qualcomm comparison is the more interesting as it echoes some of what we saw in the microbenchmarks—take into account the clock speed difference and you're looking at a 22% improvement in performance due to the new Krait 300 cores."

Brian Klug, AnandTech.com (4/12/13)

Vellamo benchmark – 2.0
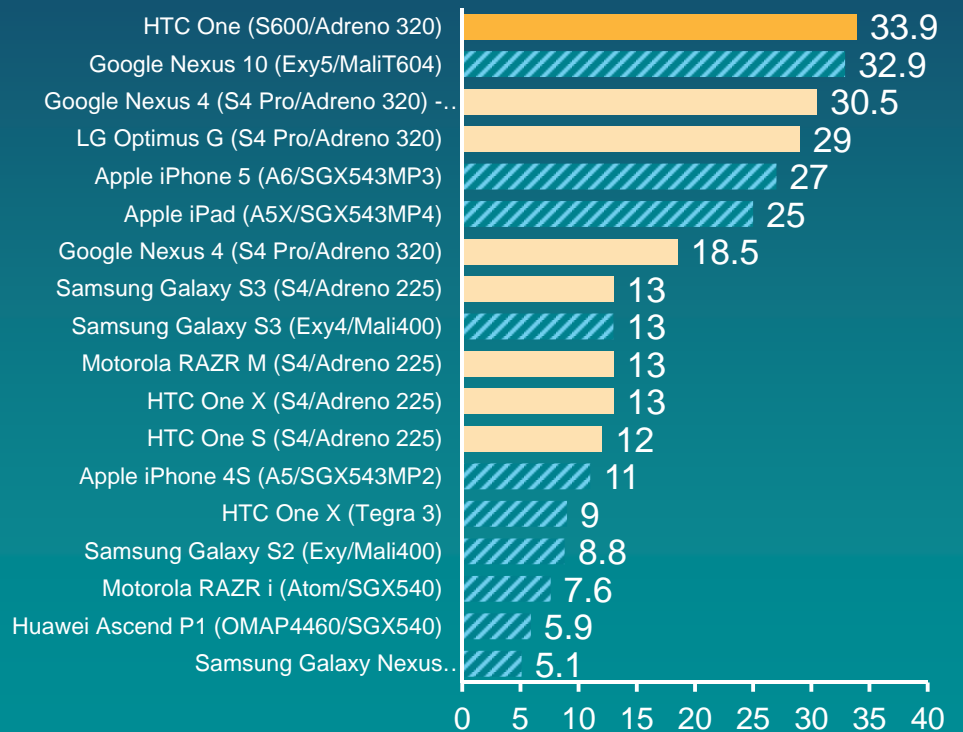### HTML5 test overall score – (higher is better)

Device	Score
HTC One (Snapdragon 600)	2398
Samsung Galaxy Note 2 (Exy4)	1778
HTC Droid DNA (Snapdragon S4 Pro)	1770
HTC One X (Tegra 3)	1693
Samsung Galaxy S3 (Snapdragon S4)	1627
Google Nexus 10 (Exy5)	1487
HTC One X (Snapdragon S4)	1482
Google Nexus 4 (Snapdragon S4 Pro)	1310
Samsung Galaxy Nexus (OMAP4460)	1306
Samasung Galaxy Note (Snapdragon S3)	1195

0   500   1,000 1,500 2,000 2,500 3,000

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GPU performance

GLBenchmark 2.5 – Egypt HD (offscreen 1080p)
Frames per second – (higher is better)

"The 'game' benchmarks in GLBench give us a good indication of overall performance. The off-screen results are most interesting from drawing comparative conclusions: The One is fast—it's now the fastest smartphone we've ever tested in the Egypt HD off-screen test."

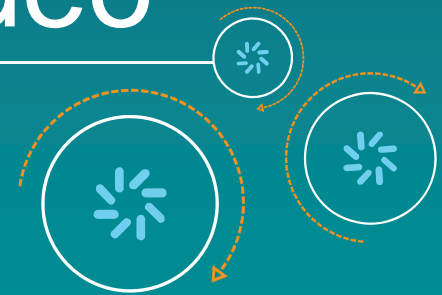Brian Klug, AnandTech.com (4/12/13)

Device	Score
HTC One (S600/Adreno 320)	33.9
Google Nexus 10 (Exy5/MaliT604)	32.9
Google Nexus 4 (S4 Pro/Adreno 320) -..	30.5
LG Optimus G (S4 Pro/Adreno 320)	29
Apple iPhone 5 (A6/SGX543MP3)	27
Apple iPad (A5X/SGX543MP4)	25
Google Nexus 4 (S4 Pro/Adreno 320)	18.5
Samsung Galaxy S3 (S4/Adreno 225)	13
Samsung Galaxy S3 (Exy4/Mali400)	13
Motorola RAZR M (S4/Adreno 225)	13
HTC One X (S4/Adreno 225)	13
HTC One S (S4/Adreno 225)	12
Apple iPhone 4S (A5/SGX543MP2)	11
HTC One X (Tegra 3)	9
Samsung Galaxy S2 (Exy/Mali400)	8.8
Motorola RAZR i (Atom/SGX540)	7.6
Huawei Ascend P1 (OMAP4460/SGX540)	5.9
Samsung Galaxy Nexus..	5.1

Browser performance video

Multimedia
Setting consumer expectations

KRAIT CPU	MULTIMEDIA Audio, video, and gestures
ADRENO GPU	
HEXAGON DSP	
CONNECTIVITY 4G LTE, WiFi, USB, BT and FM	CAMERA
	DISPLAY/LCD
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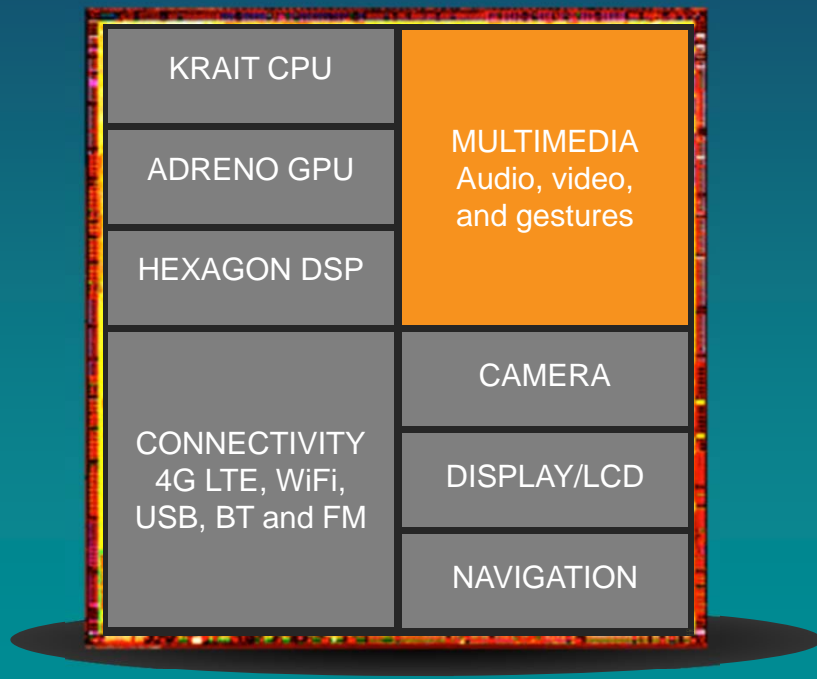
Ultra HD capture & playback*

7.1 surround sound*

Advanced camera features

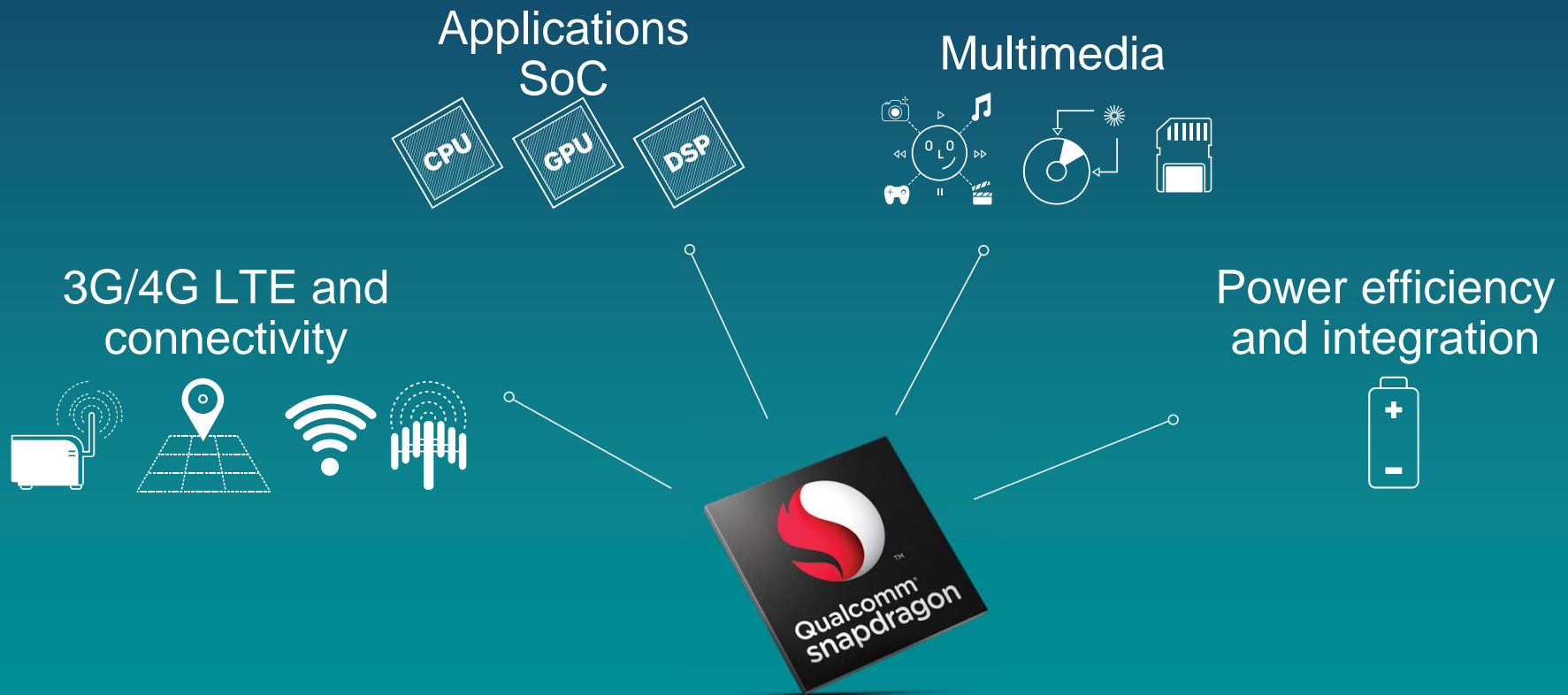*Qualcomm Snapdragon 800 Processors.

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Demos: Ultra HD and 7.1 sound
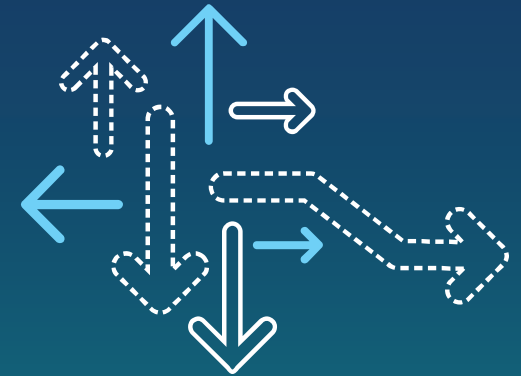
Power efficiency and integration
Critical in mobile and in our philosophy
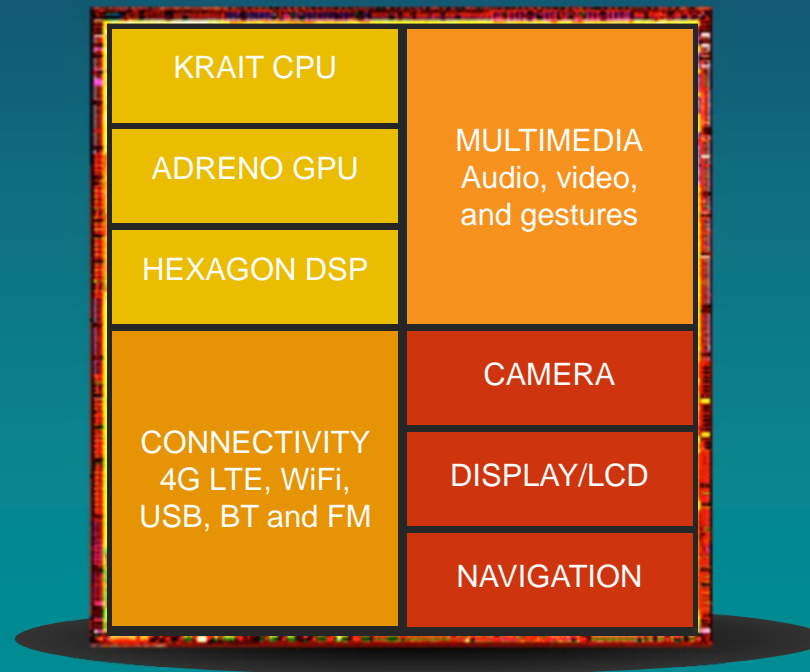
Mobile requires to master and integrate all key technologies

Applications SoC

CPU GPU DSP

Multimedia

3G/4G LTE and connectivity

Power efficiency and integration

Qualcomm® Snapdragon™ processors

Snapdragon 800

Premium smartphones, Smart TVs, digital media adapters and tablets.

Snapdragon 600

Mid-high tier smartphones and tablets.

Snapdragon 400

High volume smartphones and tablets.

Snapdragon 200

Entry level smartphones.

At the heart of devices you love

At the heart of the devices you love

Qualcomm® snapdragon

85+
Device customers

850+
Devices announced*

*Includes Qualcomm reference design
Source: Qualcomm Technologies Inc. data

Qualcomm Reference Design
Accelerating global growth of smartphones

Qualcomm
Reference Design
snapdragon

200+
Devices
launched

40+
OEMs

14
Countries

Qualcomm Reference Design is a product of Qualcomm Technologies Inc.
Source: Qualcomm Technologies Inc. data

Qualcomm Snapdragon across a range of devices

Smartphone technology is expanding into many other computing and CE categories

A Dragon is Coming video
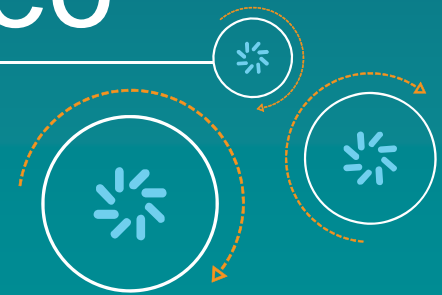
Thank you

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