

GCR Live IP & Antitrust Asia-Pacific

Prepared for panel session entitled: *IPR & Standards – market failure or market success (FRAND commitments, obligations of licensors and licensees)*

Market Health Check for SEP-Intensive Mobile Communications including Smartphones

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ICT Standards Define Entire Complex Systems

- **Audio and Video Codecs**

- “H.264/MPEG-4 AVC is a block-oriented motion-compensation-based video compression standard developed by the ITU-T Video Coding Experts Group (VCEG) together with the ISO/IEC JTC1 Moving Picture Experts Group (MPEG)” (Wikipedia)
- Many thousands of lines of software code required to implement
- Used in conjunction with other standards (e.g., Blu-Ray, defining color of laser, disk track physical specifications)

- **Mobile Communications**

- “GSM (Global System for Mobile Communications) is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones.” (Wikipedia)
- >124,000 patented technologies declared to ETSI as essential to 3GPP standards including GSM, WCDMA and LTE
- “Protocols” include radio modulation, audio and data encoding, bit error detection and correction, handover, power control, encryption, interference detection and cancellation etc, etc
- Smartphones also leading implementers of video standards



Cellular and Smartphone Markets Functioning Well

Hold-up and royalty stacking theories predict excessive royalties, other harms and effects which evidence disproves

- **Consumer adoption and consumption increasing**
- **Innovation and technical progress accelerating**
- **Cellular technology R&D up 74% to \$46bn since 2009**
- **Time-to-market for new standards shortening**
- **Technology/device OEM vertical integration collapsed**
- **Market entry downstream in smartphones burgeoning**
- **Concentration in handset OEM supply low and declining**
- **Smartphone prices falling on average, and dramatically so on a quality-adjusted basis**
- **Patent royalties are a very small proportion of prices for consumer products and services**










Highlighting Progress and Success in Mobile Services, Devices and Standard-based Technologies

- **7 billion subscribers since inception in early 1980s**
- **\$400 bn in handset sales and \$1.2 trillion in services annually**
- **Prices as low as \$20 since mid 2000s, <\$75 smartphones now**
- **Hundreds of companies including SMEs contribute to and implement 3GPP (ETSI is a partner) standards**
- **>124,000 patents declared possibly essential to 3GPP standards**
- **Relentless innovation with a major 3GPP standards release every year or so**
- **4G LTE data speeds >50Mbps are 1,000 times faster than with 2G one decade ago**
- **393 commercially launched LTE networks in 138 countries***
- **Increasing product choice (e.g. 2,919 4G LTE user devices have been announced by 297 manufacturers*)**

*<http://www.gsacom.com>





Handset Evolution to 3G

| Introduced | 2001 | 2001 | 2002 | 2003 | 2004 | 2007 | 2011 |
|------------|---|---|---|--|---|--|--|
| |  |  |  |  |  |  |  |
| Model | Motorola V60 | Ericsson T68 | Nokia 7210 | BlackBerry 7230 | Motorola RAZR V3 | Apple iPhone 2G | Apple iPhone 4S |
| Display(s) | Monochrome graphic 96 x 64 pixels Second: monochrome | 1.7" STN 256 colors 101 x 80 pixels | 1.5" CSTN 4,096 colors 128 x 128 pixels (121 ppi) | 2.6" TFT reflective 65,000 colors 240 x 160 pixels (111 ppi) | 2.2" TFT 256,000 colors: 176 x 220 pixels Second: CSTN 4,096 colors | 3.5" TFT capacitive touchscreen 16,000,000 colors 320 x 480 pixels (165 ppi) | 3.5" LED-backlit IPS TFT, capacitive touchscreen 16,000,000 colors 690 x 960 pixels (330 ppi) |
| Data | 2G GPRS 32-40 kbps | 2G GPRS 24-36 kbps | 2G GPRS 24-36 kbps | 2G GPRS (<56kbps) | 2G GPRS (38-42 kbps) | 2G EDGE (<300kbps) WiFi | 3G HSDPA 14.4 Mbps 3G HSUPA 5.8Mbps WiFi |
| Features | SMS, WAP 1.1 browser, games | SMS, MMS, Email, WAP 1.2.1 | SMS, MMS, WAP 1.2.1 browser, games | SMS, Email, BlackBerry HTML browser Qwerty keyboard | SMS, MMS, Email, WAP 2.0/ xHTML browser Video player 0.3MP camera | SMS, Email, HTML Safari Video player 2MP camera 412 MHz CPU | SMS, Email, HTML Safari HD 1080p video @ 30 fps 8MP camera Dual core 1GHz CPU |

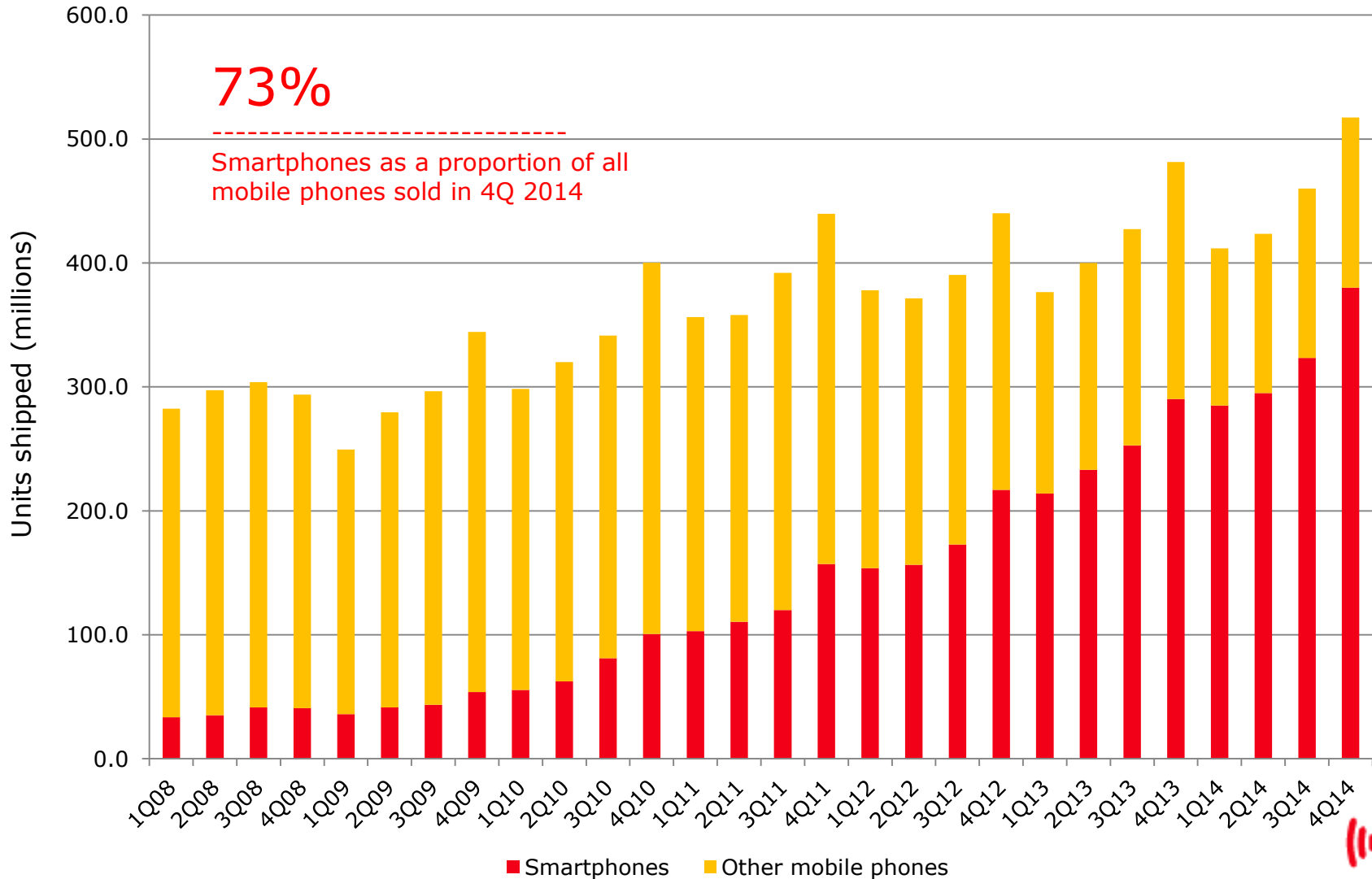


4G Devices

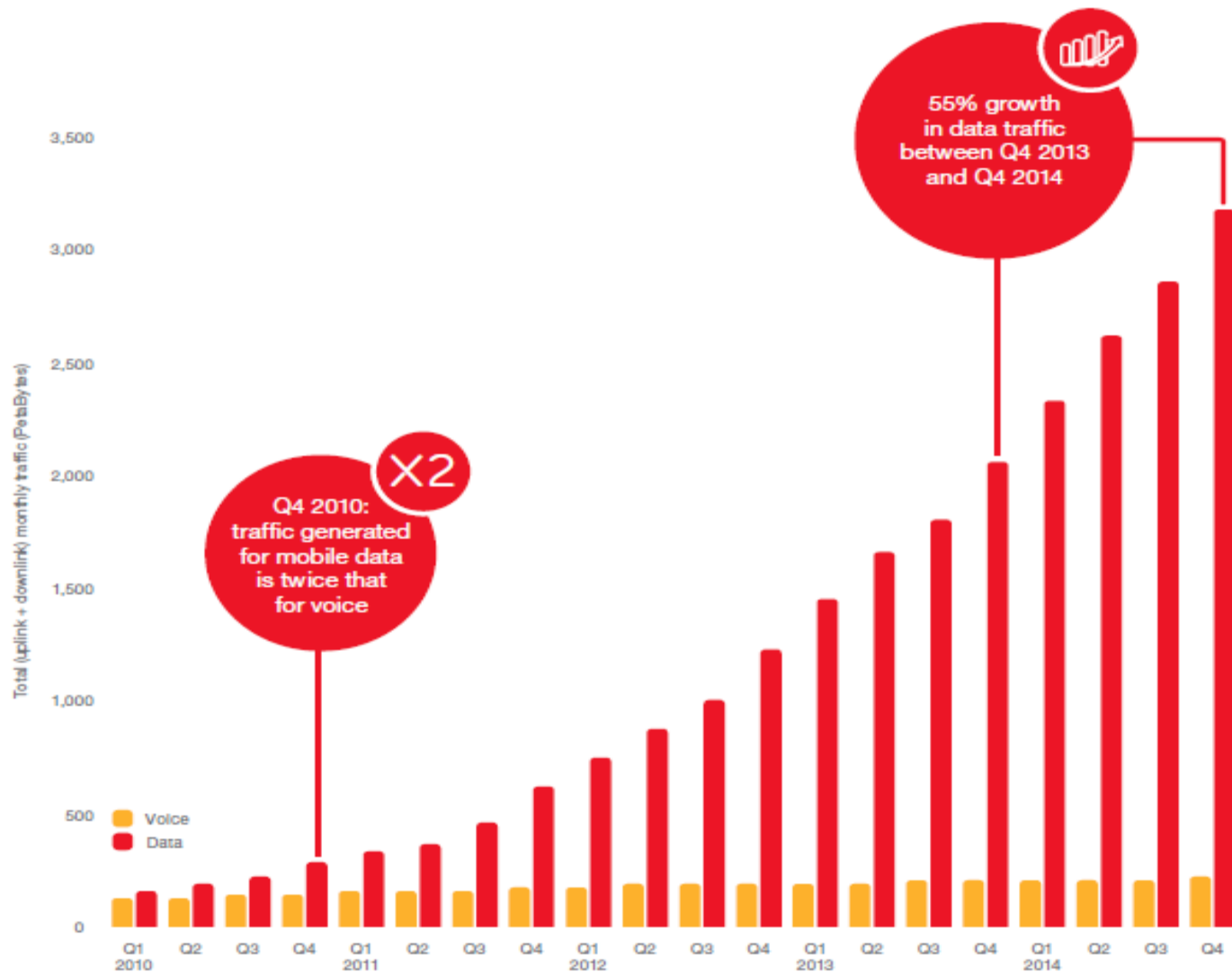
| Launched | June/September* 2012 | September 2014 |
|---------------------------|--|--|
| |  |  |
| Model | Samsung Galaxy S III: I747 and I9500* | iPhone 6 Plus |
| Network | GSM/HSPA/LTE | GSM/CDMA/HSPA/LTE, LTE-Advanced including Carrier Aggregation and VoLTE |
| Chipset | Qualcomm MSM 8960 or Exynos 4412 Quad* | Apple A8 |
| Central processor | Dual core 1.5 GHz or Quad core 1.4 GHz Cortex-A9* | Dual-core 1.4 GHz Cyclone (ARM v8-based) |
| Graphics processor | Adreno 225 or Mali-400MP* | PowerVR GX6450 (quad-core graphics) |
| Operating System | Android OS v4.0 (Ice Cream Sandwich) or Android OS v4.1.1 (Jelly Bean)* | iOS 8, upgradable to iOS 8.3 |
| Display | Super AMOLED, 16M colours, 720 x 1,280 pixels, 4.8 inches, 306 ppi | LED-backlit IPS LCD, 16M colors, 5.5 inches, 1080 x 1920 pixels (~401 ppi pixel density) |
| Touchscreen | Capacitive multitouch | Capacitive multitouch |
| Memory | 16GB storage, 2GB RAM, up to 64 GB microSD | 16/64/128 GB, 1 GB RAM |
| Cameras | 8MP, autofocus, LED flash: secondary 1.9MP, 720p @30 fps | 8 MP, 3264 x 2448 pixels, optical image stabilization, phase detection autofocus, dual-LED (dual tone) flash: secondary, 1080p@60fps, 720p@240fps, optical stabilization |
| Leading Features | Accelerometer, gyro, proximity, compass, barometer. Simultaneous HD video and image recording, touch focus, geo-tagging, face and smile detection, 1080p @30 fps video, image stabilization. GPS with A-GPS support and GLONASS, | Accelerometer, gyro, proximity, compass, barometer, geo-tagging, simultaneous HD video and image recording, touch focus, face/smile detection, HDR (photo/panorama), Active noise cancellation with dedicated mic . Siri natural language commands and dictation. NFC. |



Overwhelming Adoption of Smartphones and Mobile Broadband in Recent Years has Driven...



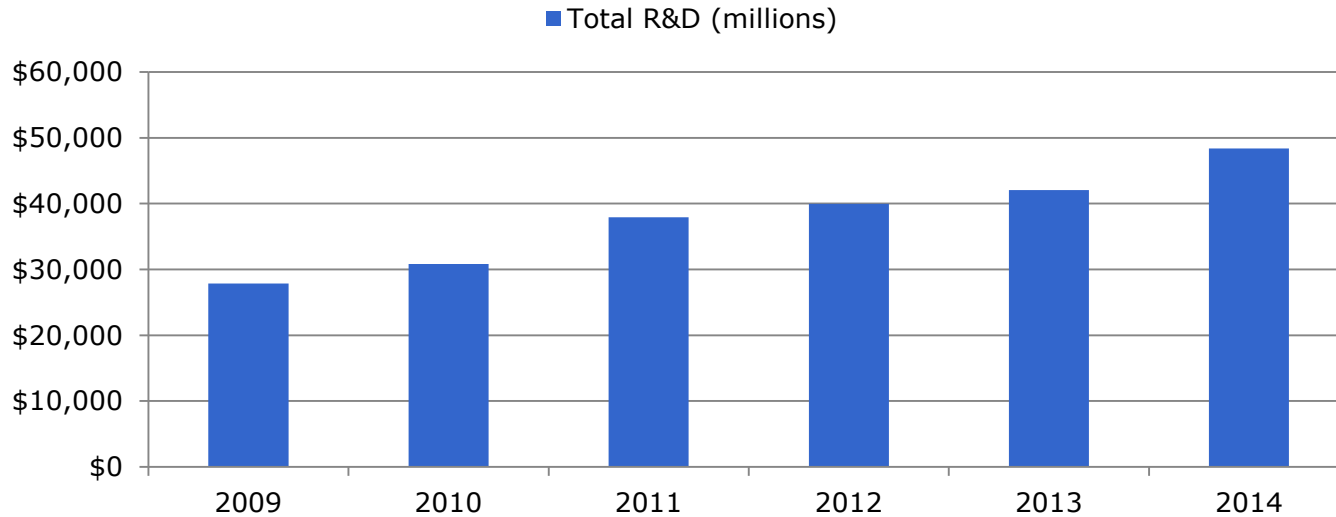
Massive Growth in Global Mobile Network Traffic



Source: Ericsson. Traffic does not include DVB-H, Wi-Fi, or Mobile WiMax. Voice does not include VoIP



R&D Growth in Line with 74% Revenue Growth

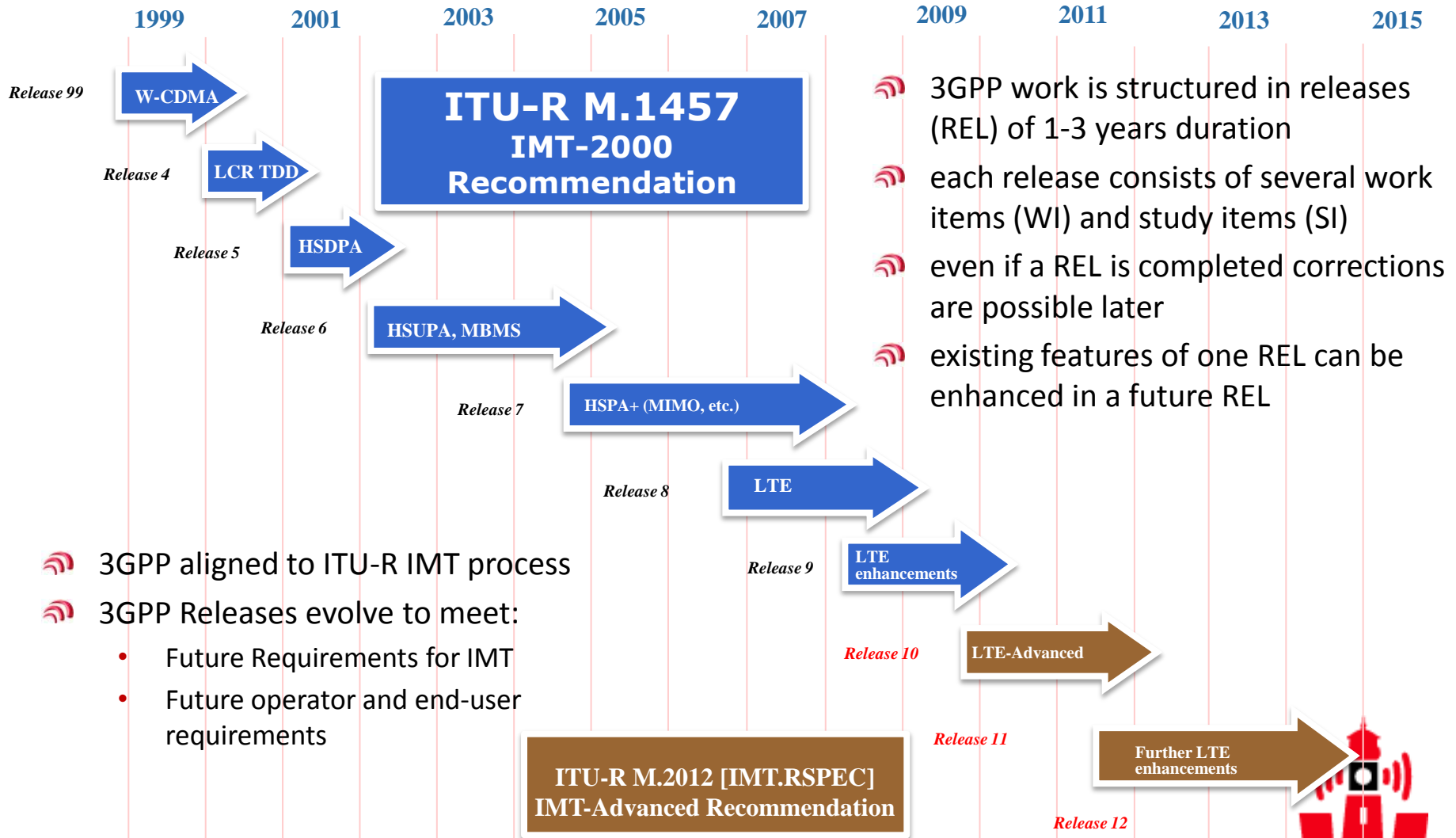


| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | Growth 2009-2014 |
|---------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------|
| Total Sales (millions) | \$353,836 | \$401,722 | \$510,840 | \$559,173 | \$582,011 | \$614,459 | 74% |
| Total R&D (millions) | \$27,854 | \$30,829 | \$37,922 | \$39,970 | \$42,073 | \$48,386 | 74% |
| R&D/Sales | 7.9% | 7.7% | 7.4% | 7.1% | 7.2% | 7.9% | |

Total revenues and R&D expenditures for eleven largest technology companies with a predominant or exclusive focus on mobile communications: Alcatel-Lucent, Apple, BlackBerry, Ericsson, Huawei, MediaTek, Nokia, Qualcomm, Samsung, LG, ZTE



Release Schedule

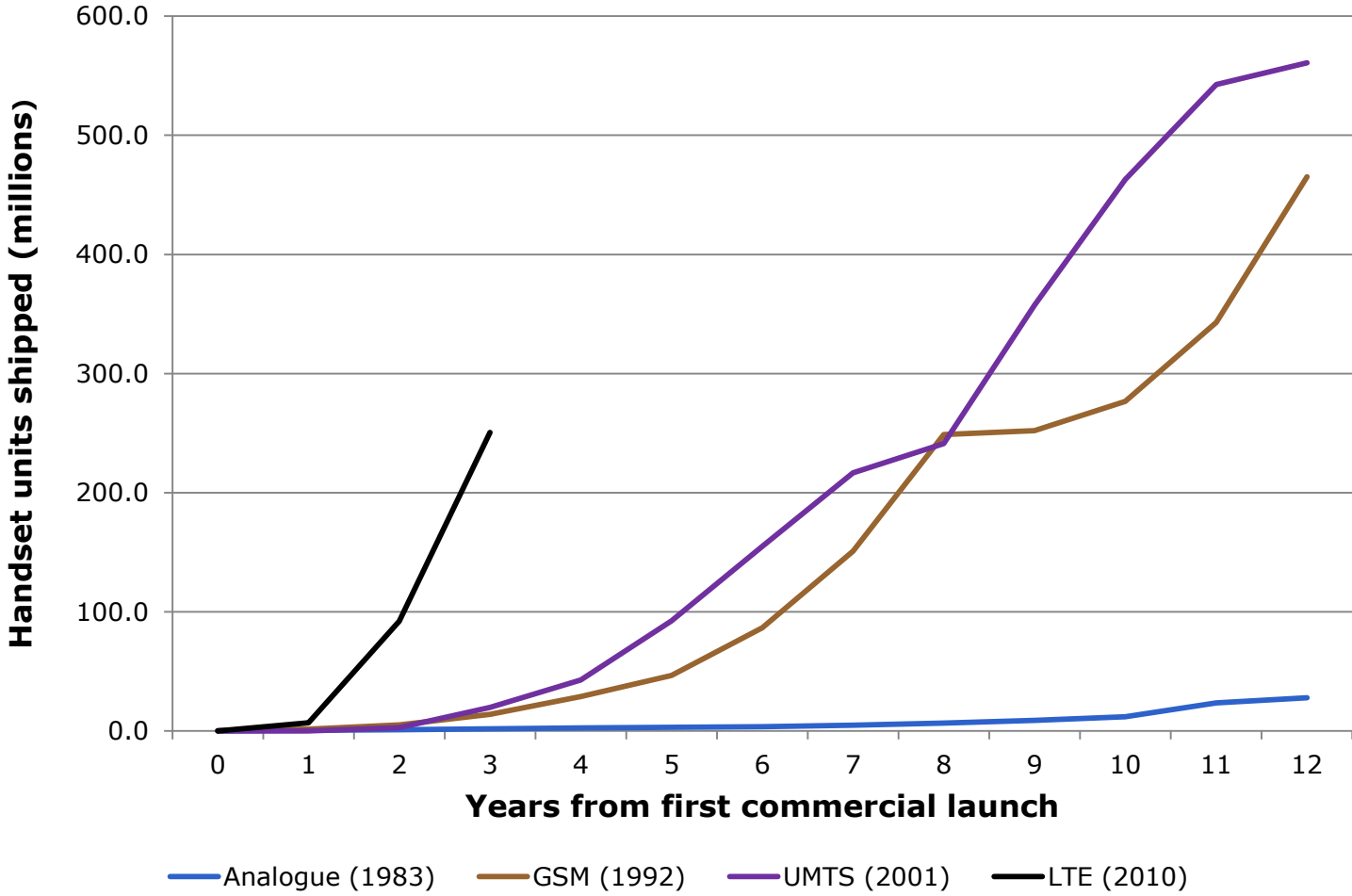


- 3GPP work is structured in releases (REL) of 1-3 years duration
- each release consists of several work items (WI) and study items (SI)
- even if a REL is completed corrections are possible later
- existing features of one REL can be enhanced in a future REL

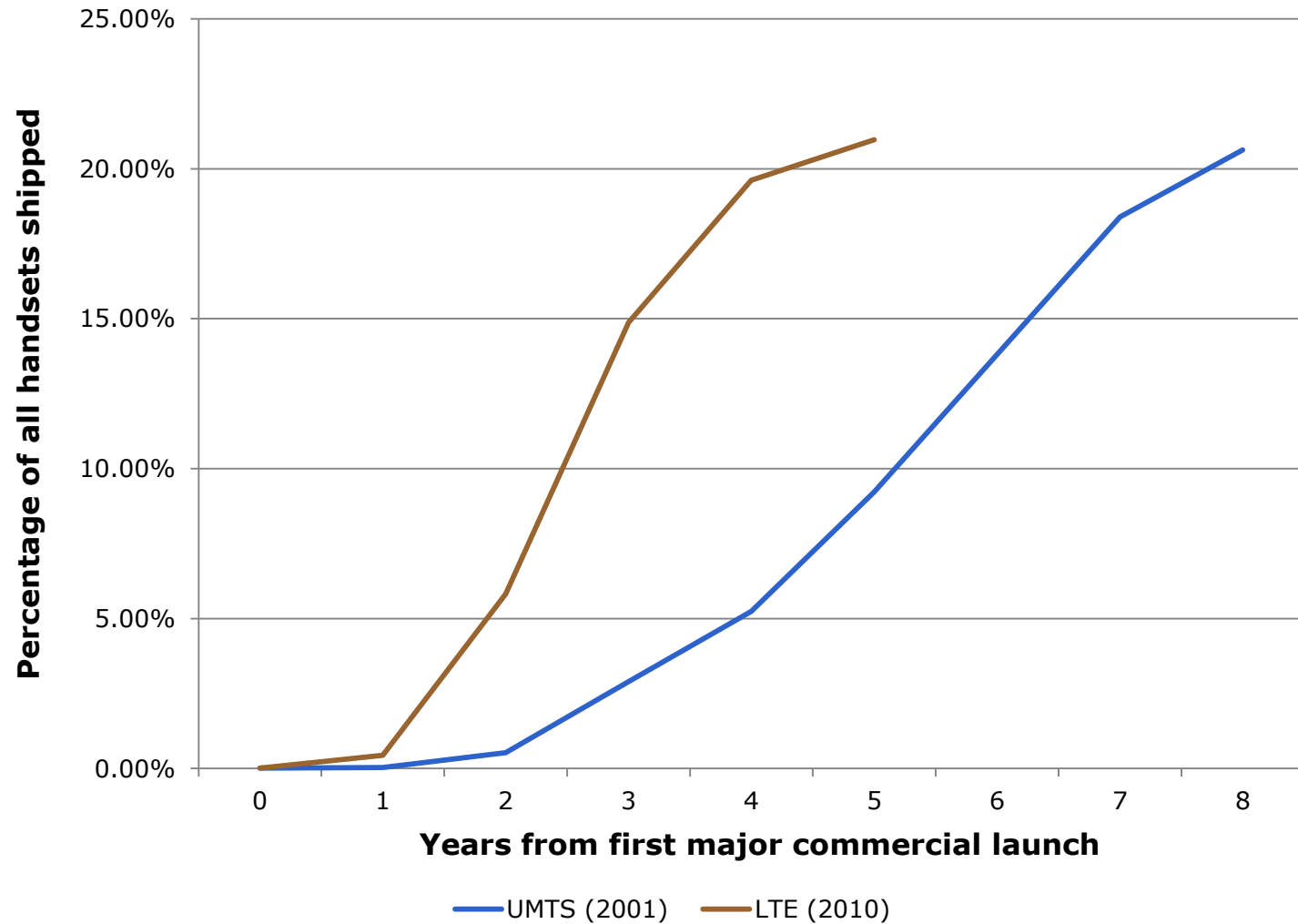
- 3GPP aligned to ITU-R IMT process
- 3GPP Releases evolve to meet:
 - Future Requirements for IMT
 - Future operator and end-user requirements



Faster Uptake for More Recent Standards



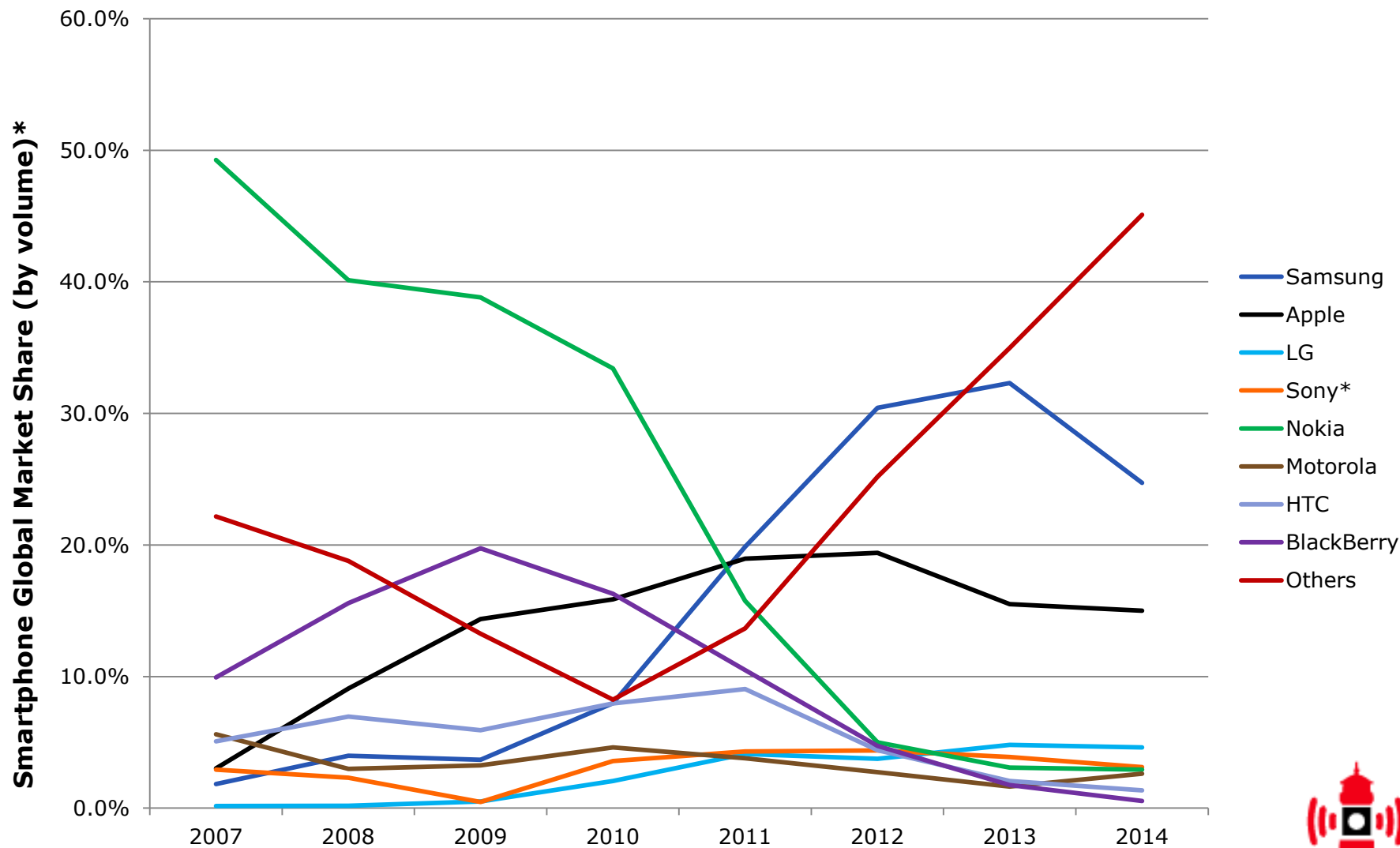
Time-to-Market and Adoption Accelerating



First release of the UMTS standard (Release 99) was in 1999; the first commercial launch was in 10/2001
First release of the LTE standard (Release 8) was in 2008; the first commercial launch was in 12/2009



How the Mighty Have Fallen: "Others" Predominate now in Smartphone Supply



*Sony Ericsson until 2011



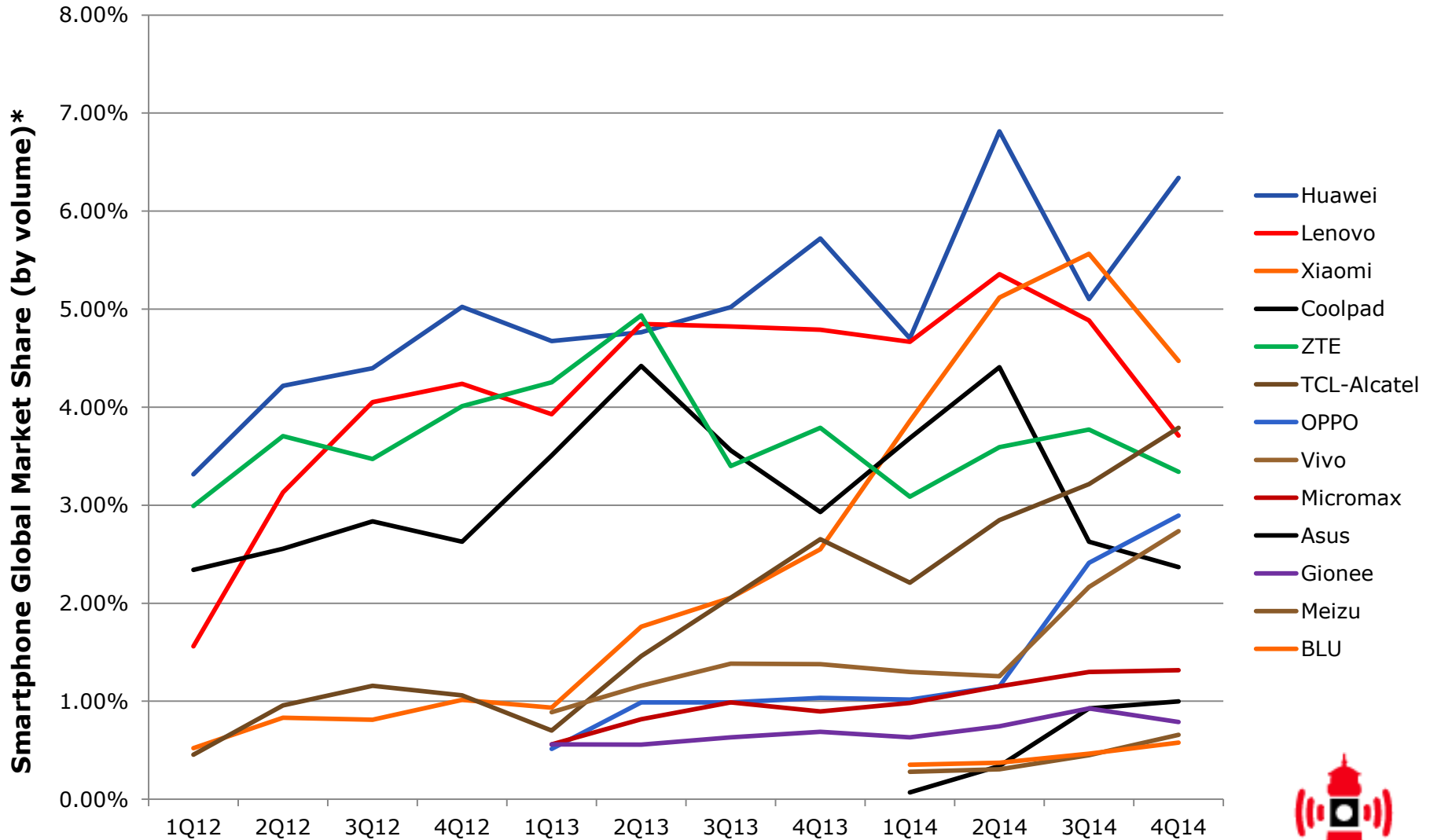
Vertical Integration of OEMs has Collapsed

- **Almost all major developers of mobile standard-essential technologies have exited the handset market, while some of the brand names are still used independently of their former parents**

| | Peak share year | Peak share % | Exited market | Prior year share | Sold to |
|----------|-----------------|------------------|---------------|------------------|---|
| Qualcomm | | Small: CDMA-only | 2000 | Small: CDMA-only | Kyocera |
| Alcatel | 2002 | 2.8% | 2005 | 1.1% | TCL: uses Alcatel OneTouch brand |
| Siemens | 2003 | 8.4% | 2005 | 7.3% | BenQ: bankruptcy followed in 2006 |
| Motorola | 2006 | 22% | 2012 | 2.7% | Google, who then sold to Lenovo in 2014 |
| Ericsson | 2007 | 9.2% | 2011 | 3.2% | Sony, following 2001-formed JV |
| Nokia | 2008 | 40% | 2014 | 15% | Microsoft |



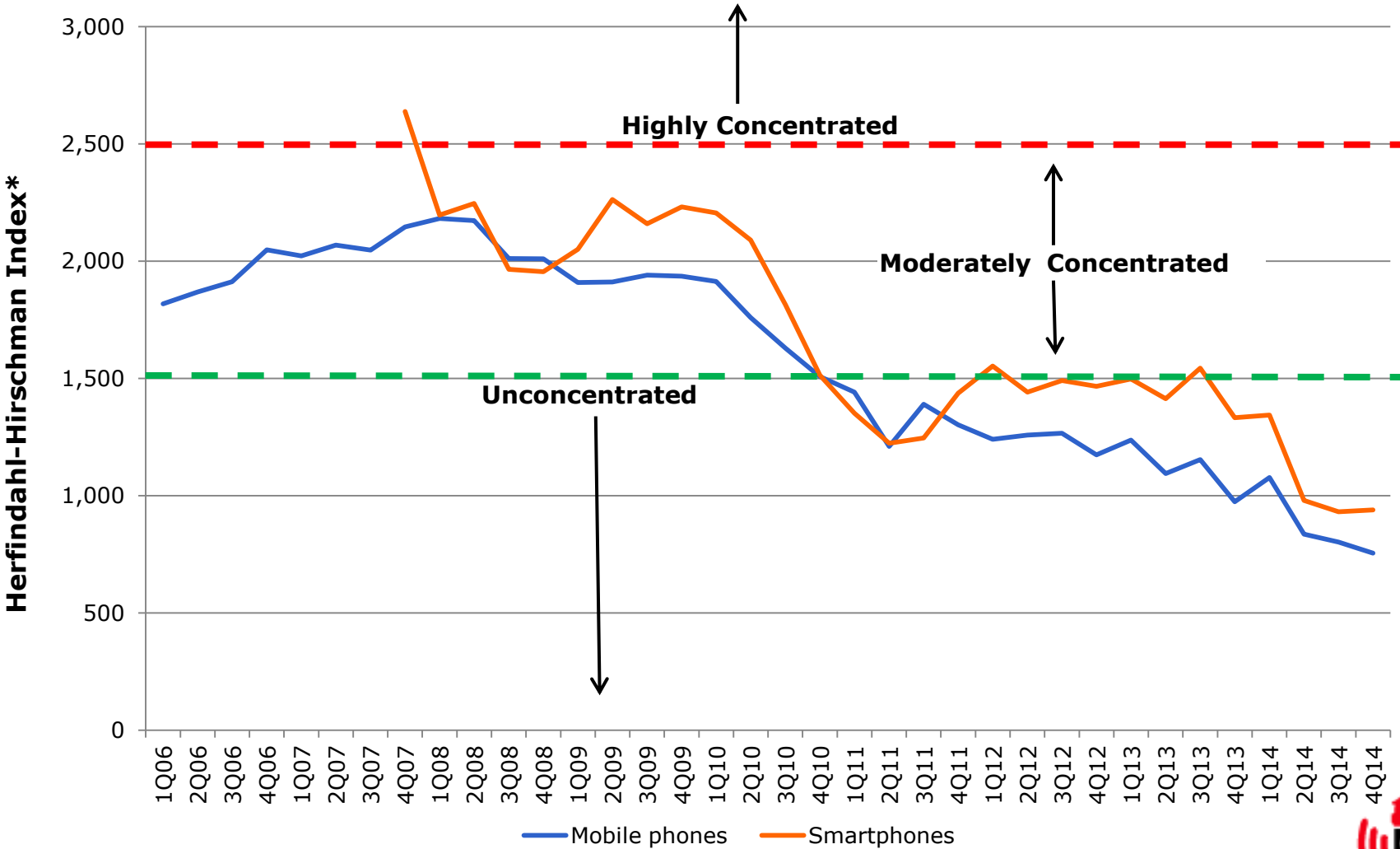
Many Fast-Growing Newcomers Capitalize on Low Barriers to Entry for Smartphone OEMs



*For new entrants with more than 0.5% market share -- equivalent to 6 million units annually in 2014



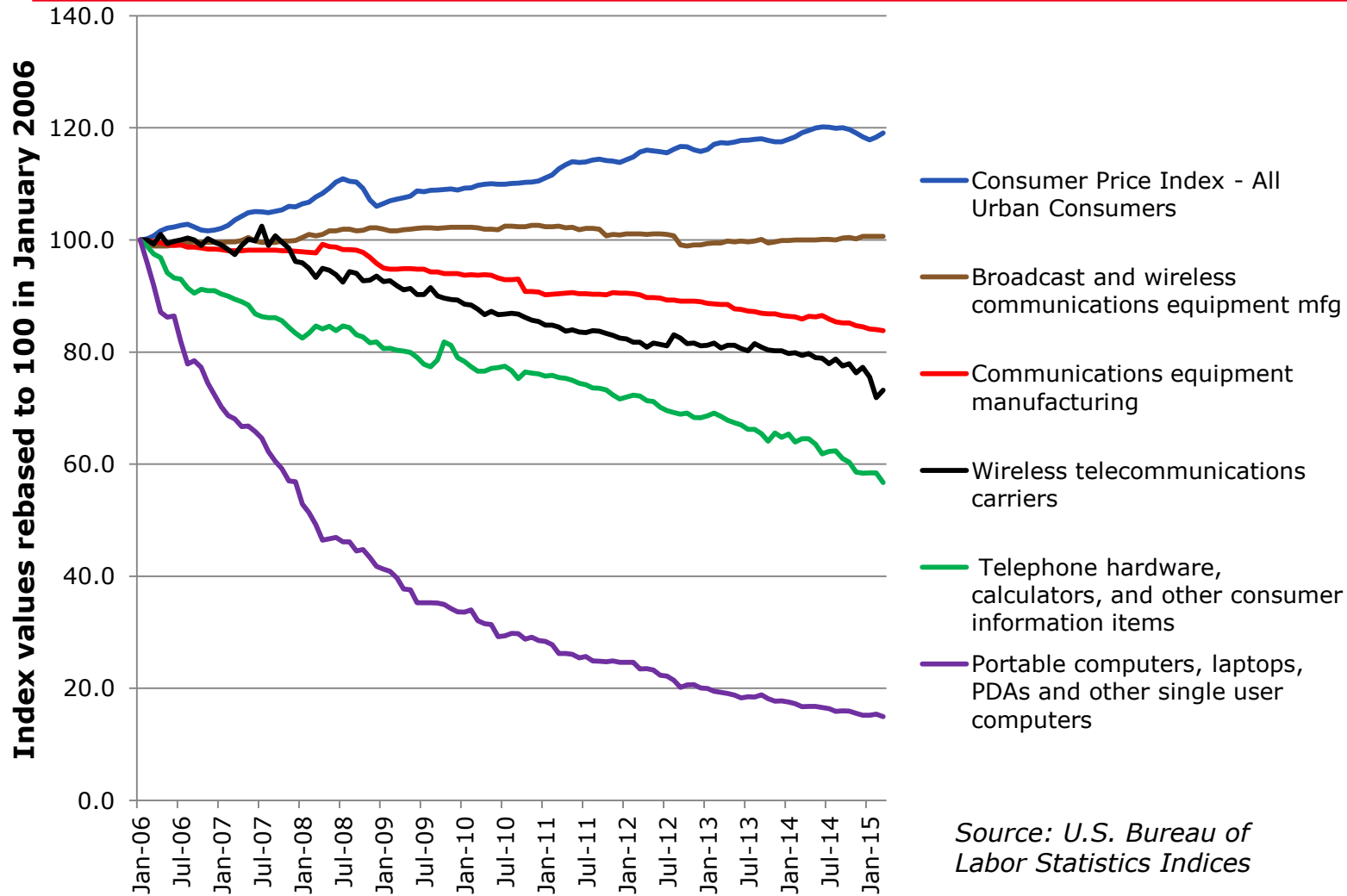
Competition: Unconcentrated Handset OEM Supply



*This widely-accepted measure of market concentration in competition analysis is calculated by summing the squared market shares of all firms in any given market



Telecom, Wireless and Personal Computing Prices Flat or Falling versus Rising CPI





Source: U.S. Bureau of Labor Statistics Indices

"Telephone" category understates smartphone price declines. PDAs are today's smartphones; which significantly exceed sales of other kinds of "portable computer" (>2 x by volume for US in 2014)



So Much More and for less Money

| Model | Nokia N93 (2006) | Samsung Galaxy S III (2013) |
|-----------------------|--|---|
| Images not to scale |  |  |
| 2G Network | GSM 900/1800/1900 | GSM 850/900/1800/1900 |
| 3G Network | UMTS (WCDMA) 2100 | HSDPA 850/900/2100 |
| 4G Network | No | LTE 700/2100 or LTE 800/1800/2600* |
| Data Speed | 384 kbps (3G) | 50 Mbps (LTE) |
| Chipset | Nokia/TI baseband processor and Texas Instruments OMAP 2420 Applications Processor | Qualcomm MSM 8960 or Exynos 4412 Quad* |
| Central processor | 332 MHz Dual ARM 11 | Dual core 1.5 GHz or Quad core 1.4 GHz Cortex-A9* |
| Graphics processor | 3D Graphics hardware accelerator | Adreno 225 or Mali-400MP* |
| Operating System | Symbian OS 9.1, Series 60 3 rd edition UI | Android OS v4.0 (Ice Cream Sandwich) or Android OS v4.1.1 (Jelly Bean)* |
| Display | TFT, 256K colours, 240 x 320 pixels, 2.4 inches, 36 x 48mm, 167 pixels per inch | Super AMOLED, 16M colours, 720 x 1,280 pixels, 4.8 inches, 306 pixels per inch |
| Touchscreen | No | Capacitive multitouch |
| Memory | 50MB storage +64 MB RAM +128 MB miniSD Card | 16GB storage, 2GB RAM, up to 64 GB microSD |
| Cameras | 3.15 megapixels, VGA @30 fps: secondary CIF videocall camera | 8MP, autofocus, LED flash: secondary 1.9MP, 720p @30 fps |
| Price without subsidy | Euro 550 x \$1.26 = \$693 | \$599-\$649 (24% cheaper with 14% cumulative inflation) |



So Much More and for less Money

| Model | Samsung Galaxy S III (2013) | August 2014 |
|------------------------------|---|--|
| Images not to scale |  |  |
| 2G Network | GSM 850/900/1800/1900 | GSM 850/900/1800/1900 |
| 3G Network | HSDPA 850/900/2100 | TD-SCDMA 2010-2025/1880-1920 |
| 4G Network | LTE 700/2100 or LTE 800/1800/2600* | TD-LTE 2570-2620/1880-1920/2300-2400 |
| Chipset | Qualcomm MSM 8960 or Exynos 4412 Quad* | Qualcomm MSM8974AC Snapdragon 801 |
| Central processor | Dual core 1.5 GHz or Quad core 1.4 GHz Cortex-A9* | Quad-core 2.5GHz Krait 400 |
| Graphics processor | Adreno 225 or Mali-400MP* | Adreno 330 |
| Operating System | Android OS v4.0 (Ice Cream Sandwich) or Android OS v4.1.1 (Jelly Bean)* | Android OS, v4.43 (KitKat) |
| Display | Super AMOLED, 16M colors, 720 x 1,280 pixels, 4.8 inches, 306 pixels per inch | IPS LCD, 16 M colors, 1080x1920 pixels, 5.0 inches , 441 pixels per inch |
| Touchscreen | Capacitive multitouch | Capacitive multitouch |
| Memory | 16GB storage, 2GB RAM, up to 64 GB microSD | 16 GB (64GB at higher price), 3GB RAM |
| Cameras | 8MP, autofocus, LED flash: secondary 1.9MP, 720p @30 fps | 13 MP, autofocus, dual-LED flash. Video includes 2140p@30fps. Secondary 8MP, 1080p@30fps |
| Launch price without subsidy | \$599-\$649 | \$400-\$460 (18% cheaper) |



Similar Spec, but at Twice the Price with Cellular*

iPod Touch 5th Generation (no cellular capabilities)



\$199 price for 16 GB version, May 2015*

iPhone 5c



\$450 price, unlocked and contract/SIM free, for 8 GB version, May 2015**

http://www.phonearena.com/phones/Apple-iPod-touch-5th-generation_id7545

http://www.phonearena.com/phones/Apple-iPhone-5c_id7983

*With equivalent comparison between iPads; cost of adding cellular is \$32 in components plus \$1 in manufacturing: <http://www.isuppli.com/Teardowns/News/Pages/New-iPad-Air-Costs-Less-to-Make-Than-Third-Generation-iPad-Model-,IHS-Teardown-Reveals.aspx>.

**According to Apple's US web site. <http://www.apple.com>



And iPhones Outsell all iPod models 46-fold in Revenues and 12-fold in Volume

From Apple's "10K" annual financial report to yearend September 2014

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Sales Data

The following table shows net sales by operating segment and net sales and unit sales by product during 2014, 2013 and 2012 (dollars in millions and units in thousands):

| | 2014 | Change | 2013 | Change | 2012 |
|--|------------------|-----------|------------------|-----------|------------------|
| Net Sales by Operating Segment: | | | | | |
| Americas | \$ 65,232 | 4% | \$ 62,739 | 9% | \$ 57,512 |
| Europe | 40,929 | 8% | 37,883 | 4% | 36,323 |
| Greater China | 29,846 | 17% | 25,417 | 13% | 22,533 |
| Japan | 14,982 | 11% | 13,462 | 27% | 10,571 |
| Rest of Asia Pacific | 10,344 | (7)% | 11,181 | 4% | 10,741 |
| Retail | 21,462 | 6% | 20,228 | 7% | 18,828 |
| Total net sales | \$182,795 | 7% | \$170,910 | 9% | \$156,508 |
| Net Sales by Product: | | | | | |
| iPhone (1) | \$101,991 | 12% | \$ 91,279 | 16% | \$ 78,692 |
| iPad (1) | 30,283 | (5)% | 31,980 | 3% | 30,945 |
| Mac (1) | 24,079 | 12% | 21,483 | (7)% | 23,221 |
| iPod (1) | 2,286 | (48)% | 4,411 | (21)% | 5,615 |
| iTunes, Software and Services (2) | 18,063 | 13% | 16,051 | 25% | 12,890 |
| Accessories (3) | 6,093 | 7% | 5,706 | 11% | 5,145 |
| Total net sales | \$182,795 | 7% | \$170,910 | 9% | \$156,508 |
| Unit Sales by Product: | | | | | |
| iPhone | 169,219 | 13% | 150,257 | 20% | 125,046 |
| iPad | 67,977 | (4)% | 71,033 | 22% | 58,310 |
| Mac | 18,906 | 16% | 16,341 | (10)% | 18,158 |
| iPod | 14,377 | (45)% | 26,379 | (25)% | 35,165 |

(1) Includes deferrals and amortization of related non-software services and software upgrade rights.

(2) Includes revenue from the iTunes Store, the App Store, the Mac App Store, the iBooks Store, AppleCare, licensing and other services.

(3) Includes revenue from the sale of accessories.

Apple is generating more that \$40 billion annually in gross profits on its iPhones with margins in the 40%-50% range in recent years



Aggregate Royalty Rate below 2.8% for the Four Licensors who Own Most Mobile SEP Value

| | 2013 | | 2014 | |
|------------------|---------------------------------|--------------------|---------------------------------|--------------------|
| | 2013 Total Royalties (millions) | 2013 Royalty Rate* | 2014 Total Royalties (millions) | 2014 Royalty Rate* |
| Qualcomm** | \$7,878 | 2.09% | \$7,862 | 1.92% |
| Ericsson | \$1,583 | 0.42% | \$1,480 | 0.36% |
| Nokia*** | \$688 | 0.18% | \$791 | 0.19% |
| InterDigital**** | \$264 | 0.07% | \$416 | 0.10% |
| Total | \$10,413 | 2.76% | \$10,549 | 2.57% |

*As a percentage of global handset revenues of \$377 billion in 2013 and an estimated \$410 billion in 2014 (Morgan Stanley)

**September yearend

***Nokia Technologies: figures for patent, technology and brand licensing

**** Net of patent disposal income in 2013

From audited company reporting in all cases. Mid-year exchange rates used



Thank You



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This presentation updates my Standards & Patents December 2013 edition slide deck.

WiseHarbor helps its clients solve commercial problems using market analysis.

Keith Mallinson is a regular columnist with IP Finance (<http://ipfinance.blogspot.com>) "where money issues meet IP rights". This weblog looks at financial issues for intellectual property rights. Keith Mallinson writes on the subject of intellectual property in standardised technologies such as those used in 2G, 3G and 4G mobile communications.

My articles with IP Finance and in trade publications are listed and linked on the WiseHarbor web site: <http://www.wiseharbor.com/publications.html>

