ABCs of Mobile Technology

Ted Moskalenko
Lead for Mobile Technologies
Client Services Group
Technology Support Services
MOBILE
MOBILE

- HARDWARE
- OPERATING SYSTEMS
- MANAGEMENT
- SECURITY
- SOFTWARE
- CARRIERS
- CLOUD
- MOBILE
- HARDWARE
- OPERATING SYSTEMS
- MANAGEMENT
- SECURITY
- SOFTWARE
- CARRIERS
- CLOUD
- MOBILE
Agenda

• Hands-On List
• Screen Technology
• Cameras
• Internal Components
• Networks
• Form Factors
• Software
Hands-On

Amazon
- Kindle Touch 3G
- Kindle HDX
- Kindle Fire 9 HD

Apple
- iPad Air
- iPad Mini
- iPhone 5C
- iPhone 5S
- iPhone 5

ASUS
- Nexus 7 (2013)
- Transformer

LG
- Nexus 5
- Nexus 4
- G2

Motorola
- Moto X
- Droid MAXX

Others
- BlackBerry Z10 & Q10
- HTC One
- Nokia Lumia 920
- Microsoft Surface Pro
- Dell Venue 8 Pro
- Lenovo ThinkPad Tablet 2

Samsung
- Galaxy Note 2
- Galaxy Note 3
- Galaxy Note 8
- Galaxy Note 10.1
- Galaxy Gear
- Galaxy S4
- Nexus 10
Display Technology
Terminology

• Epaper
• LCD: Liquid Crystal Display
  • S-LCD: Super
  • TFT: Thin Film Transistor
  • IPS: In-Plane Switching
• OLED: Organic Light-Emitting Diodes
  • AMOLED: Active-Matrix Organic Light-Emitting Diodes
    • SAMOLED: Super
• Keywords
  • Bezel
  • Contrast Ratio
  • Viewing Angle
  • Black Level
  • Nits
  • Burn-in
  • Resolution
  • Color gamut
  • Oleophobic
  • Ultrasensitive
  • Subpixels
    • RGB
    • PenTile (RGBG, RGBW)
Some Examples

- Apple iPhone 5S – 4” 16:9 LED backlit IPS TFT LCD Retina
- Samsung Galaxy S4 – 5” 16:9 Pentile RGBG Full HD Super AMOLED
- Nokia Lumia 1020 – 4.5” 15:9 AMOLED RGBG Pentile ClearBlack
- HTC One – 4.7” Full HD Super LCD 3 RGB Matrix
- Motorola Moto X - 4.7 HD AMOLED
- Amazon Kindle Paperwhite – 6” Carta e-paper technology
ePaper

1 pixel

- Transparent Electrode Layer
- Liquid Polymer Layer Containing E-ink Capsules
- Lower Electrode Layer

Appearance of pixels (seen from above through transparent electrode layer)
ePaper
LCD vs OLED
## LCD vs OLED

<table>
<thead>
<tr>
<th>Feature</th>
<th>LCD</th>
<th>OLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backlight</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Power Efficiency</td>
<td>![white]</td>
<td>![black]</td>
</tr>
<tr>
<td>Thickness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color Accuracy</td>
<td>![white]</td>
<td>![black]</td>
</tr>
<tr>
<td>Contrast Ratio</td>
<td>![white]</td>
<td>![black]</td>
</tr>
<tr>
<td>Brightness</td>
<td>![white]</td>
<td>![black]</td>
</tr>
<tr>
<td>...in Sunlight</td>
<td>![white]</td>
<td>![black]</td>
</tr>
<tr>
<td>Viewing Angle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motion Blur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burn In</td>
<td>![white]</td>
<td>![black]</td>
</tr>
<tr>
<td>Life Span</td>
<td>![white]</td>
<td>![black]</td>
</tr>
<tr>
<td>Cost</td>
<td>![white]</td>
<td>![black]</td>
</tr>
<tr>
<td>Sub pixel Arrangement</td>
<td>RGB</td>
<td>RGB, Pentile (RGBG, RGBW)</td>
</tr>
<tr>
<td>Variants</td>
<td>Super LCD IPS</td>
<td>Super AMOLED</td>
</tr>
</tbody>
</table>
LCD vs OLED (Subpixels)
RGB vs PenTile RGBW
## LCD vs OLED (Power Consumption)

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Power Con.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AMOLED</td>
</tr>
<tr>
<td></td>
<td>738.00mW</td>
</tr>
<tr>
<td></td>
<td>176.25mW</td>
</tr>
<tr>
<td></td>
<td>90.75mW</td>
</tr>
<tr>
<td></td>
<td>146.25mW</td>
</tr>
<tr>
<td></td>
<td>126.75mW</td>
</tr>
<tr>
<td>%</td>
<td>330%</td>
</tr>
<tr>
<td>(AMOLED/TFT-LCD)</td>
<td>40.27%</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Resolution

- **SD**: (720 x 576)
- **HD**: (1280 x 720)
- **FHD**: (1920 x 1080)
- **2K**: (2160 x 1080)
- **QHD**: (2560 x 1440)
- **UHD**: (3840 x 2160)
- **4K**: (4096 x 2160)
PPD

Inverse-tan(.5/11)=2.60°

11 inches
14.2 inches

2.60°

one inch
half inch

iPhone 4 display - 326 PPI - 62.6 PPD

3.7” OLED 800x480 display - 252 PPI - 62.6 PPD

20/20 eye limit = 30 cycles per degree
Theoretical eye limit = 50 cycles per degree

iPhone 3G display - 163 PPI - 62.6 PPD
Smartphone Screen PPI Trend

Pixels Per Inch (PPI)

- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014

- WQHD
- 1080p
- HD 720
- HTC
- SONY
- Galaxy Note
- Nokia Lumia
- Samsung Galaxy
- Motorola
- Apple

- HTC
- Sony
- Samsung
- Apple
- Motorola
- Nokia
- Samsung
- Apple
- Motorola
- Nokia
- Samsung
- Apple
- Motorola
- Nokia
- Samsung
- Apple
Smartphone Screen PPI Trend

Pixels Per Inch (PPI)

- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015

- 150
- 200
- 250
- 300
- 350
- 400
- 450
- 500
- 550
- 600

- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015

- HD
- 720p
- 1080p
- WQHD
Higher Density Displays: Coming Very Soon

- LG QuadHD Display
  - Announced 8/21/13
  - AH-IPS LCD
  - 2560x1440, 5.5”
  - 538 PPI
  - 1.21 mm thin
  - 1.2 mm bezel
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• Ultrasensitive
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  • PenTile (RGBG, RGBW)
Camera Technology
Terminology

• Attributes
  • Aperture
  • Resolution
  • Sensor Size
  • Pixel Size
  • Speed
  • Flash
    • LED (Dual LED)
    • Xenon
  • Video recording
    • 4K

• Technologies
  • Image Stabilization
    • Optical (OIS) vs Digital
  • Lytro
  • Attachables

• Software Improvements
  • HDR
  • SlowMo
  • HTC Zoe
  • Nokia Pro Cam
Aperture

f/2.6 Galaxy S3
f/2.4 iPhone 5
f/2.0 HTC
Sensor Size

Relative Sensor Size

- 1/1.2" Nokia 808
- 1/1.5" Nokia Lumia 1020
- 1/1.83" Nokia N8
- 1/2.3" Sony Xperia Z1
- 1/2.3" Galaxy S4 Zoom
- 1/3" HTC One
- 1/3" Nokia Lumia 920
- 1/3" Apple iPhone 5s
- 1/3.2" Samsung Galaxy S4
- 1/3.2" HTC One X
- 1/3.2" Nokia N9, Lumia 800
Pixel Size

[Image of pixel size comparison with dimensions and labels]

- HTC: 4 \mu m^2
- 8 MP: <2 \mu m^2
- 13 MP: <1.3 \mu m^2
- Leading Competition: 1.1 \mu m
- 1.4 \mu m
- 2.0 \mu m

[Image includes a comparison of pixel sizes with labels for different camera resolutions.]
OIS (Optical Image Stabilization)
Nokia Lumia 1020
41 REASONS WHY NOTHING ELSE COMES CLOSE

NOKIA LUMIA 1020

- Amazing pictures made easy with Nokia Pro Camera App
- Freelancer grip and wrist strap for increased control
- Use blurring to highlight action with Motion Focus
- Rich recording with stereo sound for unbelievable bass and treble
- Shoot blur-free HD video to better capture those moving moments
- Add movement with Action Shot
- Silent zoom on video so you only capture the sounds that matter
- Set the Exposure Value (EV) to control image brightness
- Adjust ISO to match light sensitivity to the moment
- Excellent low-light performance
- Set focal length manually and review later if you want to
- High-resolution AMOLED screen and Gorilla Glass 3
- Amazing camera and smartphone in one
- Teach you how to take better photos with built-in tutorials
- Slot design slips in your pocket with ease
- Largest smartphone back side illuminated 808 sensor, ever
- Two flash: Xenon and LED for the best night photos
- ZEISS optics for true-to-life images and video
- High-quality Images for instant sharing and one for reframing
- Live Tiles and one-touch access to social media with Windows Phone OS
- Fast-growing imaging app ecosystem using 1020’s extraordinary camera
- Capture and curate with Hipstamatic OGGP Pro app
- Siren Imaging app, Photosynth, Burberry, Panasonic, Photobeamer
- Dual capture saves one image for instant sharing and one for reframing
- Never get lost with HERE Maps & Drive
- Optical Image Stabilisation for blur-free images
- Capture more details than you imagined possible
- Wireless charging optional
- Six ZEISS lenses for the sharpest images imaginable
- Bell-helmers support floating lens for maximum accuracy
- Select the best from a quickly taken series
- Refine your photos to discover and rediffer stories
- Remove moving guests from your pictures
- Tap and send with NFC
- Easy sharing with pictures from pocket to Facebook in seconds
- Nokia Smart Camera lets you do more with your photos
- Easy access to photos stored on SkyDrive
- 41-megapixel sensor captures extraordinary detail
- Lensless zooming means getting closer than ever before
- 6-12 Dual capture saves one image for instant sharing and one for reframing
- Optical Image Stabilisation for blur-free images
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A complex arrangement of lenses captures all incoming light, preserving as much optical data as possible.

A sensor fitted with a microlens array records the color, light, and direction of about 11 million light rays.

A processor converts information from the sensor into a database that can be analyzed to extract images.
Lytro in Smartphones?
QX100

- Connects your smartphone to a better quality camera
- NFC/Wi-Fi for smartphone connection
- Saves images on both camera and phone
- Use apps to edit and share photos
- Manually control shots via smartphone display
- 1" sensor
- 3.6x f/1.8 Carl Zeiss zoom lens
- High-quality 1080/30p HD video with lower noise
Nokia Pro Cam
Capture the Right Moment
Terminology

• Attributes
  • Aperture
  • Resolution
  • Sensor Size
  • Pixel Size
  • Speed
  • Flash
    • LED (Dual LED)
    • Xenon
  • Video recording
    • 4K

• Technologies
  • Image Stabilization
    • Optical (OIS) vs Digital
  • Lytro
  • Attachables

• Software Improvements
  • HDR
  • SlowMo
  • HTC Zoe
  • Nokia Pro Cam
Internal Components
Terminology

• CPU
• SoC
• RAM
• Bluetooth
• WiFi
• NFC
• Qi Wireless charging – Magnetic Induction
• Sensors
Faster Processors, More RAM

- 2-step approach:
  - AP with ARM’s 64-bit core
  - AP with Samsung’s own 64-bit core
SoC vs CPU

The CPU is only ~15% of a modern SoC

- Basic computing
- Always on
  - Required for mobile

- KRAIT CPUs
- ADRENO GPU
- HEXAGON DSP
- CONNECTIVITY
  - 4G LTE, WiFi, USB, BT and FM
- MULTIMEDIA
  - Audio, video, and gestures
- SENSORS
- ISPs
- DISPLAY/LCD
- IZat NAVIGATION

Innovative user experiences
Qualcomm Snapdragon

Krait 400 CPU features 28nm HPM process technology, superior 2GHz performance
Adreno 330 for advanced graphics
Hexagon QDSP6 for ultra low power applications and custom programmability
Integrated 802.11ac, USB 3.0 and BT 4.0 offers broad array of high speed connectivity

Ultra HD Capture and Playback
DTS-HD and Dolby Digital Plus audio
Expanded Gestures

55MP with dual ISP
Support for up to 2560x2048 display
MiraCast 1080p HD support
IZat GNSS with support for three GPS constellations

600 PROCESSOR

Krait 300 CPU provides improved, sustained performance in a mobile power profile
Speed enhanced Adreno 320 GPU
Hexagon QDSP6 for ultra low power applications

Integrated 802.11ac, USB 2.0 and BT 4.0 offer broad array of high-speed connectivity

1080p HD Capture and Playback
DTS-HD and Dolby Digital Plus audio
Up to 21MP
Support for up to 2560x1536 + 1080p external display
IZat GNSS
Motorola X8
Apple M7

Continuously measures motion data
Accelerometer, gyroscope, compass
Enables a new generation of health and fitness apps
Apple M7
Sensors

• GPS
• WiFi
• Bluetooth
• Accelerometer
• Gyroscope
• Magnetometer
• Barometer
• Proximity
• Light Sensor
Hidden Innovation in the GALAXY S4

GALAXY S4 gets you closer to what matters in life, bringing your world together.

- **Gesture Sensor**: Recognizes the user’s hand movements using infrared rays
  - Air Gesture

- **Proximity Sensor**: Recognizes whether the mobile phone is located near the user by using infrared rays
  - Direct Call

- **RGB Light Sensor**: Measures the red, green, blue, and white intensity of the light source
  - Samsung Adapt Display

- **Hall Sensor**: Recognizes whether the cover is open or closed
  - S View Cover

- **Gyro Sensor**: Detects the mobile phone rotation state based on three axes
  - Smart Rotation

- **Accelerometer**: Detects the mobile phone movement state based on three axes
  - S Health: Walking Mate

- **Barometer**: Identifies the atmospheric pressure at the user’s current location
  - S Health: Walking Mate

- **Temperature Humidity Sensor**: Checks temperature and humidity levels
  - S Health: Comfort Level

- **Geomagnetic Sensor**: Detects magnetic field intensity based on three axes
  - Digital Compass MAP

SAMSUNG TOMORROW
Terminology

- CPU
- SoC
- RAM
- Bluetooth
- WiFi
- NFC
- Qi Wireless charging – Magnetic Induction
- Sensors
Form Factor
Terminology

• Modular Design
• Curved/Flexible
• Hardened
  • Water/Dust Proof
Form Factor (Size)

Tablet >9”
Small Tablet 7”<9”
Phablet 5”<7”
Smartphone <5”
Modular Devices
Curved and Flexible Displays
Hardened Devices

• Flexible
• Water Proof
• Self-healing
Terminology

• Modular Design
• Curved/Flexible
• Hardened
  • Water/Dust Proof
Networks
Terminology

- LTE
  - VoLTE
  - LTE-A
- HSDPA+
- GSM
- CDMA
- WIMAX
Software
Terminology

• Android skins
  • Samsung TouchWiz Nature UX 2.5
  • HTC Sense 5
  • LG
  • Motorola
  • Sony Xperia UI
• Launcher
• ROM
• Root/Jailbreak
• Voice Controls
Motorola Software – Capability Requirements

- AMOLED Screen
- SoC Always-On Cores
  - Language
  - Contextual Computing
Latest OS Updates
Apple iOS

- Redesigned UI
- Added features
  - Multitasking
  - Notifications
  - Enterprise
- Activation Lock
Taking Back Android

• Google has begun rolling releases for critical components of Android.
• Doing so improves efficiency of OTA updates.
• Now has 64 Apps in the Play Store.
• “Google Play Edition” Devices.
Human Interface
Q&A
Thank You!
Smartphone Product Announcement Trend