Is this the End of Mobile as we Know it? Smartphones in a 5G and IOT enabled World.

Thursday, October 24th
2 PM

Dritan Nesho
CEO

152 (Concourse Level 1)
Will Smartphones still reign supreme in a 5G and IoT world?

How will the role of the smartphone shift as 5G comes to life and IoT devices proliferate around the connected consumer?

What will mobile phones look like as machine learning, artificial intelligence, and ambient computing begin to penetrate our lives?

This presentation looks at data from several of HarrisX’s studies:

- Connected Devices – a monthly survey of 8,500 Connected Consumers
- Telephia – a ongoing panel 4,000+ MAUs from the newly unveiled Telephia App – part of HarrisX’s consumer behavior tracking platform
- 5G Intelligence Tracker – a monthly study of over 15,000 wireless subs, 10,000 household decision makers, and 1,000 business decision makers

We compare nascent IoT app usage trends on smartphones with non-IoT content and mobile device usage trends.
About HarrisX & Telephia in 60 Seconds

HarrisX is a research platform focused on Connected Consumers and their landscape of services and devices.

- Smart appliances
- Home automation
- Smart speakers/home hub
- Wireless home security

- Smart TV
- Connected gaming consoles
- Streaming media players
- Smart speakers

- Mobile Phones
- Tablets
- Connected Cars
- Connected Wearables
- Connected Devices
- Consumer Internet of Things

- Services
  - Wireless
  - Wireline
  - TV service
  - Internet service
  - Home security
  - Streaming Services
We specialize in marrying Survey Research with Behavioral Research to understand both attitudes and action across hardware and services.

**WHY HARRISX?**
HarrisX changes the dynamics of research

FROM
180 Degree View
Attitudinal Research + Respondent Recall

TO
360 Degree View
Attitudinal Research + Respondent Behavior Through Measured Data

PASSIVE MEASUREMENT:
Measured Research w/in the Operating System

Our Syndicated Surveys:
Stated Research through Online Surveys

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Our next generation Telephia app unlocks the layers behind the device to capture user’s true data, usage, and behaviors

**APPLICATION LAYER**
Taps into all applications that are used on the device. Which ones, how long, when, where, etc.

**DEVICE LAYER**
Measures all background usage and sensors. Device turned on, off, location, device performance, battery, etc.

**NETWORK LAYER**
Detects and measures all network traffic and usage, including cellular, Wi-Fi and Bluetooth
Telephia also gives consumers an opportunity to earn money for their data and opinions, and saves them some money too.

1. Download Meter
2. Take Surveys
3. Assess Your Network
4. Cash Out Automatically
5. Refer Your Friends

In General Availability today in the iOS & Android store

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Since 2016, smartphone penetration in the US has grown exponentially, reaching ~92% in September 2019

U.S. Smartphone Penetration
Base: All Respondents

Sample (n): ~31K respondents/month

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And there’s still a lot of room left for growth in the smartphone space, as the next 4 billion are digitized and 5G phones roll out.
The IoT Opportunity: $1.1 trillion global revenues by 2025

**GLOBAL REVENUES BY 2025 – $1.1 TRILLION**
- 30% North America
- 70% Rest of World

**CONNECTED DEVICES BY 2025 – 25 BILLION**
- 24% North America
- 76% Rest of World

Source: GSMA Intelligence 2018, from APAC IoT Innovation Summit, September 2019
What connected consumers are telling us about IoT...

The connected ecosystem in and out of the home is growing fast

More smartphone owners are using connected devices & technologies
US Smartphone Owners (%)
The number of connected devices used by each smartphone owner is also on the rise.

The device mix:
- Fitness bands
- Smartwatches
- Connected cars
- Smart Speakers
- Smart TVs
- Smart Home Tools

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Jul-18</th>
<th>Jul-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+ of the mix</td>
<td>15%</td>
<td>17%</td>
</tr>
<tr>
<td>3 of the mix</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>2 of the mix</td>
<td>31%</td>
<td>31%</td>
</tr>
<tr>
<td>1 of the mix</td>
<td>45%</td>
<td>40%</td>
</tr>
<tr>
<td>None of the mix</td>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Are you the primary user of the following devices?
July 2018/July 2019: (n=27,835/28,362)

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Consumer IoT leads in terms of penetration within homes today

The Smart Speaker segment leads adoption of connected home technologies

All Households aware of connected technologies

Please indicate how familiar you are with each of the below connected home technologies which you can control from an app, website, or with your voice.

Q2 2019: (n=5,562)
Consumers are looking for improvements in device connectivity and ease of use at home

### Desired Improvements for Connected Home Technologies

**Connected Home Technologies User**

What, if anything, do you want to improve about your connected home technologies?

Q2 2019: Smart speaker (n=1,487), Wireless home security (n=990), Smart thermostats (n=876), Smart lighting and switches (n=766), Smart home hub (n=685), Smart smoke detector (n=679), Smart outlets (n=614), Smart appliances (n=520), Smart locks and garage control (n=510), Sprinkler and irrigation controls (n=418)

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Most consumers say they still rely on smartphones to manage connected technologies within the homes

How do you connect to or control your connected home technologies? What is the primary way you connect to or control your connected home technologies?

Q2 2019: Connected Home technologies users (n=2,399)

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5G is where smartphones come together IoT to show us they have a long staying power

Consumers who own multiple IoT devices are generally more familiar and favorable towards 5G

How favorable are you towards 5G? How familiar are you with 5G?

July/August 2019: None of the mix (n=9,223), 1 of the mix (n=7,793), 2 of the mix (n=4,360), 3 of the mix (n=1,976), 4 of themix (n=686), all of the mix (n=187)

* The mix: Fitness band, Smartwatch, Connected car, Smart Speaker, Smart TV
Furthermore consumers who are favorable towards 5G are also more likely to own multiple connected devices, creating a virtuous cycle.

**Linear Regression Analysis**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS smartphone</td>
<td>0.349112</td>
</tr>
<tr>
<td>Favorability towards 5G</td>
<td>0.249652</td>
</tr>
<tr>
<td>Android smartphone</td>
<td>0.229943</td>
</tr>
<tr>
<td>Familiarity with 5G</td>
<td>0.211437</td>
</tr>
<tr>
<td>Family and Friends</td>
<td>0.100903</td>
</tr>
<tr>
<td>TV/Online/Radio Ad</td>
<td>-0.110626</td>
</tr>
</tbody>
</table>

5% Significance shown by bolded coefficients.

Base: All respondents who had answered questions in MI about 5G familiarity and CL about IoT first exposure (June, July, August), N = 2,268
Dependent Variable: Number of IoT devices owned by user, range from 0 – 10.
Independent Variables: Awareness/Favorability of 5G, current smartphone OS, Age, Where they first heard of IoT devices

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Consumers spend less time on IoT apps, an average of 34 seconds per session vs 181 seconds for all apps...

<table>
<thead>
<tr>
<th>IoT app</th>
<th>Average time per app session (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YouTube</td>
<td>770</td>
</tr>
<tr>
<td>Chrome</td>
<td>255</td>
</tr>
<tr>
<td>Google</td>
<td>197</td>
</tr>
<tr>
<td>Facebook</td>
<td>143</td>
</tr>
<tr>
<td>Amazon Alexa</td>
<td>89</td>
</tr>
<tr>
<td>Blink</td>
<td>53</td>
</tr>
<tr>
<td>Google Nest</td>
<td>39</td>
</tr>
<tr>
<td>Samsung SmartThings</td>
<td>33</td>
</tr>
<tr>
<td>ADT</td>
<td>32</td>
</tr>
<tr>
<td>Philips (Hue)</td>
<td>31</td>
</tr>
<tr>
<td>Comcast Xfinity Home</td>
<td>31</td>
</tr>
<tr>
<td>Fitbit</td>
<td>30</td>
</tr>
<tr>
<td>Google Home</td>
<td>29</td>
</tr>
<tr>
<td>Ring</td>
<td>26</td>
</tr>
<tr>
<td>Samsung (Health/Fit)</td>
<td>22</td>
</tr>
<tr>
<td>Garmin</td>
<td>20</td>
</tr>
<tr>
<td>Google Fit</td>
<td>14</td>
</tr>
<tr>
<td>Honeywell Total Connect</td>
<td>14</td>
</tr>
</tbody>
</table>
... but usage on cellular networks is comparable between IoT apps (an average of 45% on cellular vs WiFi) compared with 43% for all apps.
And IoT apps are as often used often outside the home as they are inside.

**IoT App usage in-home vs out**

<table>
<thead>
<tr>
<th>App</th>
<th>Outside home</th>
<th>In-home</th>
</tr>
</thead>
<tbody>
<tr>
<td>LG</td>
<td>23%</td>
<td>77%</td>
</tr>
<tr>
<td>Amazon Alexa</td>
<td>32%</td>
<td>68%</td>
</tr>
<tr>
<td>Google Fit</td>
<td>36%</td>
<td>64%</td>
</tr>
<tr>
<td>Blink</td>
<td>39%</td>
<td>61%</td>
</tr>
<tr>
<td>Google Home</td>
<td>43%</td>
<td>57%</td>
</tr>
<tr>
<td>Samsung (Health/Fit)</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td>ADT</td>
<td>46%</td>
<td>54%</td>
</tr>
<tr>
<td>Garmin</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>Fitbit</td>
<td>56%</td>
<td>45%</td>
</tr>
<tr>
<td>Samsung SmartThings</td>
<td>61%</td>
<td>39%</td>
</tr>
<tr>
<td>Ford Sync</td>
<td>68%</td>
<td>32%</td>
</tr>
<tr>
<td>Google Next</td>
<td>80%</td>
<td>20%</td>
</tr>
<tr>
<td>Ring</td>
<td>82%</td>
<td>18%</td>
</tr>
<tr>
<td>Philips (Hue)</td>
<td>82%</td>
<td>18%</td>
</tr>
<tr>
<td>Ato</td>
<td>88%</td>
<td>13%</td>
</tr>
</tbody>
</table>

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The US market is mature, with very slow subscriber growth. This drives a focus on two primary value creation tactics – both of which are a race to the bottom:
1. Revenue growth from the existing base
2. Customer retention, or churn reduction

5G will create sizeable new use cases – but monetization, & who captures it, that’s another question.

The 5G business case is difficult: is it’s really all about network perception?

“Getting a deal” drives switching, “Perception” of network quality drives retention.

– 5G deployment can impact the first,
– 5G marketing can impact the second...

Spectrum considerations will impact Carrier product more than with previous wireless generations.
The US market is mature, driving carriers to search for revenue growth from their existing base.

Number of mobile phone users in the U.S. from 2012 to 2020 (in millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Users (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>232.2</td>
</tr>
<tr>
<td>2011</td>
<td>237.4</td>
</tr>
<tr>
<td>2012</td>
<td>242.2</td>
</tr>
<tr>
<td>2013</td>
<td>247.2</td>
</tr>
<tr>
<td>2014</td>
<td>252.8</td>
</tr>
<tr>
<td>2015</td>
<td>258.0</td>
</tr>
<tr>
<td>2016*</td>
<td>262.2</td>
</tr>
<tr>
<td>2017*</td>
<td>265.9</td>
</tr>
<tr>
<td>2018*</td>
<td>270.4</td>
</tr>
<tr>
<td>2019*</td>
<td>273.8</td>
</tr>
<tr>
<td>2020*</td>
<td>276.7</td>
</tr>
</tbody>
</table>

Growth in phone subscribers from 2019 to 2020: ~1%
As growth stalls, carriers look to add: Lines per account, tablets, smart watches, and other subscription services.
Contrasting expected benefits vs. Anticipated new capabilities

Fact is: Neither users nor the industry really know what will emerge...

Faster speed
More reliable service
Higher quality streaming
Wider network coverage
More connections
Better plan options
Home BB replacement
New technologies
Cable TV replacement

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Consumers haven’t internalized how 5G will impact them.

Q90051: How much of an impact do you expect 5G will have on the following?
Data shown pertain to sum of % choosing “A great deal” and “Somewhat” on a 4-pt scale. July/August 2019

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And there are few expectations for disruption outside of Telecom and Emergency Services

Top industries 5G is expected to benefit

- Telecommunications
- Emergency services
- Transportation
- Healthcare
- Engineering
- Education
- Retail
- Manufacturing
- Real estate

Wireless Subscribers: 72%
BDMs: 67%

Q90052: Which of the following is closest to your view?
Q90054: What industries do you believe will benefit from technologies enabled by 5G? Wireless Subs (N=24,606), BDMs (N=731)
Today speed is the underlying theme touted by most BDMs as a benefit of 5G

Maybe its not about the need for speed?

Other specific themes included

- Increased productivity/connectivity/collaboration with employees and clients
- Greater AI capabilities

I work in e-commerce, so having faster, more reliable service will improve the service I can provide.

Improved access to customer information. Shorter lead times in obtaining information from our data bases and information outside our systems.

I work in healthcare. Telehealth services are becoming widely used. This will greatly improve data quality and speed for sending complex documents.
In fact, both BDMs and Consumers are focused primarily on speed increases:

<table>
<thead>
<tr>
<th>Benefit</th>
<th>BDMs</th>
<th>Wireless Subs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faster Speed</td>
<td>68%</td>
<td>66%</td>
</tr>
<tr>
<td>Higher quality streaming</td>
<td>48%</td>
<td>40%</td>
</tr>
<tr>
<td>More reliability</td>
<td>46%</td>
<td>40%</td>
</tr>
<tr>
<td>Wider network coverage</td>
<td>39%</td>
<td>35%</td>
</tr>
<tr>
<td>Better service plan options</td>
<td>33%</td>
<td>21%</td>
</tr>
<tr>
<td>Ability to connect more devices to the internet</td>
<td>32%</td>
<td>22%</td>
</tr>
<tr>
<td>Enhanced communication</td>
<td>31%</td>
<td>26%</td>
</tr>
<tr>
<td>Enhanced data security</td>
<td>31%</td>
<td>27%</td>
</tr>
<tr>
<td>Accelerated development of new technologies</td>
<td>27%</td>
<td>18%</td>
</tr>
<tr>
<td>Increased productivity for employees on the go</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td>Upgrade home internet to 5G</td>
<td>20%</td>
<td></td>
</tr>
</tbody>
</table>

But some BDMs are starting to think more about IoT applications.

Q90048. Which of the following potential benefits about 5G, if any, are you excited about? Wireless subs (N=24,606) BDMs (N=731)

July/August 2019
Most BDMs believe 5G will be worth paying for, while wireless consumers are split on its value.

Q90073. Based on what you know, how strongly do you agree or disagree with the following statement?
"Given the anticipated benefits of the technology, 5G is worth paying more for”
BDMs (N=731), Wireless Subs (N= 24,606)
July/August 2019
GETTING A DEAL” drives switching

NETWORK” perception & customer service drive retention

Willingness to pay… only if more value is delivered

- Dramatically more data
- Many more devices
- Much greater capability and utility
- Displacement of other costs

Will switch for 5G
(as long as the phone/device is free…???)
And the industry already struggling to get a return on capital investment...

Operator struggle to make business case for 5G

By Matt Kapko | Feb 14, 2019 1:39 pm

5G

U.S. Mobile Operators Will Spend $100B on 5G by 2020, Study Says

The latest GSMA Intelligence report on 5G estimates that U.S. operators will spend about $100 billion (excluding spectrum acquisitions) between 2018 and 2020 on upgrading their LTE networks and investing in 5G.

That equals to about $33 billion per year and accounts for about 15 percent of mobile revenue per year during that time frame. However, expansion of 5G to a larger footprint, especially in rural areas, could require more capex than what is forecast in 2020, the group said.

Total Wireless CAPEX in US will exceed $33B in 2019

Persistently negative capital value margins in the industry

Note: WACC = Weighted Average Cost of Capital; ROI = Return On Invested Capital.

Source: PuC analysis.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Last Price</th>
<th>Change</th>
<th>Chg %</th>
<th>Currency</th>
<th>Market Time</th>
<th>Volume</th>
<th>Shares</th>
<th>Avg Vol (M)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>+0.64</td>
<td>+2.00%</td>
<td>USD</td>
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<td>S</td>
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<td>TMUS</td>
<td>78.50</td>
<td>+4.13</td>
<td>+5.48%</td>
<td>USD</td>
<td>11:07AM EDT</td>
<td>10.597M</td>
<td></td>
<td>3.138M</td>
</tr>
</tbody>
</table>
Spectrum matters – what’s the sweet spot for 5G?

Trump’s FCC Is Auctioning the Wrong 5G Spectrum

If the US wants to be a leader, our tests show that Ajit Pai’s plan to liberation massive amounts of millimeter-wave airwaves are breaking up the wrong light poles.

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The strategic role of 5G for OEMs in the U.S.

The US market is mature, with very slow subscriber growth.

Carrier "switching" is a purchase-driver for new smartphones, but industry churn is at an all time low.

Upgrade cycles are lengthening as a result of:

- The end of "subsidy" purchase method, which established a $199 price point for new smartphones.
- New iconic price points well above $1,000.
- Phones are lasting longer, less differentiated, and less exciting in terms of new features.
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