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September 11, 2017

EX PARTE **NOTICE VIA ECFS**

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

RE: *Notice of Ex Parte Communication*; Authorizing Permissive Use of the "Next Generation" Broadcast Television Standard; GN Docket No. 16-142

Dear Ms. Dortch,

T-Mobile USA, Inc. ("T-Mobile") provides herein for the record in this proceeding a technical white paper entitled "Complications Associated With ATSC 3.0 Implementation In Mobile Devices." This paper discusses in detail the significant challenges associated with ATSC 3.0 reception in existing mobile devices. As the Commission works toward completing a review of the new ATSC 3.0 standard, T-Mobile believes it would be beneficial to have a full understanding of the technical efforts necessary to integrate ATSC 3.0 into mobile wireless equipment. This includes the potential harm that imposing a mandate to include ATSC 3.0 in devices would have on device performance, efficient use of spectrum, and competition. In particular:

- Mobile devices require an entirely new receiver chain for ATSC 3.0 reception, including new antenna(s), filters, amplifiers, oscillators, and ATSC 3.0 demodulator/receiver. Adding dedicated ATSC 3.0 receive integrated circuitry increases cost and size of mobile devices that are likely to render them uncompetitive with devices without ATSC 3.0 capabilities;
- ATSC 3.0 requires a new antenna (or more likely a new antenna array) within a mobile device that will likely degrade performance for LTE, 5G, and ATSC 3.0 reception, including in bands currently used for competitive broadband services. Degrading mobile reception performance results in less efficient use of spectrum, degraded service to Americans (particularly in rural areas and for E911), and reduces competition;

- Including the larger antenna and additional components necessary to support ATSC 3.0 would consume a significant amount of space. The limited physical space in a mobile device should be available for more valuable uses than ATSC 3.0, such as 4x4 MIMO functionality, which provides more efficient use of spectrum, increased throughput, capacity, and coverage;
- ATSC 3.0 will not enhance public safety and emergency message delivery but instead would be an inferior platform compared to the well-established wireless network; and
- Interference to wireless reception will occur, particularly for devices operating in the 600 MHz band, unless the mobile device is modified extensively and in a way that is likely to make those devices uncompetitive commercially.

ATSC 3.0 reception is a complicated issue that requires significant effort and careful consideration of the impact on the overall performance of a mobile device. This technical paper provides information on the many trade-offs associated with ATSC 3.0 mobile device integration. Particularly in light of the detrimental effects that inclusion of ATSC 3.0 can have on the cost and size of a device, the technology trade-offs required to accommodate competing technologies, and the reduced performance and spectral efficiency that it will have for other mobile bands and services, the decision as to whether to include ATSC 3.0 in a device must be left to the market to decide.

Pursuant to Section 1.1206(b)(2) of the Commission's rules, the attached has been filed electronically with the Commission. Please direct any questions regarding this filing to the undersigned.

Respectfully submitted,

/s/ Steve B. Sharkey

Steve B. Sharkey
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Attachment

Complications Associated With ATSC 3.0 Implementation In Mobile Devices

Technical White Paper

September 2017

I. EXECUTIVE SUMMARY

Broadcast entities argue that ATSC 3.0, the new digital television standard, can easily integrate into existing mobile devices.[1] This technical white paper discusses the significant issues associated with implementing ATSC 3.0 mobile device reception capability. ATSC 3.0 reception requires substantial modifications to wireless phones that could harm product functionality. Mobile products are tightly configured to maximize the small device footprint and provide consumer benefits. The receive chain and antenna configuration within mobile products are optimized for efficient and effective reception of a multitude of different RF transmissions. Adding a new ATSC 3.0 capability sacrifices device performance and inhibits emergency communications, including 911 calls. This white paper describes the significant issues associated with mobile device reception of ATSC 3.0.

In particular:

- Mobile devices require an entirely new receiver chain to receive ATSC 3.0, including new antenna(s), filters, amplifiers, oscillators, and ATSC 3.0 demodulator/receiver. Adding dedicated ATSC 3.0 receive integrated circuitry increases cost and size of mobile devices that are likely to render them uncompetitive with devices without ATSC 3.0 capabilities;
- ATSC 3.0 requires a new antenna (or more likely a new antenna array) within a mobile device that will likely degrade performance for both LTE, 5G and ATSC 3.0 reception, including in bands currently used for competitive broadband services. Degrading performance for mobile bands results in less efficient use of spectrum, degraded service to Americans (particularly in rural areas and for E911), and reduces competition;
- Including the larger antenna and additional components necessary to support ATSC 3.0 would consume a significant amount of space. The limited physical space in a mobile device should be available for more valuable uses than ATSC 3.0, such as 4x4 MIMO functionality, which provides more efficient use of spectrum, increased throughput, capacity and coverage;
- ATSC 3.0 will not enhance public safety and emergency message delivery but instead would be an inferior platform compared to the well-established wireless network; and
- Interference to wireless reception will occur, particularly for devices operating in the 600 MHz band, unless the mobile device is modified extensively and in a way that is likely to make those devices uncompetitive commercially.

ATSC 3.0 reception is a complicated issue that requires significant effort and careful consideration of the impact on the overall performance of a mobile device. This technical paper provides information on the many trade-offs associated with ATSC 3.0 mobile device integration and clearly identifies the potential performance degradation that inclusion of ATSC 3.0 can have on the provision of competitive wireless services.

[1] *See* M.Aitken, M. Simon, L. Libin, *Sinclair's 3.0 Vision – The Future of Broadcasting* (released April 22, 2017).

II. BACKGROUND

ATSC, or the Advanced Television Systems Committee, is an international, non-profit organization that develops voluntary standards for over-the-air reception of digital television signals.[2] The early efforts of ATSC led to the development of the ATSC 1.0 standard, which is used today to deliver High Definition (HD) and Standard Definition (SD) television to over-the-air viewers. ATSC 1.0 was designed to transmit high quality video, audio, and ancillary data over a single six megahertz channel.[3] The system can deliver approximately 19 Mbps of throughput in a 6 MHz terrestrial broadcasting channel (19.4 Mbps) employing the MPEG-2 transport stream syntax for the packetization and multiplexing of video, audio, and data signals.[4] For RF transmission, ATSC 1.0 relies upon an 8-VSB modulation method that is fully described in the ATSC Digital Television Standard Part 2 – RF/Transmission System Characteristics (A/53).[5] The 8-VSB modulation scheme was well-suited to replicating analog television signals and enabling the development and deployment of more spectrally efficient digital over-the-air broadcasting signals. However, it is neither optimized for mobile services, nor for today's data-intensive networks that rely upon Internet Protocol (IP).[6]

Over the past several years, the ATSC has been working to finalize a new television standard, ATSC 3.0, that would update the existing television modulation scheme. This new physical layer protocol is defined in ATSC Standard: Physical Layer Protocol (A/322).[7] The new ATSC 3.0 physical layer standard is built upon an Orthogonal Frequency Division Multiplexing (OFDM) modulation scheme that is consistent with the modulation used by wireless mobile networks and offers broadcasters the flexibility to choose among many different operating modes (depending on desired robustness/efficiency tradeoffs).[8] This allows more efficient use of the six megahertz broadcast channel and enables the transmission of bit rates from less than 1 Mbps to over 57 Mbps (or nearly triple the bit rate supported by ATSC 1.0).[9] Moreover, rather than relying upon MPEG-2, the new ATSC 3.0 standard is IP-based, allowing for more flexibility in delivery of any content desired by the broadcaster. Finally, higher resolution programming (such as 4K/Ultra HD) will be possible under the new physical layer standard.

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[2] *See* https://www.atsc.org/about-us/about-atsc/.

[3] *See* "A/53: ATSC Digital Television Standard, Parts 1-6, 2007 (rel. Jan. 3, 2007) (https://www.atsc.org/wp-content/uploads/2015/03/a_53-Part-1-6-2007.pdf).

[4] *Id.*

[5] *Id.*

[6] Experience has shown the 8-VSB modulation scheme is particularly susceptible to multipath effects, making reception through obstacles and within dynamic physical environments challenging.

[7] *See* "ATSC Standard: Physical Layer Protocol (A/322), (rel. June 6, 2017) (https://www.atsc.org/wp-content/uploads/2016/10/A322-2017a-Physical-Layer-Protocol.pdf). There is a separate "bootstrap" standard (A/321) that allows for development of the ATSC 3.0 system, but the focus of this paper is the physical layer standard.

[8] *Id.*

[9] *Id.*

III. ATSC 3.0 RECEPTION IN MOBILE DEVICES WILL REQUIRE SIGNIFICANT CHANGES TO EXISTING PRODUCTS

Devices used by the wireless industry, such as the smartphone, are extremely complex and composed of a large number of interconnected circuits. As is shown in the block diagram below, a smartphone includes amplifier circuits, oscillators, frequency up- and down-converters, and other integrated circuits (ICs) with many other types of functions. This diagram is significantly simplified – in fact for most mobile devices in the marketplace there are multiple antennas and receivers required to decode and demodulate the various signals received (including LTE, GSM or CDMA, Bluetooth, GPS, Wi-Fi, and other RF transmissions).

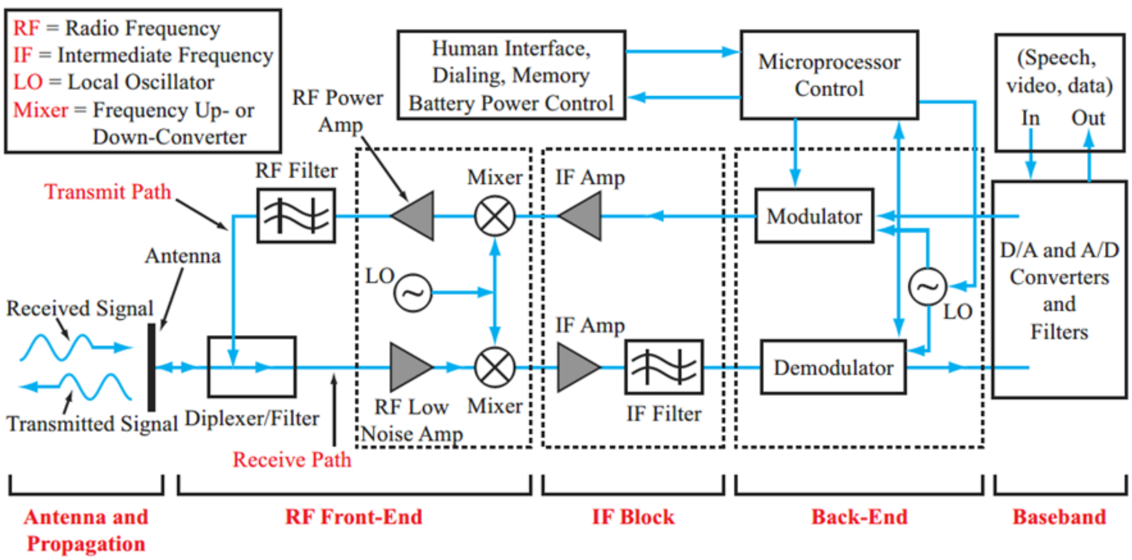

Figure 1: Smartphone Block Diagram

Factors such as compatibility among the various ICs, proper electrical connections, and effective antenna placement and size are all vital to ensuring that the device operates as expected without harmful interference effects. When considering reception of a new ATSC 3.0 signal, focus would be on the smartphone's RF Front-End as that portion of the device would require the most extensive modifications.[10]

[10] While the RF Front-End is most significantly impacted, the RFIC, modem, application processor, the associated software, and the handset form factor will also be impacted.

Sinclair, through its ONE Media venture, has offered to provide one million ATSC 3.0 receiver chips free to each mobile phone manufacturer willing to embed the chip in a mobile device.[11] It appears that Sinclair believes that integration of an "inexpensive" ATSC 3.0 receiver chip (costs of approximately $1 per chip) will be all that is necessary to enable over-the-air ATSC 3.0 reception by mobile devices.[12] However, as can be seen from Figure 2 below, adding the circuitry required to successfully demodulate and process an ATSC 3.0 transmission would create a much more complex device than that needed for LTE reception alone. As will be discussed below, the antenna will require modification, including a significant increase in size, to allow for reception of ATSC 3.0 signals in the 470-608 MHz band (assuming ATSC 3.0 signals are only in the UHF-TV spectrum) in addition to the existing capability within the device to receive the 600 MHz band (Band 71 or 617-698 MHz).[13] Next, and most importantly, an entire receiver chain must be added to the RF Front-End. The new receiver chain will require: (1) a new ATSC 3.0 receive bandpass filter to ensure that there is no intermixing between ATSC 3.0 and LTE reception, (2) a new low noise amplifier, (3) a new local oscillator, and (4) the ATSC 3.0 demodulator/receiver chip, as shown below.

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[11] Phil Kurz, *Sinclair Free Chips Offer Key To Mobile Future*, TVNEWSCHECK (May 25, 2017), http://www.tvnewscheck.com/article/104413/sinclair-free-chips-offer-key-to-mobile-future.

[12] *Id.*

[13] Broadcasters will continue to provide TV in the Low VHF-TV band (channels 2-6) and High VHF-TV band (channels 7-13) as well as the UHF-TV band (channels 14-36). Therefore, the possibility exists for ATSC 3.0 broadcasting in the VHF-TV bands. Providing additional capability to receive ATSC 3.0 signals in the VHF bands entails even more complexity due to the need for an entirely separate receiver chain optimized with its own antennas and filters.

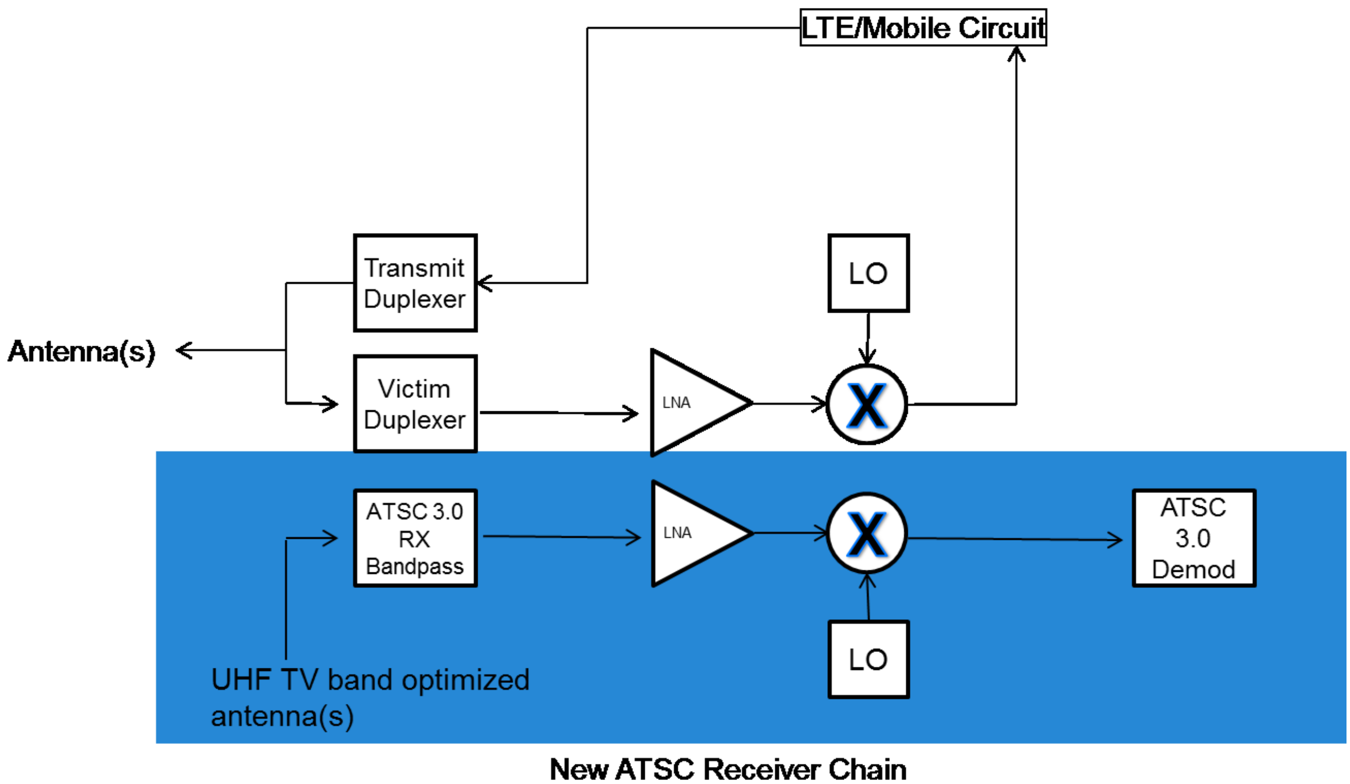

Figure 2: Block Diagram Of New ATSC Receiver Chain

The addition of all these new components is necessary because, while the ATSC 3.0 physical layer is based upon the same OFDM modulation scheme used by wireless devices, it has essentially nothing else in common with the LTE physical layer. Therefore, a dedicated ATSC 3.0 receiver IC is required for ATSC 3.0 over-the-air reception. Adding new circuitry could entail significant design and integration costs to ensure both compatibility with existing LTE circuitry as well as to accommodate placement of the ATSC 3.0 chip within the phone. In addition, there will be other non-trivial development and deployment cost increases associated with bringing a mobile device that can receive ATSC 3.0 to market. While Sinclair has offered to provide its ATSC 3.0 mobile receive chip for free (estimated to be approximately $1 per chip for up to 1 million devices),[14] other materials needed to ensure ATSC 3.0 reception are needed. The cost of those materials will be borne by the manufacturer. Based on vendor estimates, the new UHF antenna array, low noise amplifier, local oscillator, bandpass filter, and other associated IC items would likely add at least an additional $4+ per device in bill of materials costs – for a grand total of $5+ per device in cost increases.[15] Device manufacturers would also incur significant additional costs to design the ATSC 3.0 capability into smartphones, including

[14] *Id.*

[15] The costs are more than simply the $4+ cost as the volume will greatly exceed 1 million devices if ATSC 3.0 is to be provided to any mobile operator. Therefore, the cost increases include the $1 for the ATSC 3.0 receiver chip as well as the $4+ increase in other materials per device.

research, development, and testing. These resource costs (as well as the opportunity cost of not working on other projects) will cause an increase in the cost per device. Finally, equipment manufacturers typically mark up such bill of materials adders as they are inconsistent with the normal manufacturing and testing process. Based on this past experience, this could result in as much as $30 in added costs per device for an ATSC 3.0-compliant smartphone, which would make such devices uncompetitive with non-ATSC 3.0 capable devices.

These increased costs would be exacerbated because the volume associated with ATSC 3.0 mobile receivers is expected to be much less than is prevalent in the wireless marketplace. Because the number of devices using ATSC 3.0 would be a small fraction of the total devices manufactured, the cost of adding this functionality can only be borne by a small fraction of the entire mobile device ecosystem. For example, over 1.5 billion smartphones were sold globally in 2016,[16] with nearly 262 million active smartphones in the U.S. by the end of 2016.[17] The ATSC 3.0 standards have not yet been finalized nor has any scale been brought to the manufacturing process for ATSC 3.0 receiver chips. Sinclair's offer of one million free ATSC 3.0 receiver chips represents less than 0.1 percent of the global market for mobile smartphone devices and less than 0.4 percent of the existing U.S. market for active smartphones (a market that continues to grow). Indeed, most popular devices on U.S. mobile operator's networks typically have sales volumes of more than one million devices in the *first day* and multiple millions of new devices in the first month.[18] Finally, the marketplace for smartphones is global, not limited to the United States. Smartphone manufacturers are working to limit the number of models that are provided and avoiding development of market or operator specific versions.[19]

In sum, the Sinclair offer of 1 million receiver chips is insignificant compared to the U.S. or global mobile device marketplace. More importantly, the receiver chips offered by Sinclair represent only a small portion of the needed modifications to existing mobile devices to allow for the reception of ATSC 3.0.

IV. MODIFICATIONS TO CONSUMER ACCEPTABLE MOBILE DEVICES FOR ATSC 3.0 ARE INFEASIBLE DUE TO SPACE LIMITATIONS

In addition to the integrated circuits discussed in detail above, mobile devices require a large number of other components to function including: (1) a battery ; (2) antenna(s); (3) memory (both virtual and real); (4) cooling capabilities; (5) and a variety of other elements. Given the small, handheld size desired by consumers, packing these myriad components in the most effective manner is critical. Indeed, all available space in a mobile device is utilized as effectively as possible.

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[16] *Strategy Analytics: Global Smartphone Shipments Hit a Record 1.5 Billion Units in 2016*, Strategy Analytics (Jan. 31, 2017).

[17] *See* Comments of CTIA, WT Docket No. 17-69, at 8 (filed May 8, 2017).

[18] *See e.g.*, G. Gottsegen, *The Galaxy S8 is reportedly selling like hotcakes*, C/NET, May 16, 2017;

[19] For example, Apple's current iPhone only has three different models for the vast majority of countries in the world. *See* https://www.apple.com/iphone/LTE/.

Antenna Issues. Initially, combining the ATSC antenna function with the main or secondary cellular antenna introduces complexities which will adversely affect performance at both ATSC and 3G and LTE cellular radios and result in degraded reception of the 600 MHz band (and other low band mobile reception). Extending the main or secondary cellular antenna bandwidth to include the ATSC frequency band will result in increased size and higher losses. Increasing a load's (such as from an antenna) bandwidth will result in an increase in the reflection coefficient compared to that which can be achieved from a loss-less matching circuit. This higher mismatch loss will need to be accommodated in the main or secondary cellular antenna when adding the ATSC frequencies to one of the cellular antennas, and this higher mismatch loss will result in reduced antenna efficiency. Moreover, the components used in matching circuits to provide the additional required bandwidth also have associated losses, and these losses will also negatively affect the antenna efficiency (in addition to the at least 2.2 dB loss mentioned below). This reduced antenna performance will occur at both ATSC and cellular frequencies, resulting in degraded reception of both ATSC and low band (such as 600 MHz) LTE signals. One additional effect is the need to add more filtering with its associated insertion loss to protect both the ATSC and cellular receivers from de-sense. Finally, even if the antenna was adjusted to support reception of ATSC and LTE, it would need to be tunable to limit reception to just ATSC 3.0 or LTE, not both at the same time. This additional complexity would potentially degrade performance of the mobile device and would add more costs to the development of the product.

These issues are because RF antennas and filters consume space proportional to the wavelength of the spectrum bands being supported – the higher the frequency, the smaller the antennas needed for reception.[20] Antennas are resonant at whole number multiples or fractions of the frequency of interest. Since the wavelength at 600 MHz is approximately 50 centimeters (cm) (about 20 inches), an optimal antenna for reception at this frequency would be about that length. Consumers have gotten used to and enjoy the aesthetics of modern devices which are designed with internal antennas. A nearly two-foot long antenna would require either a significant increase in mobile phone size or reverting back to large external antennas. Fortunately, using the physical property that allows antennas to resonate at whole number multiples or fractions (1/2, 1/3, 1/4, etc.) of the fundamental frequency allows smaller antennas to be used. However, reducing the antenna's size has some detrimental impact on the efficiency and impedance of the antenna, which negatively affects the its performance. Therefore, it is critically important that manufacturer's tightly control the antenna size to maintain the expected performance of the mobile device. A common example for radio communications utilizing this physical feature is a half-wave dipole antenna that is one-half of the wavelength, divided into two quarter-wave lengths called elements (shown in the Figure below). Each element is set at 180 degrees from the other and fed from the middle.

[20] The wavelength of a wave is determined by the formula $\lambda = c/f$, where f is the frequency in Hertz (Hz), λ is the wavelength in meters (m), and c is the speed of light (a constant 2.998×10^8 meters/second).

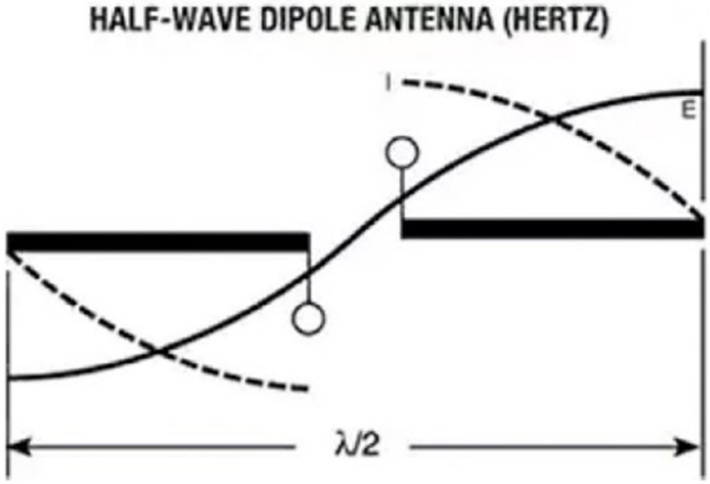

Figure 3: Half-wave Dipole

For a typical smartphone operating in the 600 MHz band, the quarter wavelength (1/4 of the resonant frequency wavelength) is about 12.5 cm which roughly matches the typical dimensions of a smartphone (14x7 cm).[21] Since space within a mobile device is at a premium, a more common antenna implementation is to use a single quarter-wave element of a dipole and allow the ground plane on the device's circuit board serve as a counterpoise, creating the other quarter-wave element.[22] The dimensions of the ground plane on the internal circuit board constrain the antenna performance in the 600 MHz band as the ground plane at this frequency is an integral part of the antenna. Additionally, the selectivity bandwidth for an antenna for the low band (like 600 MHz) is typically about 300 megahertz. Introducing a new spectrum band (470-608 MHz for ATSC 3.0)[23] would necessitate a 138 megahertz increase of the antenna bandwidth (or approximately a 30% increase in bandwidth range) and lower the overall antenna efficiency by at least 2.2 dB. These factors indicate that any change to the internal antenna system used in the mobile device will have effects on the efficiency of the antenna (adversely affecting performance by decreasing the ability to receive 600 MHz LTE signals) and will also potentially disrupt the carefully designed configuration of the antenna and circuit board to provide an effective half-wave dipole.

In addition, the physics of antenna design dictate that a low frequency ATSC antenna be placed along one of the short dimensions of the smartphone to achieve optimal gain characteristics. This is due to the antenna requiring the longest extent of ground plane for best operation, with the ground plane being provided by the circuit board that houses the radios and other components. Unfortunately, the main and secondary cellular antennas used for 3G and 4G LTE operation (especially for the new 600

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[21] The iPhone 7 is roughly 13.8 cm x 6.7 cm; the Galaxy S8 is roughly 14.8 cm x 6.8 cm.

[22] A counterpoise is a network of suspended wires or cables (or a metal screen) used as a substitute for an earth (ground) connection in a radio antenna system.

[23] The wavelength at 470 MHz is approximately 64 centimeters, or over 25 inches – a 30 percent increase over the wavelength at 600 MHz.

MHz band) also need to be located along the short dimensions of the smartphone to optimize performance for low band LTE, with the main antenna positioned along one end of the smartphone and the secondary antenna positioned along the opposite edge. This phenomena of improved low frequency antenna operation with proper alignment of the antenna to the circuit board points toward the concept of combining the ATSC antenna with either the main cellular or secondary cellular antenna.

Space Constraints. As noted, in addition to antennas, modern mobile devices are densely packed with batteries, filters, sensors, and other processors. Due to the variety of spectrum bands available for use by the wireless industry, most devices must support up to 15 different mobile spectrum bands. Moreover, support of Wi-Fi, Bluetooth, and other low-power services (such as NFC) are demanded by consumers and require specific hardware to support them. Additionally, wireless devices must be able to provide accurate location information to comply with the Commission's requirements for enhanced 911 services. This requires added functionality such as GPS reception within the device. Finally, mobile devices have duplicate antennas for receive diversity and support of Multiple Input Multiple Output (MIMO) capabilities. MIMO allows for increases in channel capacity, link reliability, and more efficient use of the spectrum.[24] Each of these elements have led to tightly constrained space within the mobile device. Because of the large amount of loss that would occur in a single, wideband UHF antenna capable of receiving both ATSC 3.0 and 600 MHz cellular signals, it is highly likely an array of narrower bandwidth antennas will be necessary to facilitate effective receiver performance. Subsequently, this design requirement will likely double the required footprint just for new antennas to allow for effective reception of ATSC 3.0 along with 600 MHz mobile signals.

Adding the substantial receiver chain needed (antenna(s), filters, digital receiver functionality) to successfully receive and process ATSC 3.0 signals is infeasible in existing mobile devices without sacrificing other needed functionality. For example, wireless providers would receive much greater benefits by adopting 4x4 MIMO for Band 71 within the limited device space. Current mobile devices, after more than 20 years of effort, have been able to incorporate 4x4 Multiple Input Multiple Output ("MIMO") antennas for mid-band reception – but have not been able to deploy for low-band (below 1 GHz) where broadcast ATSC 3.0 signals would be received. If there were additional space available, deployment of 4x4 MIMO would not require an entirely new receive chain, allowing improved capabilities without significantly impacting the available space in the device. 4x4 MIMO integration would greatly increase the robustness of the receiver, resulting in improved data rates and reducing susceptibility to interference. This in turn would allow for better provision of all services such as emergency alerts, E911, voice calls, video, text messaging, and data as opposed to the limited services associated with one-way ATSC 3.0 services.

[24] A. Katalinic, R. Nagy, R. Zenter, *Benefits of MIMO Systems in Practice: Increased Capacity, Reliability and Spectrum Efficiency* (March 12, 2007).

V. ATSC 3.0 WILL NOT PROVIDE A BETTER CONDUIT FOR PUBLIC SAFETY AND EMERGENCY MESSAGES

Finally, broadcast parties have asserted that ATSC 3.0 will provide a more robust platform for the delivery of emergency messages than the existing Emergency Alert System (EAS) or Wireless Emergency Alert (WEA) system.[25] As a technical matter, this is fundamentally untrue. Broadcast television is characterized by a single, high-powered transmission site providing one-way blanket coverage in a market area. In contrast, mobile base stations are seamlessly deployed throughout a market area, including in-building systems and small cells, with many thousands of cell base stations covering a market area. Mobile systems are also two-way – meaning that the consumer is able to communicate back as necessary or to initiate a call or text to communicate with public safety parties. The more uniform signal levels associated with a mobile network in a market area means that reception by a mobile device is more robust and consistent than what would be present for a broadcast television ATSC 3.0 signal. Moreover, this would remain true even if broadcasters deployed a Single Frequency Network ("SFN") and slightly increased the number of transmission sites in a market area. SFN would increase the density of broadcast television transmit sites (possibly ten-fold) but this increase is significantly smaller than the density of sites deployed by mobile operators (by orders of magnitude). In addition, the widespread nature of wireless base stations provides the ability to tailor emergency messages for an area rather than the one-size-fits-all nature of a broadcast signal.

The majority of consumers today receive public safety messages, news, alerts, E911, and location services via existing mobile devices. In comparison, penetration of mobile ATSC 3.0 receivers is *zero* today, the implementation of ATSC 3.0 will be voluntary and extremely slowly to be adopted. Moreover, given the 6% growth rate in wireless connections and CTIA's estimate of 396M connections at the end of 2016, Sinclair's 1M chips represent less than one quarter of one percent of the mobile devices expected to be deployed by the end of 2018. ATSC 3.0 therefore will be an inferior platform for emergency purposes compared to current wireless alerting technology, which continues to evolve.

CONCLUSION

Mobile reception of ATSC 3.0 is a complex issue that requires careful consideration of all the necessary physical characteristics of a mobile device. A new receive chain, including new antennas, filters, and other materials, is required. ATSC 3.0 antennas can affect the device performance, especially in the 600 MHz band. The limited space in mobile devices precludes new ATSC 3.0 functionality and that physical space could be utilized for other, more beneficial purposes. Finally, ATSC 3.0 does not enhance the ability of emergency communications but may instead endanger reception of such transmissions. The Commission should understand the many trade-offs associated with integration of ATSC 3.0 into mobile devices.

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[25] Comments of ONE Media, LLC, PS Docket No. 15-94, GN Docket No. 16-142, at 1 (filed July 31, 2017) (asserting that the EAS and WEA is severely constrained and should yield to the dramatically more robust enhancements associated with ATSC 3.0).