



Next Generation Broadcast Television

November 30, 2017

<https://cpbnet.webex.com/cpbnet/onstage/playback.php?RCID=33eb8ce1041b5e952171d2c86df619>

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Welcome

Ted Krichels

Today's Presenters

- Lonna Thompson, APTS
- Talia Rosen, PBS
- Eric Wolf, PBS
- Dennis Wallace, Meintel Sgrignoli & Wallace

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Ted Krichels:

Okay. We are going to get started. This is the CPB, PBS and APTS ATSC Next Gen TV Webinar. Thank you for joining us; we have a great panel. We have Lonna Thompson, who is the executive vice president and COO, and general counsel at APTS. Talia Rosen, who is assistant general counsel and senior director of Standards and Practices at PBS, Eric Wolf, who is the vice president of technology and standards at PBS, and everybody's favorite consultant, Dennis Wallace, partner at Meintel, Sgrignoli & Wallace.

Submitting Questions

- Press Q&A button in top right of screen
- At bottom right, choose Q&A
- Under "Ask," select "Host"
- Type question in field at bottom of screen
- Hit send

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We have a lot of material to cover today. Let me start by telling you how to submit questions. Very straightforward. You press the Q&A button at the top right of the screen, at the bottom right you choose Q&A, under "Ask" select "Host," type the question in the field at the bottom of the screen, and then hit send. Send your questions whenever you have them, the sooner the better. We're going to try to answer them in the context of what we're talking about at the time, to fit them into the agenda as we go through. We anticipate a lot, and we want to answer if not all, as many as we possibly can.

Agenda

- Regulations
- Core Capabilities
- Business Planning
- Technical Planning
- Implementation
- Q & A

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We have a robust agenda, as you can see. We're going to cover a lot of ground, from the technical to the business. We have regulations, core capabilities, business planning, technical planning, implementation, and then at the end for any questions we haven't answered, we'll try to finish up with Q&A. Let me turn it now to Lonna Thompson, who will talk about our timeline.

Timeline (estimated)



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Lonna Thompson:

Great, thanks so much, Ted. I'm just going to share two slides with you, before I pass on to my colleague, Talia Rosen, to dive into the order the FCC adopted. But I wanted to first look at where we have been, where we are today, and then take a little look ahead to the future, and what we need to do as an industry. First of all, let's take a look at this timeline, and honestly, let's pat ourselves and our industry on the back for really pushing forward the development of the Next Gen TV standard.

Look at this: In 2013, development of the standard begins. And in 2017 we were ready to put forward an FCC rulemaking, and we just got final rules approved by the FCC. In four years, the industry's come together and worked with CEA and other industries in the relevant sphere here. And I will say a huge piece of this goes to the leadership of ATSC, Mark Richter and his group, but another huge thanks goes to the great work that our station engineers on the committees did, and the PBS engineers, going back to Jim Kutzner, who's already ice fishing somewhere up cold there, Chris Homer and everyone else. Bill Lake, who was the chair of the Media Bureau at the FCC, who is now with Wiley Rein, and actually a consultant for APTS, told us way back when, "If you guys can get this done in time for the re-pack, we'll make sure the repack rules work around to accommodate it."

Bill shared with me recently when I asked him, candidly, "Did you ever think we could do it?" He said, "I was hopeful, but I didn't think it could be done." Anyway, I just want to say that we've done an amazing job on this.

Legislative Role?

- Legislative role remains to be seen
- Distinct from DTV transition
- Commissioner Rosenworcel remarks
- Congressional letter to FCC
- Funding uncertain
- Consumer education



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I just want to talk a little bit about what this transition isn't, and what I think it needs to be. Is there a legislative role in this transition? That's always possible,

but at this current time, we don't see it. This is very different from the DTV transition, where there was a mandated date where everybody had to switch, when at the last minute, the Hill realized that they had to put in funding for consumer education and that was put forward. This isn't the case. This is a voluntary transition of the broadcasters, just as with every other industry. When the wireless guys want to transition to their next LT standard, they do it. And so we're doing this, and a big burden is on us, but we'll pull it off.

Interestingly, just before the FCC, a couple days before the FCC adopted their final rules on November 9, at a New America event, Commissioner Rosenworcel, one of the Democratic commissioners on the commission, kind of threw a Hail Mary pass and said, "I really think we ought to go back to the Hill and have the Hill legislate this and make it a mandatory pass. To which we all groaned and said, "We're too far along on that."

But what this will mean is that as an industry we need to work together, and our three organizations are doing that, APTS, CPB and PBS. We're looking at what has to be done in terms of the transition. We're certainly looking at where will funding come from for equipment transition. We're looking at how does the transition from 1.0 to 3.0, I'll say it for the last time, gonna happen. Maybe look at a pilot market or two, along with our commercial brethren. We're working with great consultants like Dennis Wallace, on making this work for us. But we will need to do this as an industry. We're talking to a number of the commercial broadcasters around their plans. It's going to be important that we work together closely with them as we move forward.

So with that, I'll turn it over now to my colleague at PBS, Talia Rosen.

Regulations | Order Adopted

- FCC adopted Next Generation broadcast television transmission standard (ATSC 3) on **Nov. 16, 2017**
 - Voluntary
 - Market-driven
 - Multi-year
 - PTV successes
 - Next steps



http://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db1120/FCC-17-158A1.pdf

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Talia Rosen:

Thank you so much, Lonna. Thanks everyone for joining us today. The main impetus for this webinar was that the FCC just on November 16 adopted its final rules around the deployment of Next Generation broadcast television, or ATSC 3. So those rules are now in force. Stations can begin to deploy ATSC 3, and we wanted to take the beginning part of this webinar to go through what exactly these rules say. It's 120, 130 pages of rules that the FCC adopted, covering all sorts of different aspects of ATSC 3 operation. I want to answer your questions, I want to walk you through the nuances of those rules.

First things first, at the high level, I think as everyone knows is a voluntary, market-driven transition, which means that a whole number of different market factors are going to really drive the pace of adoption, whether that's device manufacturers, broadcaster adoption, cable and satellite companies, and consumer interest. So I don't think anyone knows how many years it's going to take, but everyone knows it's going to be a multi-year process that is stretched out over the next three, five, seven, 10 years or maybe more. Some folks that I talked to recently said that the holiday season of 2019 would be really the first time this hits consumer devices. So we'll see then. That feels both far away, but also very close, given all this business planning and strategy we need to engage in, in the next couple years to be ready for that point.

I will say that the public television organizations working together — APTS, CPB, PBS, the ETAC and all of the station input really led to a very successful rule-making from a public television perspective. The one-step licensing approach that the commission adopted, and the scaled back requirements around simulcasting, which I'll talk about, both owed a lot to what public television entities did in the advocacy leading up to the adoption of this rule. The language in the order around must-carry is very encouraging for the long term, rejections to what various cable industry associations had asked for in terms of cost shifting, were exactly what public television had been pushing for.

And then the language of the order around repacking reimbursement and around the scope of the technology standard requirements. They're all good wins that show that when public television organizations all work together like we did in this rulemaking, we can secure a lot of favorable regulations.

Going forward, there's another-rule making that I'm going to talk about later that's in terms of the next steps in some minor issues. I think in terms of other next steps, a big thing is going to be station education. This webinar is hopefully going to be the first of a number in a wide range of ATSC 3 opportunities, challenges, possibilities. And many of you are beginning to engage in discussions across the industry about potential collaborations and ways to leverage this new standard. And I think that over the next year or two there's going to be a lot of that, a lot of education and a lot of discussion as people figure this thing out.

Regulations | Simulcasting

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Regulations | Simulcasting

- Simulcast ATSC 3 content in ATSC 1 standard
 - Partner with host station in same DMA
 - Primary feed (“substantially similar” content)
 - Five year sunset of content requirement

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Looking at simulcasting specifically, the order that the FCC adopted is that stations have to simulcast their ATSC 3 content in the ATSC 1 standard. So you

can't just flash cut over the ATSC 3. This means you're going to need a partner station in your same DMA. It only applies to your primary feed, though, so if you're running three or four channels in ATSC 3, only the primary has to be simulcasted in ATSC 1. It has to have substantially similar content. The way the FCC actually defines substantially similar is pretty much identical. It has to have really identical content except for any special features, which are based on the enhanced capabilities of ATSC 3, like interactivity or customization.

If you're time-shifting programming from one slot to another, that does not count as substantially similar, but the FCC did not adopt a format requirement, so HD versus SD is entirely up to the station when it comes to their simulcast. The substantially similar requirement sunsets five years from the date of the order. So at the end of 2022, in theory, depending on who knows where the rules will be, you'll ultimately have continuous simulcasting, but there won't be a substantially similar requirement. I think the simulcast requirement is envisioned as a temporary measure, and the FCC says they'll get rid of simulcasting altogether once ATSC 3 is more fully adopted.

Regulations | Simulcasting

- Simulcast ATSC 3 content in ATSC 1 standard
 - Partner with host station in same DMA
 - Primary feed ("substantially similar" content)
 - Five year sunset of content requirement
- Coverage requirement (community of license)
 - Expedited if service loss < 5% of population

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In terms of coverage for your simulcast, it's required that your ATSC 1 simulcast continue to cover your entire community of license. It doesn't have to cover your entire contour area, the more of your contour or population, the better. If you are able to cover at least 95% of your original population, then you can have expedited processing of your simulcasting application. If it's less than that, then they're going to take a little bit longer to process that application.

Regulations | Simulcasting

- Simulcast ATSC 3 content in ATSC 1 standard
 - Partner with host station in same DMA
 - Primary feed (“substantially similar” content)
 - Five year sunset of content requirement
- Coverage requirement (community of license)
 - Expedited if service loss < 5% of population
- Translators and LPTV exempt

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Translators and all LPTV are exempt from the simulcasting requirements, so if you want to experiment in ATSC 3, and you have translators, you can flash cut any of those over to ATSC 3. Obviously there are going to be audience implications of that, but it is one possibility. One thing the FCC says, is it allows translators to serve as a lighthouse. And we're going to talk about lighthouses more later in the presentation, but it opens up some options there.

Regulations | Simulcasting

- Simulcast ATSC 3 content in ATSC 1 standard
 - Partner with host station in same DMA
 - Primary feed (“substantially similar” content)
 - Five year sunset of content requirement
- Coverage requirement (community of license)
 - Expedited if service loss < 5% of population
- Translators and LPTV exempt
- Case-by-case waivers to flash cut (no “viable” partner)

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There will be case-by-case waivers of the simulcasting requirements. The FCC specifically recognizes that public television stations may find it uniquely difficult to find a simulcasting partner given how you all tend to be sited in more rural, remote, and isolated locations, and you're not really sited as much on DMA boundaries as your commercial counterparts.

So the FCC is very well aware of that issue. They didn't ultimately grant a full-on noncommercial or public television exemption for the simulcasting requirement, but they acknowledge the need for waivers if you don't have what they call a viable simulcasting partner.

I think what would be really helpful for us at the national level is if you are interested in moving to ATSC 3 in the next couple years, at the early end of the timeline, and don't think you have a viable simulcasting partner— that is, another full power station that covers the vast majority of your population — let us know. Our email addresses are going to be on the last slide here, you can email Lonna or Ted, or me or Eric. And we really want to know if you are interested in ATSC 3 and envision significant problems based on the simulcasting partner.

Regulations | Simulcasting

- Simulcast ATSC 3 content in ATSC 1 standard
 - Partner with host station in same DMA
 - Primary feed (“substantially similar” content)
 - Five year sunset of content requirement
- Coverage requirement (community of license)
 - Expedited if service loss < 5% of population
- Translators and LPTV exempt
- Case-by-case waivers to flash cut (no “viable” partner)
- Open question on vacant channel use

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An open question that the FCC has not decided, and is looking at in further notice of present rule making, is whether or not they'll let stations use vacant channels, or make those frequencies in their market to simulcast with themselves. So if you're a rural station that has no viable simulcasting partner, could you set something up in that way? Microsoft and Google and others pushed back hard on that ask that we had, and so that's an open question that the FCC is continuing to evaluate.

Regulations | Simulcast Contracts

Contract Requirements

- 1) Access to shared facilities
- 2) Allocation of capacity
- 3) Operation and maintenance of facilities
- 4) Description of financial obligations
- 5) Termination and assignment conditions
- 6) How signal may be transitioned off host station

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When you simulcast, you have to do a simulcast contract. And the FCC specifically listed six things that need to be in your simulcast contract. So you'll have a host station that you're working with, and you'll either convert your facilities to 3.0, and put your 1.0 signal on their facility, or the reverse. You'll stay as 1.0, and you'll have a 3.0 signal hosted on your partner station.

Either way, you'll need to do a contract together. It will need to outline each station's rights and responsibilities in all six of these areas that are listed here. I'm not going to go through them in detail, but these slides are going to be posted on the Station Management Center. I just wanted to pull this little piece out of the giant FCC document and put it there in a slide so you know some of the things that those contracts will need to address.

Ted Krichels:

Talia, quick question that just came in. How do you see the state networks working with the simulcasting requirements?

Talia Rosen:

I think the 16 state networks around the public television system have unique challenges with this, and it's something we've brought up with the FCC on several occasions. I think that some of the transmitters that state networks operate will fall into that bucket of having no viable partner. And it means that either we'll need to get permission to use the vacant channels, so that they can partner with themselves, or they'll need to decide when in the next few years have we reached the tipping point of consumer adoption, where flash cutting is a viable solution. Some stations have talked about, "Could I look at a program where I help make available low-cost adapters to people in my community if I'm in a particularly rural or not highly populated area?"

I think it's going to vary from state to state. But in general, it's going to be harder and take more time, obviously, to get a state network converted. You also don't want to have the issue of disenfranchising part of your state, by saying we're going to have advanced features and really interesting advanced emergency alerting and interactive kids content that we can't offer throughout the state. So I think that's a balancing act that will involve PR considerations, and equity considerations and all of that.

It's a good question though, and if your state network is interested in this, definitely reach out to us. We'll talk about this. It doesn't hurt to start having conversations in your community— whether in a state network or not — having initial conversations with other broadcasters in your community, whether they're commercial or noncommercial, seeing who might be interested, who might not. I think people are all over the map on this, and it doesn't hurt to get a sense of who might be a viable partner. There doesn't even need to be money changing hands. This could be a case of stations just working together, exchanging bits. Obviously, there's new equipment that will cost money, and people will need to figure that out, but it's always good to start those conversations.

One last thing on the contracts. You don't have to file those with the FCC, but the FCC has said that they need to be available upon request. They didn't say what circumstances would lead them to request the contracts, but know when you do one of these that the FCC may ask you for a copy of it. It's not like a channel sharing agreement, where you actually had to submit it proactively.

Regulations | Licensing

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Regulations | Licensing

- One-step licensing (*modeled after PTV proposal*)
- Streamlined application

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When you do the simulcasting arrangement, you have to get licensed. Because what the FCC has said is that you're going to have a 1.0 channel and a 3.0 channel. One of those is aired on a partner host, and the one that's hosted by someone else is going to be licensed as a temporary second channel of the originating broadcaster. That's you. So you'll have two separately authorized companion channels under your single, unified license. This is a brand-new

concept that the commission is putting into place, and it's actually one that public television developed about a year ago. The FCC had looked at a full-on licensing approach, with construction permits and all sorts of regulations that we didn't think were necessary. And then they looked at a fully unregulated multicast style of simulcast, which had its own whole host of other issues I'm not going to get into.

And what we did, working across public television with a whole bunch of different stations, was come up with this intermediate hybrid approach, and then we worked across the commercial television industry to get buy-ins from a whole bunch of commercial associations. And the FCC has put in place this one-step licensing with a streamlined application that is not perfect by any means, but they think it's better than either of the possibilities they put out there originally.

Regulations | Licensing

- One-step licensing (*modeled after PTV proposal*)
- Streamlined application
- Modified schedule to **FCC Form 2100**
 - Qualify as minor change
 - No construction permit needed
 - **60** day standard processing; **15** days if expedited

So you'll need to submit an application. It needs to be approved by the commission before you can actually launch an ATSC 3. The host station itself doesn't need to take any action, it's just the station that is going to be now hosted on a new channel. There's going to be a new FCC form 2100 that's going to be modified to accommodate this, hopefully simplified, and they've said they're going to process that form within 60 business days of when you submit it, because they're at an ideal, they don't always meet their goals. It'll be 15 days between when you submit it, 15 business days, if your simulcast reaches at least 95% of the population of your current signal today, in your FCC protected contour.

Regulations | Licensing

- One-step licensing (*modeled after PTV proposal*)
- Streamlined application
- Modified schedule to **FCC Form 2100**
 - Qualify as minor change
 - No construction permit needed
 - **60** day standard processing; **15** days if expedited
- Enforcement authority / compliance obligations

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That's the timeline there. The point of doing some form of licensing, one point is so that the FCC has enforcement authority over the source of the content. So if you're acting as a host, for instance, and the commercial or other station's content is on your transmitter, but it's really not your responsibility, you don't want to be responsible for their captioning issues, their indecency issues, their underwriting issues, their EAS issues. So the FCC's approach here that we worked with them on is, essentially, the content is attributed to the originating licensee, rather than the transmitting licensee. So the compliance obligations all flow to the originating licensee, whose content it really is.

Regulations | License Application

Application Requirements

- 1) Any alternative partners with less service loss, and why proposed partner was chosen
- 2) Steps planned to minimize impact of service loss (e.g., providing adapters)
- 3) Public interest benefits of simulcast arrangement and why benefits outweigh harms

Now when you do licensing and you file this application, you need to tell the FCC any population that's going to lose access to your ATSC 1 service as a result of the simulcast. If you're co-located and you have identical footprints, great. If you're not, someone's going to lose service. That's understandable; the FCC recognizes that. But they want you to answer these three questions in your licensing application, to license your simulcast about any alternative partners you could've gone with that might've had less service lost, or why your partner was chosen, steps you've considered to minimize the impact of the service lost, and the public interest's benefits of the simulcasting.

These are really big, broad, open-ended questions that the FCC kind of threw out there a little bit unexpectedly at the last minute into the order. Nobody quite knows what this application is going to look like, how extensive this needs to be. I'm hopeful that maybe these end up being more pro-forma questions that don't require you to write a dissertation about your licensing plan. But that remains to be seen. I think the first few license applications will be sort of guinea pigs, if you will. I don't expect the FCC to get in the way of a lot of these simulcast arrangements, but it may depend on what else is going on at the FCC, and how this all sort of plays out.

Regulations | Other Issues

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Regulations | Other Issues

- Cable carriage – Must-carry for ATSC 1, not yet for ATSC 3 (while FCC requires local simulcasting)

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The last few regulatory issues that I want to talk about, and then I'm going to turn it over to Eric to talk about the capabilities of the technology and the business planning, there are just a few more issues that I want to touch upon. The first is cable carriage. I mentioned at the beginning that cable carriage, you

retain much carriage of your ATSC 1 signal regardless of whether it's transmitted on your facility or on someone else's facility. So the primary feed, retains and must carry, whether or not you're the ATSC 3 lighthouse, or you're the ATSC 1 lighthouse.

They say that cable must carry will not extend to ATSC 3 while the FCC requires local simulcasting. I was encouraged by this language, because every time they say that ATSC 3 does not lead to must carry, they said while simulcasting is required. And then separately they say that simulcasting is a temporary fix during this transition.

So I read that as very encouraging for ultimate must carry for ATSC 3. That is, I think a number of years down the road.

Ted Krichels: So Talia, very quickly. You may have answered this, I want to make sure. So MVODs don't want to be forced to carry 3.0, which migrates to 3.0 and carry a 1.0's signal only in SD. Is that allowed in the MVODs to drop us from HD carriage of our primary signal and only show in SD. What about multicast channels? And if we don't carry them in 1.0.

Talia Rosen: That's a very good question. Essentially the question is, if the spectrum constraints that exist in a lighthouse environment force you to stop carrying your 1.0 signal in either HD or force you to stop carrying all of your multicast channels on your 1.0 feed, will you still get carriage for those, and will you still have must carry to your primary feed, or contractual carriage rights for your multicast, and the answer is no. If you drop things off of your 1.0 broadcast, you will not be guaranteed carriage for them. I think in your lighthouse arrangements you want to try to maximize the quality of your 1.0 primary signal, and the capacity of your 1.0 multicast signal.

That being said, I think that most MVPDs that I'm familiar with would want to continue to carry you in HD if you were able to deliver an HD signal to them. especially if you're the only station with this content in the market. I can think of one that might be particularly difficult, but most of them would want to carry you in HD even if you're just broadcasting in SD. I don't think that would be a problem. I think the multicast could be more of a problem if you're not able to continue carrying those.

I think the encouraging thing is, and Dennis can speak to this better than me, but with all of the new encoders, I think it is, and people that can have the capacity on ATSC 1 signals to allow for a decent amount of multicasting.

Dennis Wallace: Right, exactly, and we'll talk a little bit more about this in the technical part of the presentation this afternoon, but certainly stations will likely enter in to 1.0 lighthouse channel-sharing arrangements that will probably entail upgrading

existing encoders to newer technology that has better MPEG2 efficiency. So we anticipate that existing MPEG 2 encoding equipment will get better, certainly vendors are working on that, and they are certainly much better in terms of efficiency and quality than they were even five years ago. So the problem of having to drop HD because of capacity issues, I think, will be a solvable problem as we move forward.

Regulations | Other Issues

- Cable carriage – Must-carry for ATSC 1, not yet for ATSC 3 (while FCC requires local simulcasting)
- Cost shifting – FCC rejected calls to shift certain cable costs to TV broadcasters

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Talia Rosen:

So that's cable carriage. The other thing is cost shifting. I would say good news, some cable industry associations pushed the FCC fairly hard to reassign costs associated with ATSC 1 carriage, both for commercial and non-commercial stations from the cable companies to broadcasters, and we pushed back hard against that, and the FCC sided with us, and rejected any calls to shift cable operational costs to broadcasters. We were very happy with that.

Regulations | Other Issues

- Cable carriage – Must-carry for ATSC 1, not yet for ATSC 3 (while FCC requires local simulcasting)
- Cost shifting – FCC rejected calls to shift certain cable costs to TV broadcasters
- Repack reimbursement – Equipment with “improved functionality” eligible (not “new optional features”)
- Viewer notification – On-air consumer education for 60 seconds per day for 30 days prior to simulcasting

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The FCC also reaffirmed that equipment with "improved functionality" is eligible for repacking reimbursement, so the 43% of you out there that are being repacked, that's some good news. Your equipment that has new optional features, as the FCC says, that piece of it is not covered. But the ATSC 3 readiness of your equipment is a fact that is covered under the repack fund.

The last thing is on viewer notification. All stations that relocate their ATSC 1 signals to a host station have to air at least 60 seconds per day of on-air consumer education, PSAs or crawls, beginning at least 30 days prior to the date that you're going to terminate your ATSC 1 operation on your existing facility. Your discretion over the time slots that you air those, and the FCC, interestingly, says, "We're not mandating specific language, but you do need to convey all of the following information," which is a long list: The date of the channel relocation and the expected date of the ATSC 3 signal launch informed viewers about how they need to re-scan, explain that some viewers may no longer receive their ATSC 1 signal, inform viewers that they may need to purchase new equipment in order to receive an ATSC 3 signal, and state to viewers that they might get more information on the station's website or by contacting the station by telephone.

In addition, any station that gets a waiver to flash directly needs to do all of that consumer education as well.

Regulations | MVPD Notice

Notice Requirements

- 1) 120 days in advance during repack (90 days afterwards)
- 2) Date and time of ATSC 1 channel change
- 3) Channel occupied before and after commencement
- 4) Any modifications to antenna position, location, or power level
- 5) Stream identification information, including program numbers for each programming stream
- 6) Engineering staff contact information

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I said that was the last thing, but there's one more thing: that you need to give notice to the MVPD, these are the multi-video programming distributors, which is all of the cable and satellite companies that carry your signal. You need to provide notice to those MVPDs if they currently carry your station's 1.0 signal from an existing location, and they're going to have to continue to carry it from your new location. You need to give that notice at least 120 days in advance during the repack, only 90 days in advance once we get past the summer of 2020, or whenever the repack actually ends.

And that notice to the MVPD has to include all of the things listed there. In the interest of time, I'm not going to walk through them. These slides are going to be available after the webinar. But put a tickler in, if you're looking at ATSC 3 and launching ATSC 3 and doing an ATSC 1 simulcast, make sure on your to-do list is telling all of your viewers with those PSA crawls, and telling all of the MVPDs that carry you as a station.

Core Capabilities | Evolution of TV

NTSC (1941-2009)

- 1 SD stream
- Stereo audio

ATSC 1 (2009-2020+)

- Multiple streams - HD, SD
- Surround-sound audio
- PBS stations avg 3.5 feeds
- Targeted only to televisions
- Static channel lineup

Next Gen TV / ATSC 3 (2018-)

- Richer Content
 - Many streams - 4K, HD, and SD
 - Numerous advanced format audio channels
 - Advanced emergency alerting
- Aligned to internet-based media
 - Interactivity
 - Personalized, targeted content
 - Combined broadcast & online content
 - Use available wifi to deliver/return data
- Targeted to multiple device types
- Upgradeable

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Eric Wolf:

All right. We're going to turn from the rules around ATSC 3 to what the heck is this ATSC 3 thing, anyway. For some of you this may be a little bit of repeated things that you know, but for some of you it's hopefully brand new.

One way to look at this is to compare Next Gen TV or ATSC 3 with what's come before it. So I think you're all very familiar with NTSC world, and the ATSC 1 world that we live in today. And when we think about them, we think about them in terms of, "What's the video, what's the audio, what can you do with it?"

So starting to put Next Gen TV in that context, we'll start by saying it gives us richer versions of all the things we have today. It gives us more capacity for richer video, up to 4K or potentially even 8K in the future, and continuing with HD and SD. It gives us a more advanced audio format, which also compresses better, but also allows us to have essentially, I won't say completely unlimited, but a much wider array of audio channels associated with these content, which gives us a lot of really interesting possibilities. And it leaps forward the emergency alerting capabilities of the standard well, well beyond what we've got today.

The second thing that we see in ATSC3 is something that we've really never had before, which is that it's really well-aligned to the internet-based media world that more and more of our audience are living some part of their lives in. And that is, it can handle interactivity. We can deliver personalized content — that is, content that is adapted to the individual who is viewing in certain ways. We can deliver targeted content, content based on things we know about the households to which we're delivering. We have ways to combine broadcast and online content, which is kind of interesting. So part of the show can be coming

from an over-the-air broadcast, and a television set that's connected can be retrieving additional material and including that in the program.

And we have the ability with a connected TV to actually deliver data, fast, from the program or from the audience back to us to understand what viewers are doing, and what they're watching. Obviously, a lot of interesting possibilities in understanding and analyzing what our audience is doing with our content.

Another characteristic is what kind of device can receive that signal? Today in our ATSC 1 world, what can receive a signal is a television. But in the ATSC 3 world, we really can target multiple different types of devices still starting with televisions, but then moving onto other kinds of consumer electronics devices that are developed such as a home gateway device, which would take in an ATSC 3 signal over the air and then provide that programming over WiFi to connect the devices within the home. And those devices could be anything from a phone to a tablet to a computer, or even to a television.

There's also the possibility of targeting mobile devices when they're not in the home. And those devices would need an ATSC 3 receiver. But once those devices are built, the standard is designed in such a way that you can actually receive those devices. We can receive the signals in devices that are on the move, even as fast as 50 or 70 miles an hour.

Finally, something that this standard has that in the past we've never had is, it is upgradable. And what does that mean? It means that as we make advancements in some areas of these technologies, like for instance we come up with better audio encoding in the future, there is a possibility — and I will admit that I'm a little bit of a skeptic on how easily upgrading is going to work — but there's the possibility of being able to update the receivers to add capability or to improve on the way that systems work.

Lonna Thompson: And that's just the data, right?

Eric Wolf: That's over-the-air delivery of new capabilities.

Core Capabilities | Richer Content

16

Core Capabilities | Richer Content

Video

- Contrast (HDR)
- Color space (REC 2020)
- Frame rate (120 Hz)
- Resolution (4K+)

16

So diving a little bit into the richer content area, again the things we're used to are video, audio, and then we're adding interactivity. So in video, we take advantage of the fact that we've got HEVC encoding, so for those of you that don't spend your time geeking out about encoding, in today's world, we compress all of the video that goes out with MPEG2. And MPEG2 is kind of a late '80s, early '90s kind of technology. And then most of the world today, not in

broadcast, but in cable and online, is using MPEG4, which is about two times better than MPEG2.

ATSC is where the whole world is moving today. Again, that's about two times better than MPEG4. So it's about four times better than what we have today, in terms of being able to compress video and keep its quality in place.

We also get what is maybe again, a bunch of features in video. We get high dynamic range, the ability to have a bigger distance between the brightest brights and the darkest colors in a scene, so shadows pop, things look more vibrant and more real. And in fact, when they've done consumer testing around the future of video, the feature that consumers really react to and really respond to is content that has HDR, high dynamic range.

Along with that comes an expanded color space, basically able to make pictures that look closer to the real world. We get faster frame rates. Public television isn't really high frame rate content, usually. But the sports folks like the idea of being able to have high motion video that looks more smooth and more realistic. And finally, the thing that often gets talked about first, we get to go from the one-and-a-half K world of HD to the 4K world of ultra-high definition. Frankly, as the industry has done most of the analysis, 4K of those things is the least interesting.

Core Capabilities | Richer Content

- Video**
 - Contrast (HDR)
 - Color space (REC 2020)
 - Frame rate (120 Hz)
 - Resolution (4K+)
- Audio**
 - Flexible tracks
 - Online audio delivery
 - Object-based audio

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Looking at the audio world, I mentioned before, we can have better quality sound. So sound can be a richer, more vibrant sound. We can get much more flexible set of audio tracks. But today, you have your primary audio, and then you have an SAP channel for instance, and so probably that has Spanish if you're

doing a second language. But there's no ability to have a flexible lineup of different languages for a given show.

Now we could do that. Or we could do what's my favorite example: I don't always like to listen to the regular baseball, the regular announcers on a baseball broadcast, but the broadcaster could actually provide me alternative broadcasters. Maybe the two people I like to sit next to in the bleachers give much better commentary than the official guys in the booth. They could be an alternate audio-track I could listen to.

Ted Krichels: Eric, the joint licenses. What is the radio quality if you wanted to simulcast classical music or news?

Eric Wolf: I'm not a radio expert, so I can't compare to, for instance, what's in digital radio today, but it's certainly significantly advancing the quality of audio.

And then the other thing that's going on is that we're going to what's called object-based audio, which for the production community will give them enormous, enormous potential with how they describe the sound field, and how the audio is laid out when it's played back on an appropriate system in the person's home.

One of the great features I think that public television audiences are going to like is there is an ability in the audio world to actually differentiate the volume for the voices, spoken word from a soundtrack. And so our audience, like me, who are aging, and would like to hear the voices a little louder please, can actually have that capability.



And then of course adding interactivity, this is going to be a wide-open area, and there's a lot of research that's going to need to be done, but the really cool side of this is there's a lot of work by a lot of people in the standards process of public television who are big advocates of this. All of the interactivity that's built in is built around HTML 5, which means the web developers we've all been trying to find and build into our businesses to help with social media and online presence will now be able to build assets that actually can be used in broadcast. And many of the assets we're already building for those other platforms will be able to come back and run them.



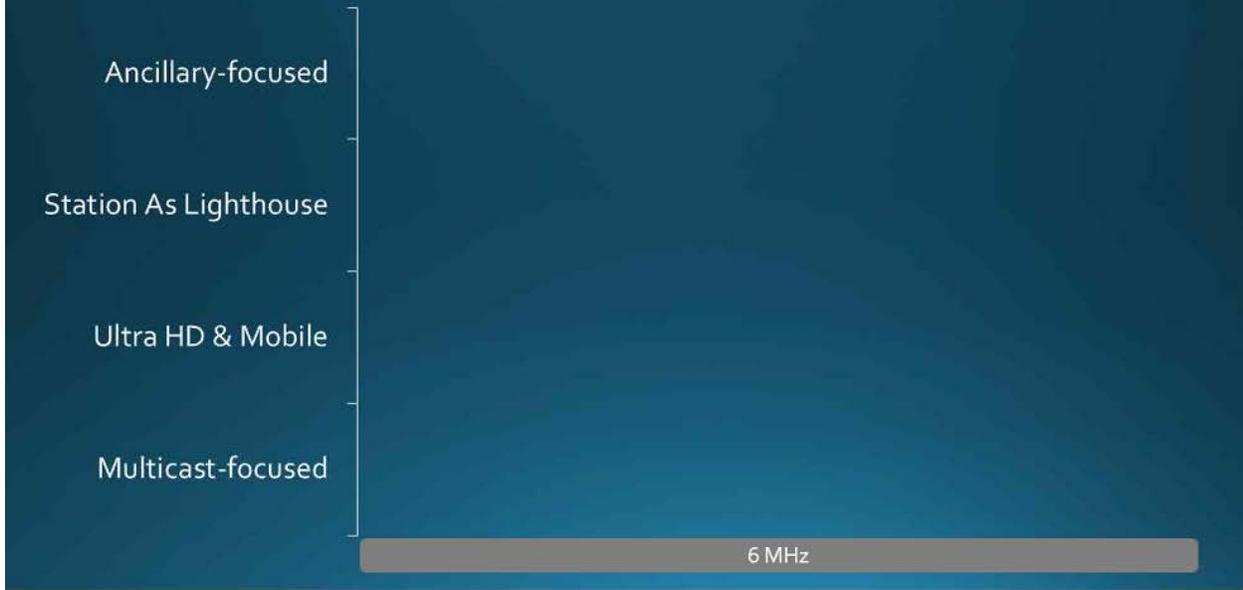
When you start to mesh those things together, you start to get really quite an interesting picture of how rich just our traditional content is.

Core Capabilities | Capacity & Compression

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Another way that we often look at a new standard is to think about what's the capacity of the standard, and how much can you get in there? And let me start by saying this is kind of an even more complicated challenge in the ATSC 3 world than it was in the ATSC 1 world. Because we both have to deal with how much can we compress the video and audio, and in what kind of device are we targeting? Are we targeting a fixed device with a big antenna? Or a small device that's roaming at 15-70 miles an hour? And you'll be able to split up your signals and target it to different places.

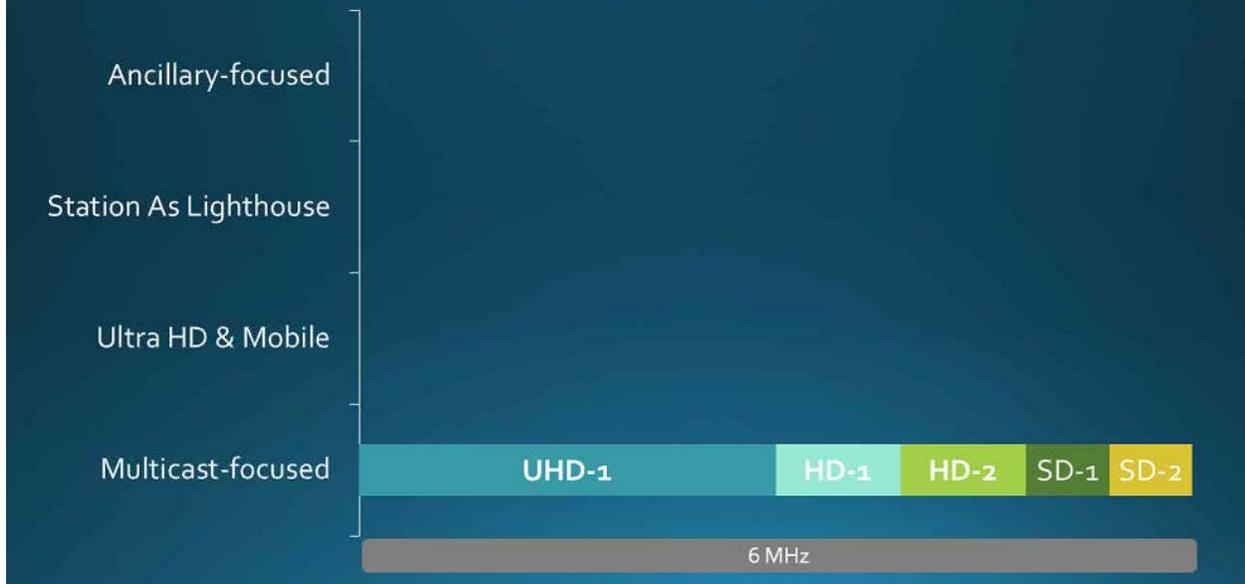
Core Capabilities | Capacity & Compression



I'm going to take you through four examples. These are four fictional examples we've made up just to spur your thinking. There are in fact millions of examples about the millions of combinations of how you can put things together, almost an unlimited combination.

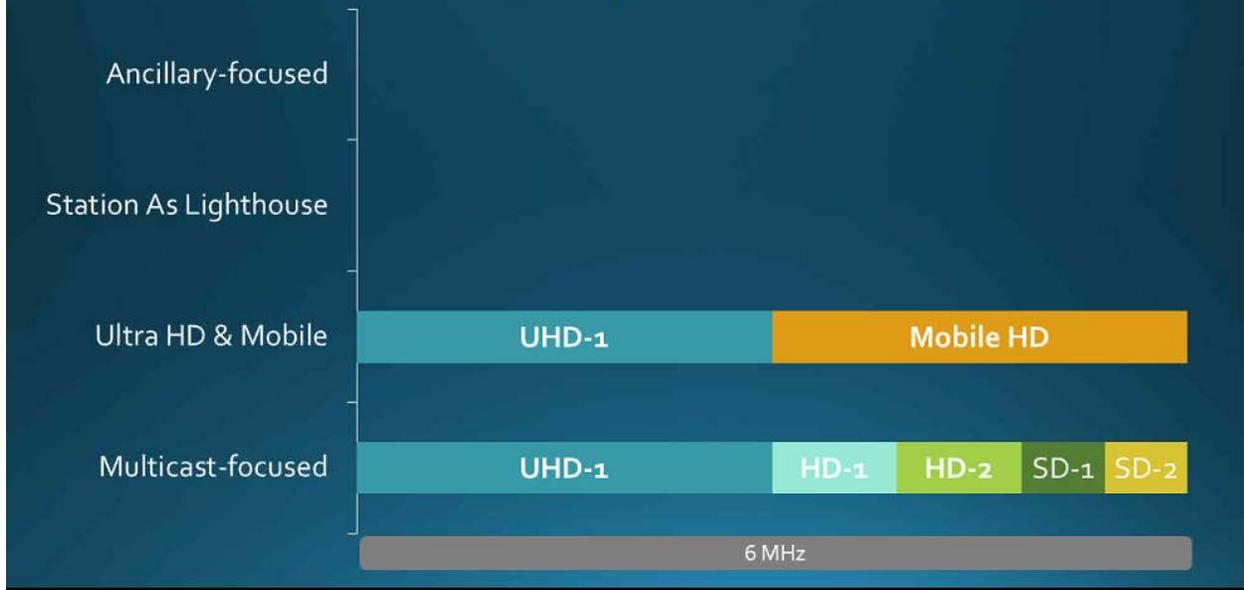
I spent some time the week before last with ETAC, and a number of other PBS folks at WRAL in Raleigh who are broadcasting in ATSC 3 today, and talking with their staff. This complexity of how you map out audio and video and coding and modulation schemes to reach different devices has been a thing they've spent a lot of time experimenting with, and we're hoping public television can ride behind.

Core Capabilities | Capacity & Compression



Let's imagine one station wants to do something very similar to what they're doing today. So they want to be multi-task focused, it's all about video and audio, and they want to get into ultra-high definition. Maybe their future station gets laid out like this. One ultra-high definition signal in 4K, maybe a couple of HD signals, and a couple of SD signals. You've got what you've got today, but more of it, and at higher quality. Sort of an interesting starting place, and a pretty basic idea.

Core Capabilities | Capacity & Compression

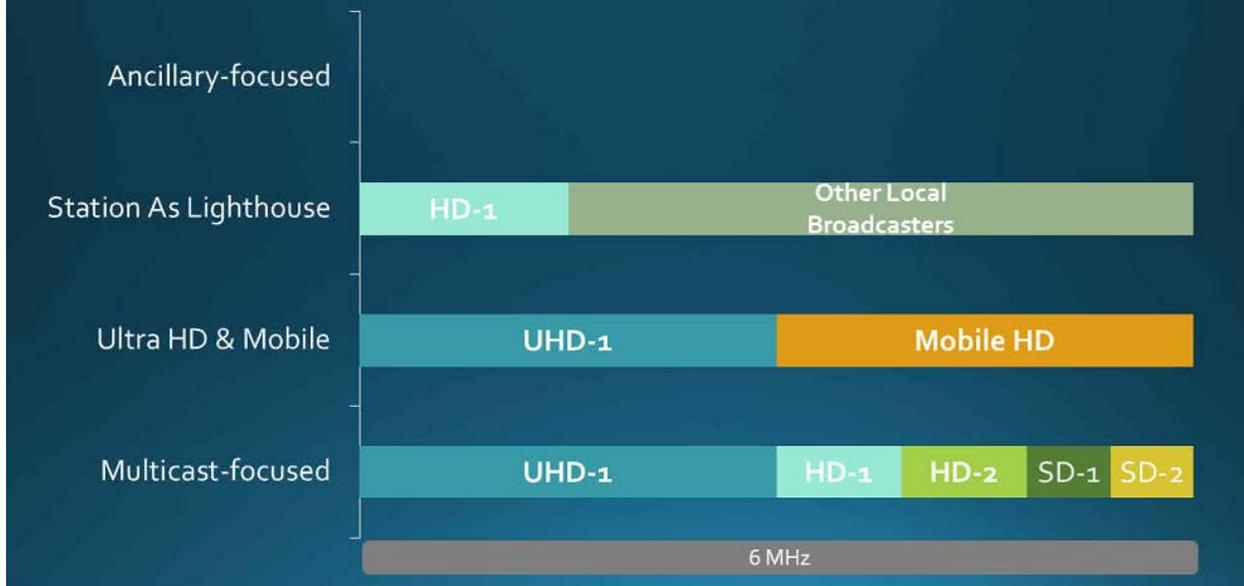


Or maybe, like WRIL today in Raleigh who are doing this experiment, you want to experiment with ultra-high def and you want to experiment with mobile. So they've taken their 6 MHz, and they've basically taken their ultra-high definition signal and put it on one app. And they've taken their signal that they're trying to reach mobile devices with, and they've put it in the other half.

Now you might say to yourself, "But it looks like you're only putting HD to those mobile devices, so why isn't that mobile HD as small as HD1 and HD2 in the first example?" And the answer is, HD1 and HD2 in the first example are targeted to a television set sitting in the living room with a big antenna and not moving around.

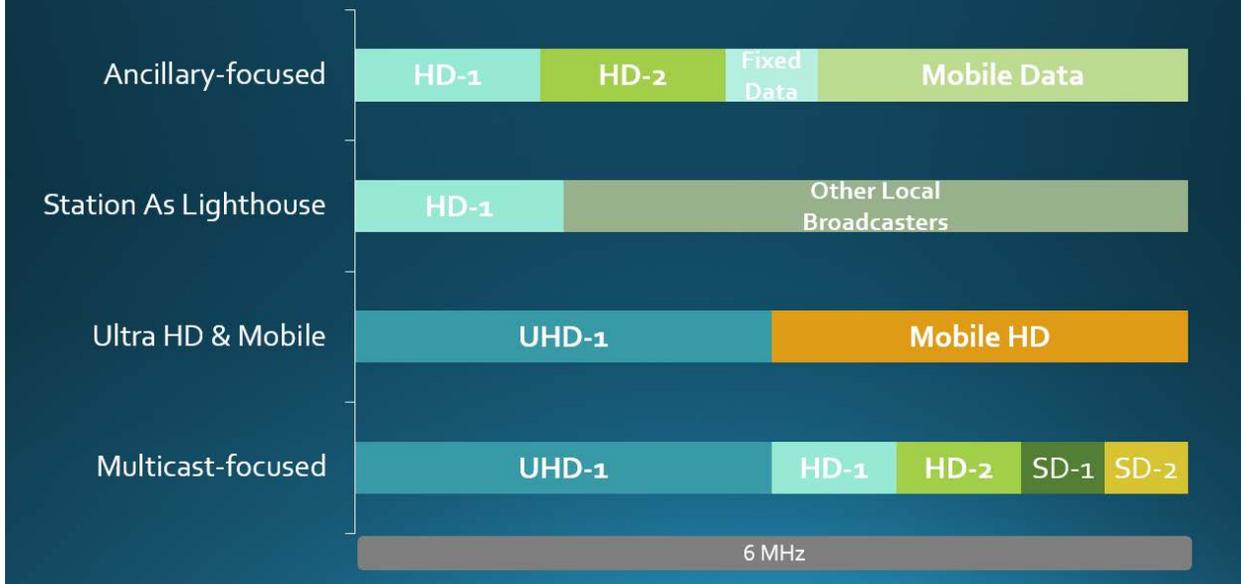
If you're trying to reach a mobile device that is smaller and might be in motion, you need to devote more of your MHz to that symbol. That mobile HD symbol might be the same 5 MHz per second to video as the HD1 example below, but in order to make that receivable by a phone, you need to allocate more of your signal to that purpose.

Core Capabilities | Capacity & Compression



Again, this is going to get complicated, and I'm going to give you a caveat in a moment that will put you back at ease. Maybe you're thinking about participating at the lighthouse station, and Dennis is going to go into this later, in your market. So you're going to light up ATSC 3 very quickly, and you're going to have other people sharing with you. Well then, you might only have, let's say 20%, or 25% available for your signal at the outset, and as the market continues, you'll expand and have the full use.

Core Capabilities | Capacity & Compression



Or maybe you're really focused on ancillary businesses, you're looking for a way to go do datacasting for some other business that's going to use your signal for some other purpose. You might have a couple of HDs, but you might have one signal that's targeted for fixed data devices, and another one for mobile data devices. Again, realizing that trying to hit a mobile device is going to take more of your signal.

Here's the big caveat. You don't need to try to answer this today. In fact, you should not try to answer this today. We're all trying to figure out where this business is going to go, and the purpose of this webinar and everything that the national board is doing is trying to get people aware of what the possibilities are, thinking and engaging about the responsibilities. But this is the tail end of the decision-making process, not the starting point in the decision-making process.

Talia Rosen:

The other takeaway from this is you're going to have a lot more options in an ATSC 3 world. There's going to be more capacity and better compression, but there's always going to be difficult decisions about how to use this PSP source that you have, what to prioritize it, what your business strategy, and these, as Eric said, are four of a million different possibilities of where you can mix and match different options. But yeah, not something you should be deciding today, over the next many months. I think it's all about education, about exploring the possibilities and probably over the next couple of years, really.

Eric Wolf:

A lot of information sharing. And one other thing that goes with it, this can all be done very dynamically in the new standard as well. So it's not, you make a business decision on day one and you can't change anything. In fact, much more

than ATSC 1, ATSC 3 allows you flexibility to, through the course of a day or a show, or other things change how the business is run.

Talia Rosen:

Because at any time of day, you might have different models.

Business Planning | Service Models

- Improved content
- Interactive children's education
- Journalism
- Accessibility
- Emergency alerts
- New audiences



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Eric Wolf:

You might have different models. So now, being one of the technical people on the call, I'm going to shift to talk about business. And the reasons I'm going to do this is I just want to make my strongest statement about from this whole day. The thing you've got to focus on is your organization strategy, your mission, your public service, and your strategy around revenue. Every decision you should be making around Next Gen TV should be not just driven out of technology, out of a dream of what you could do because this new technology exists, but out of a focus on what business you're in, what service you provide, and how you drive revenue from that service.

If you start from the technology, and try to determine what to do with business, try to invent a business to fit with the technology, you're not likely to succeed in doing what you as an institution are trying to do.

So that's my counsel. If you are an engineering person on this call, go sit with your CEO if you're not already. If you're a CEO on this call or a GM on this call, you should be talking with your engineering people. This isn't one of those things that the engineers can just go figure out and make happen.

Business Planning | Revenue Models

- Fundraising
- Sponsorship
- Leasing
- Hybrid OTT
- Datacasting
- More TBD

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Obviously, these are service models that stations engage in today. All of those service models could benefit from, or be extended by what's possible with ATSC 3. Similarly, there are revenue models that stations can engage in today. All of these revenue models can be extended or benefit from ATSC 3.

I will say at the bottom, if you get into things like hybrid [inaudible 00:45:38] and some of the advanced data casting people are looking at, there are new businesses that can be enabled. I'm not trying to say that the only thing you can do is what you do today, but I am trying to say this should all be driven out of your business strategy, and not out of some experimentation.

One of the things that we've done over the last couple of months, and I'm going to walk you through this relatively quickly, is to come up with a few scenarios that seem to be helpful in getting people's minds around how the technology that's available might apply to the different kinds of services we provide today.

What if...? | Richer Content



Technical Capability	PTV Opportunity
High Dynamic Range video	<ul style="list-style-type: none"> Vivid, compelling experience
Updated audio	<ul style="list-style-type: none"> Control of voice and music tracks Vietnamese audio track
Interactivity	<ul style="list-style-type: none"> Press button to see map of place being discussed
Content downloads	<ul style="list-style-type: none"> Longer versions of interviews Material that had to be cut
Personalized, targeted content delivery	<ul style="list-style-type: none"> Seamlessly integrate local segments
Integration to mobile	<ul style="list-style-type: none"> Paired / synchronized experience on mobile while watching broadcast

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Talia Rosen:

These are entirely hypothetical. The idea is to get the creative juices flowing about okay, this is a wide open, green field of possibilities. What kind of things could I maybe do of, and do with this, and then hopefully, you can take these and run with them in ways a whole bunch of things we never dreamed of using this kind of technology.

Eric Wolf:

Yep. And we expect to see a lot of invention and experimentation going on at the station level, at the national level, and collaboratively. And with producers it's going to be particularly critical as well, because a lot of invention is required. So all of these are fictional examples, none of the organizations involved in them were consulted in creating these, so my apologies to Ken Burns right from the outset. But can you imagine if Ken Burns were creating "Vietnam" today, or five years from now in an ATSC-centered environment. What more could he possibly do?

One is, high-dynamic range video. If you could take scenes, or they can be that more realistic or vivid, I'm not sure we necessarily want them to be more vivid, but that's certainly one possibility. With the audio capabilities, "Vietnam" had an amazing soundtrack. That soundtrack would sound even better and be even more vibrant. But a really interesting thing came out when we put a version of the documentary online with a Vietnamese language soundtrack. There were 600,000 streams of a Vietnamese language of a documentary about the Vietnam War. That was pretty impractical to do in broadcast. You could've put Vietnamese on SAP, but then how do you educate everybody to go look for it there, etc.

Well in the world of ATSC 3, you can have multiple soundtracks with different languages, and people who were in households that have indicated on their TV that they want to hear Vietnamese language would presumably get that offer. We don't know exactly what the user experience would be, but they would have the ability to get that soundtrack. And interestingly, those soundtracks can even be delivered in parallel over the internet, so you could have something that was an extremely obscure language that wasn't worthwhile to put into broadcast everywhere, but could be delivered just to those households that needed it.

Interactivity, well, you could have had a button available throughout the show that would've allowed you to overlay a map on things. If you didn't know where something was. He could've enabled content downloads, we could've had local station content integrated more seamlessly somehow. There could've been a lot of more interesting things that could've been done. And it could've been paired to the mobile app, and you could actually trigger things in the broadcast that would make things happen in the mobile app.

What if...? | Audience Relationship




Technical Capability	PTV Opportunity
Personalization + Interactivity + Conditional access + Viewership data	<ul style="list-style-type: none"> Passport membership extends to broadcast "Pledge" becomes "Thank you" for members Seamless experience across platforms
	<ul style="list-style-type: none"> Become or participate in OTA "skinny bundles" or other new models
	<ul style="list-style-type: none"> Deeper understanding of both aggregate and individual viewership

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On another front, in the audience relationship world, now in a world where we can personalize the experiences on the TV where we can make the experience in each home customized to a degree to that home, what about extending Passport back into the broadcast domain, so that people that are members of your station and have become sustainers and they're past due, they've activated Passport. What if when the next pledge drive came around on air, instead of getting a request for money, they got a thank you for being a member. And maybe that's showing just extra content that was just for members or something. Again, we're making this up, but it's an interesting idea and an

interesting way to tie together the audience members that are connected to your station, and their experience online and on air.

What if...? | Kids & Interactivity



Technical Capability	PTV Opportunity
Deliver apps over-the-air	<ul style="list-style-type: none"> ▪ New content / functionality ▪ Even for people with no internet connection
TV apps use HTML 5.0	<ul style="list-style-type: none"> ▪ PBS Kids web and mobile apps already built using HTML 5.0 ▪ May be able to deliver our most educational experience to every child even without broadband
Most TVs will be WiFi connected	<ul style="list-style-type: none"> ▪ Where connected, seamlessly extend PBS Kids ecosystem

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In the interactivity world, the PBS KIDS products obviously are terrific, and there's wonderful video, and through experimentation they've found that when you add interactivity to video, kids retain more and learn more. The challenge is, in the broadcast domain, we don't interactivity today. So what would happen if we could take at least some of the interactivity that's in our kids' games, and import it over to the television using the same HTML 5 technology? And then enable kids to be able to engage that interactivity during or adjacent to a broadcast. It's really cool.

What if you don't even need an internet connection, so now kids who don't have an internet connection at home, or the 20% of households where there's no broadband connection can benefit from that activity, that interactivity and bridge the digital divide? Very very powerful, I think.

And where kids do have connected TVs, all that interactivity can flow, and the parental engagement and other things can be important. Again, constant.

What if...? | Public Safety



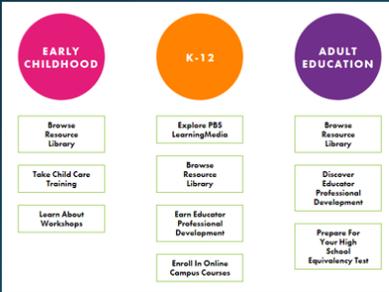
Technical Capability	PTV Opportunity
Detailed data (e.g. maps) in alerts + Devices wake on alert	<ul style="list-style-type: none"> Increased importance to public safety community Increased value to audience
Geo-targeting	<ul style="list-style-type: none"> Increased relevance of local station Increased relevance to audience Opportunity to link to state / local alert systems
Targeting to mobile devices	<ul style="list-style-type: none"> Potential for consumer alerting <u>Datacasting</u> vital information to First Responders Reach where LTE does not cover

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What if in the public safety domain, public television has worked hard, and frankly our commercial peers have embraced the idea of more powerful public safety features built into the ATSC 3 standards. Features like waking up devices when an alert comes in, which has saved lives in Japan. Features like geo-targeting so that you get alerts that are related to where you are. And features such as targeting to mobile devices to the extent they have ATSC 3 receivers in them.

Clearly this is an area that's rich for public television stations, stations are very interested in, and there'll be a lot to take advantage of.

What if...? | Distance Learning



Technical Capability	PTV Opportunity
TVs run HTML 5	<ul style="list-style-type: none"> Create rich applications that are distributed over the air and can combine broadcast and broadband content
Ability to pre-download targeted content OTA	<ul style="list-style-type: none"> Download the right lessons to the right classrooms Even if no / poor internet
Personalized content	<ul style="list-style-type: none"> Continuity back to home

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A final example that I'll just include, and this came actually out of discussions with stations, distance learning is something that a number of stations are engaging in today. In some places you have very well-connected schools, but in some cases not so much. What if something like PBS LearningMedia or your station's distance learning tools could have interactivity built in, and still be delivered in a broadcast fashion, and including the ability to pre-deliver content overnight and play it back later on.

Those are five scenarios— again, not proposals, not products, just pure concepts — for you to consider and stimulate your thinking. We're looking for more ideas, we hope we'll hear from all of you, and again, let me as one of the technical people, just say, go back to the business, go back to the mission, go back to the revenue strategy, think about how those are extended and enhanced, not how to take some feature and try to turn it into [inaudible 00:52:42]. And with that I'll turn it back to Ted.

Ted Krichels:

Great, thanks very much. If you have questions, submit them. You know how to do it now, press Q&A button in the top right of the screen, at the bottom right choose Q&A, under "Ask" select "Host," type the question in the field at the bottom of the screen, and hit send. We've got a number of these, we're going to try to get through them all as we go through, but I want to now turn it over to Dennis Wallace.

Technical Planning | Key Technologies

- Entirely IP system (not MPEG Transport Stream)
- OFDM Modulation (not 8-VSB)
 - Many choices depending upon broadcasters implementation
- Hybrid System for a seamless viewer experience
 - Integrates over-the-air and internet connectivity
- Bootstrap Hierarchical Signaling enables future upgrades



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Dennis Wallace:

Thanks Ted. So I just want to cover some high level technical aspects, and some of the key technologies of ATSC 3. This is not meant to be an exhaustive technical presentation, obviously this webinar is geared to higher-level concepts, and it will probably be a series of additional webinars, I'm speculating, that will be a little deeper technically. But just to give everyone a sense of the capabilities of the system, and some of the key technologies that are included in Next Generation Television, I think those are key things for everyone to keep in mind.

Probably the most key things for you to walk away, particularly our managers and CEOs that are on the meeting today, is that this is an entirely IP system. And when I say IP, I mean internet protocol. So the key piece of that is that we're moving television into the IP world. We're getting rid of MPEG transport streams that we've relied on in ATSC 1.

And I'll talk about this more in a moment, but one of the key advantages of an IP system is that brings us into the world of interoperability. Now we have the ability to inter-operate with other devices in the home, as Eric pointed out in tablets, and televisions, and computers and other things that are IP-based. This really brings broadcasters into the world of IP. So that's one of the key pieces of ATSC 3 and Next Generation Television to keep in mind.

Just a little deeper in terms of technical pieces of the system, the physical layer or the RF Modulation, that is the signal that we send over the air from the tower to the consumer's home. We're changing from what we call today 8-VSB modulation to OFDM modulation. One of the key advantages of that particular modulation scheme, and the way it is implemented in ATSC 3 is, we have a

variety of choices from which to choose. And this decision on how to operate your facility is really up to the local broadcaster.

So you could choose to operate at a different data rate or a different robustness level that would support the business decision that you've made about the business content, and other decisions that you've made around ATSC3.

One of the key things to walk away from today understanding is there are many choices of modulation depending on your implementation, and that will vary depending upon the robustness level you desire to deliver to your broadcast service area, and the amount of payload that you need to deliver the services that you desire.

Another key difference as sort of a key technology to the things that Eric just outlined is the hybrid system. This system allows us to integrate over-the-air and hybrid delivery of internet protocol through the internet to provide a seamless experience for the viewer. So we're integrating over-the-air and internet connectivity to allow us to do a much fuller offering of services. One of the examples that Eric gave was potentially another foreign language delivered via the internet for the video content that is delivered over the air. And all of that is integrated seamlessly in the receiver.

I think that from public television's perspective, hybrid is going to be one of the things that really allows us to open our horizons in terms of the services that were available to deliver to our communities and to meet our core missions for our organizations.

Also about ATSC 3, the last item there is the bootstrap provides a hierarchical signaling, which enables us to do featured upgrades. And we briefly touched on this earlier, but the idea is as we upgrade our various components, layers of the system, this bootstrap signal is kind of the core piece of the system that allows us to send updates and tells the existing receivers to ignore the new signals that are coming, because those are not meant for legacy receivers, and allows new receivers that are able to decode those new signals, the ability to ignore the legacy parts of it.

So the bootstrap is an integral part of ATSC 3 and the hierarchal system that we have for signaling the various layers in the system is one of the key features that allows us to do upgrades for the system.

Technical Planning | Key Technologies

- New Audio / Video Compression Systems (CODEC)
 - Higher Resolution Video
 - High Dynamic Range
 - Wide Color Gamut
 - High Frame Rate
- Advanced Emergency Alerting Capabilities
- Voluntary Standard (not mandated by government)
- Simulcast ATSC 1 / ATSC 3 with channel sharing to enable market transition



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As Eric and others have talked about, some of the other key technologies that are implemented in ATSC 3, new audio and video compression systems, or as we refer to them as Codecs, allow us to do high-resolution video, high-dynamic-range video, wide color gambit, high frame rate. And it allows us to do that in a much more efficient manner. In other words, it takes much fewer bits to deliver the same-quality video or in some cases even higher-quality video than we have today, due to the efficiency of the high-efficiency codecs that we have in the system.

Another core key technology of 3.0 are the emergency alerting capabilities. And I know this was touched on a moment ago, but I think that's one of the key pieces for public television in particular and public media companies, is we've always been involved deeply in emergency alerting, particularly in our state networks and with our WARN systems that we've installed. So advanced emergency alerting and capabilities that are baked in to the ATSC 3 standard.

These emergency alerting capabilities, I think, will find great acceptance and certainly opens the horizons for public media to partner with local emergency services to make those a reality.

As Talia mentioned earlier, it is a voluntary standard, it's not mandated by the government, so the decision about when to move to ATSC 3 and Next Generation Television is really ultimately a local decision by the television station. And obviously the business considerations for that are different for different organizations.

I view that as a positive. It is sort of a key technology in that we do not have a mandate with a specific timeline, and it gives stations the flexibility to move to Next Generation Television when they're ready.

Finally, the simulcast of ATSC 1 and ATSC 3 with the channel sharing is what's going to enable our market-by-market transition. And I'll give you an example of that here in just a moment.

Technical Planning | Plant Basics

- **Studio equipment**
 - HEVC Video Encoding
 - AC-4 Audio Encoding
- **IP Transport streams**
 - Now all IP-based standard
 - Multiplexer / DASH packager
 - Electronic Service Guide (Metadata)
 - Scheduler/Gateway



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From a technical perspective, I know I get this question frequently, what are some of the technical planning pieces that we should be thinking about. I know many folks are putting together long-term technical plans or budgets that run several-year cycles. The question often comes up, "What should we be thinking about in terms of equipment for 3.0?" So let me touch on a few key areas. Obviously in the studio, in order to do 3.0 transmission, you'll need a new high-efficiency video encoding equipment and AC4 audio encoding equipment for the actual content.

As I mentioned, this is an entirely IP transport stream system, so now it's all IT based, so that means that our MPEG2 transport that we've traditionally used is no longer applicable for Next Generation TV, so we'll be replacing multiplexers. In order to do 3.0, you'll need a packager. The electronic service guide, or what we would refer to in today's world as PSIP. That equipment would need to be changed as well as what we refer to as a scheduler or gateway, which actually tells the transmitter to put this particular packet in this particular data frame, and when to transmit it. It's a little different approach than we have had with our ATSC 1 service, but those are all components on the studio side that would need to be replaced as we move through ATSC 3.

Eric Wolf: Dennis, if I could jump in, one comment on that again, from our visit to WRAL in Raleigh. Pretty much all of that fits in a couple of traditional IT servers now. So you're not going out and buying a lot of big boxes, it's a couple of HP servers and licensing a bunch of software.

Dennis Wallace: Yeah. Eric brings up a good point, which is that most of this is virtualized on a blade, basically, at this point, and many of you know I'm involved in an ATSC 3 station in Cleveland, and literally that station is three racks of nothing but servers. There's an entire television station and three racks of servers. Many of these components that I'm outlining for you are actually, physically, software running on a blade.

Technical Planning | Plant Basics

- **Transmitter**
 - OFDM higher Peak/Average power ratios
 - Newer transmitters designed for OFDM operation
 - Modification of ATSC 1 transmitter possible with new exciter
- **RF filters**
 - Mask Filter same as today – 6MHz Channel
- **Antenna systems**
 - Consider adding Vertical Polarization Component

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The other items that you would need to sort of think about in terms of converting to 3.0, I know this has been covered by several folks, but I just bring it up again for those of you that are not buying new transmitters as part of the repack, the OFDM signal does have a higher peak-to-average power ratio, which means that older transmitters may or may not have the ability to correct for the inter-modulation products and the power amplifiers. Obviously, folks that are moving to new channels in the repack, as many of those will be purchasing new transmitters. Virtually all of the transmitters on the market today are designed to be 3.0 ready, which means that they have the capability to pre-correct for power amplifier distortion and handle the high peak to average power ratios of ATSC 3, so that's an advantage there.

However, if you want to modify an ATSC 1 transmitter that you have today, you're not being repacked, you want to just modify an existing transmitter, you can do that. And it's really actually just the replacement of that ATSC 1 exciter

with a new ATSC 3-capable exciter. If the power amplifiers in that transmitter are capable of handling the high peaked average power, then it's really a pretty straightforward matter to convert an ATSC 1 transmitter to an ATSC 3 transmitter, just simply by replacing the exciter.

The good news about transmitters also is that the mask filter will be the same as we have today, it's the same as the six MHz channel. The bandwidth of the ATSC 3 signal is just slightly wider than the ATSC 1 signal, but it still fits within the six MHz band that we have today. The only caveat to that is some of the very old, IOT transmitters that had very sharp-tuned notch filters in order to make their intermodulation specs. These are transmitters that were manufactured in the '98, '99, 2000 time period. Some of those mask filters would not necessarily be optimum for ATSC 3 performance.

But generally speaking, most of the common mask filters in the field today would be usable for ATSC 3. And then finally in antenna systems, I know this is a topic of a lot of discussion, particularly among RF folks, is "Do I need to replace my antenna system?" My general answer to that is that the antenna you have today will work just fine for ATSC 3.

The reason that a lot of folks are changing their antenna configurations as part of the repack to add some vertical component is because they need the power density, or they feel like they want to add power signal density to their existing coverage area. That's really sort of a separate issue from whether you convert to ATSC 3. Certainly, it helps if you're planning on business models that involve mobile or deep indoor reception to get higher-power density, but even if your station was going to stay as an ATSC 1 station for a very long time, it would make sense to consider some vertical component, because that additional power density is going to improve indoor reception for example, which is what a lot of our board cutters are moving to, with indoor antennas, and certainly not 30-foot outdoor antennas.

Antenna replacement is something to consider, but it's not required for ATSC 3, and even for those stations that are staying in ATSC 1 for the foreseeable future, an antenna upgrade may be worthwhile, considering.

Technical Planning | Key Choices

- Audio Encoding – Dolby AC-4
- Video Encoding – HEVC
- IP Packaging (ROUTE/DASH) (MMT)
- Multiplexer
- Electronic Service Guide (PSIP)
- Broadcast Gateway / Scheduler
- Transmitter / Exciter



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Some of the key choices in terms of technical facilities as I mentioned, you'll need a new audio encoder that would support Dolby AC4 in the North American Market, video encoding for North America is going to be the high efficiency video codecs or HEVC.

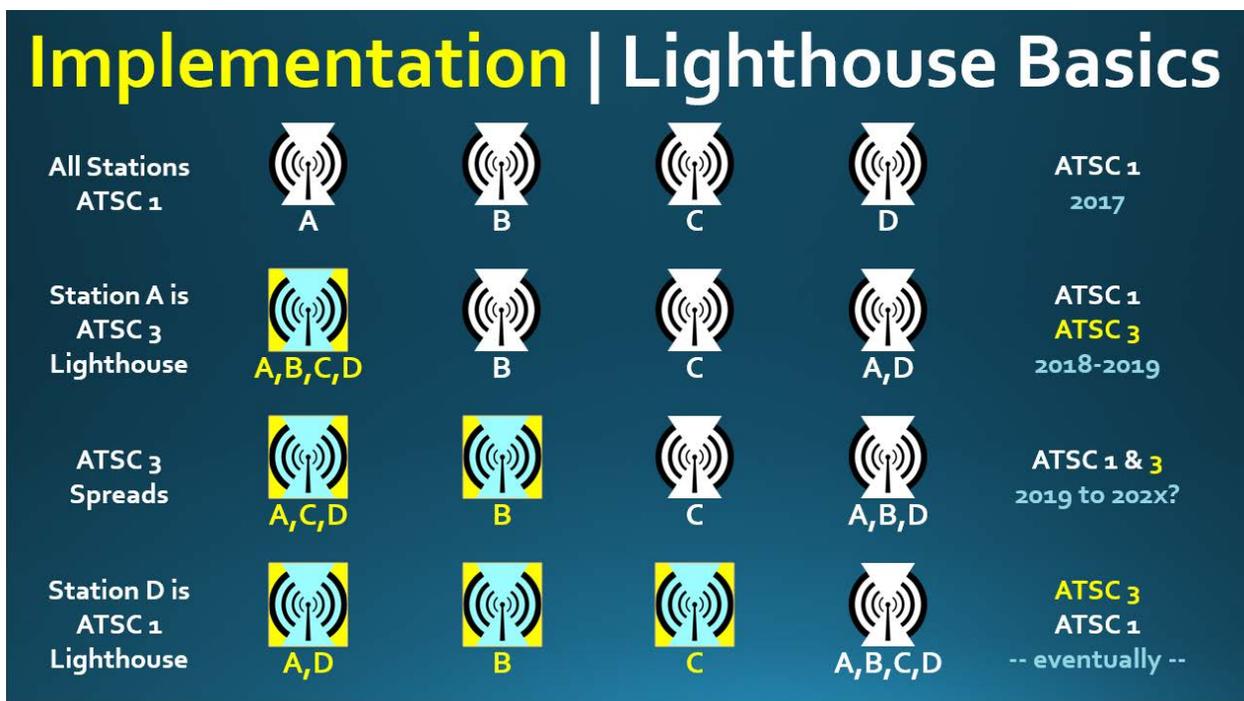
In IP packaging, there are two ways to do this that are encapsulated in the standard. One is Route Dash, and the other is MMT. Generally speaking, the consensus in North America is that we're probably going to deploy Route Dash for most commercial and non-commercial broadcasters in the United States. Korea is doing MMT, there's really some esoteric differences between those, which are far too technically deep for this webinar, but suffice it to say, what you're buying for your stations in the next three to five years is going to be Route Dash equipment.

Also a Multiplexer, and the multiplexing in this system is on a couple of different levels. When I say multiplexer, people typically think of Statlux for their video coding, which is part of the video encoding HEVC codec, but also service multiplexing. That is adding maybe a robust channel, and a high definition or an ultra-high definition channel. The multiplexing of the services is done in a different way in ATSC 3 as it was done in ATSC 1. So there will be a need for a new service multiplexer.

Also, electronics service guide will be referred to in one as PSIP is a different implementation. A lot of the vendors that have provided that product in the past have an ATSC 3, or a Next Gen TV version of that product that's available on the market today.

And then the broadcast gateway or scheduler, as I mentioned, this is essentially a server. The computer that essentially takes that IT stream from the multiplexer in the electronics service guide computer, and tells the transmitter what to transmit, which packets at what robustness level, and what the framing of that data looks like. So it's an integral piece to the transmission facility. As I mentioned earlier, the transmitter and exciter, whether you're starting with a brand new ATSC 3-ready transmitter, which would have presumably an ATSC 3-ready exciter that just requires a software upgrade at a minimal cost, or if you're going to convert an ATSC 1 transmitter to ATSC 3, that might require a new exciter.

Those are kind of the key things from a long-term planning and capital perspective that you may want to consider in terms of planning.



Now let's talk a little bit about implementation in the lighthouse. I'm going to go through this in a couple of different steps to try to explain it in a way that doesn't get too complicated. But we're just going to use this as an example of the market today. We have a market that has four stations in it, station A, B, C, and D. All of those stations are currently operating in ATSC 1. And they decided that they're going to implement a lighthouse in this market and move to ATSC 3. In this case, Station A has volunteered. They're going to become the ATSC 3 lighthouse for that market, and they would convert their facility to ATSC 3 transmission, and they would carry the signals, or the simulcast ATSC 3 signals, of stations A, B, C, and D as a multicast on that ATSC 3 lighthouse.

I'm leaving out some of the real technical specifics, because ultimately this will be negotiated on a market-by-market basis. But suffice it to say if you could sort

of imagine, this might be four stations that are sharing that Station A running for 10 ADP wide color gambit HDR signals, just as an example.

Stations B and C in that market would remain as ATSC 1, still broadcasting the same content that they are today. There would be no changes to B and C, other than that now they're providing a simulcast to station A with their 3.0 content that's being broadcasted by station A. And then Station D becomes the ATSC 1 sharing station, so station D now carries the ATSC 1 simulcast content for station A that converted.

That's sort of the first step of a market transition, where we have one lighthouse station, we have another station that's volunteered to act as the 1.0 simulcast partner, or channel-sharing partner, and then two stations that have stayed the same.

Talia Rosen: The point of this is that all stations are available in both formats, right?

Dennis Wallace: Correct.

Talia Rosen: So it can get you either way.

Dennis Wallace: Right, exactly. The question always comes up, "What about accessing the signals that I have today?" And the advantage of this implementation is that everybody suddenly has continued access to the 1.0 signals that they've always had, but now they also have access to the 3.0 signals. And as television sets penetrate the market and we have uptake from consumers, they have TV sets, they have both ATSC 1 and ATSC 3 tuners, they'll be able to access both of those stations as time goes on.

Now in the next round, we have another station, we have television sets that have penetrated the market. There's considerable consumer uptake, and the market looks like we could support having another ATSC 3 station in the market. So in this case, station B decides that it's going to convert and become an ATSC 3 station, so it would no longer simulcast on station A, it would carry its own signal on its lighthouse station, and then station C would remain just the same as it is today, and station D now is carrying the ATSC 1 simulcast of stations A, B and D. And then it just progresses.

In the next step we add another station to the ATSC 3 lighthouse, now stations A, B, and C are all transmitting in ATSC 3, and then station D is carrying the ATSC 1 simulcasts of all four of those stations in the market.

That's a multi-year process of how it would likely work in implementing a lighthouse and transition an ATSC 3 and next generation TV, in a market. Obviously these are going to be unique circumstances for each and every television market in the United States. I said to someone recently that every

market is a snowflake, they are all different. You've seen exactly one market when you've looked at one.

But the number of players in the market that are interested in participating in ATSC 3 will dictate how this will roll out in each one of your individual markets, and the willingness of stations to participate in channel sharing and pooling will directly impact that as well, but as we've talked about, there is an opportunity here for public television, both to act as a 1.0 simulcast station, and potentially to act as an ATSC lighthouse station, and individual stations and organizations will make those choices based on their current organizational mission and goals and their financial resources and what makes sense for them and their individual markets in serving their core missions in their communities.

Implementation | DTV Comparison

- Key Similarities
 - Broadcasters and viewers need new equipment
 - More than just new transmitter
 - Communication and education are key
- Key Differences
 - Voluntary for stations and viewers
 - Starting cost for consumer equipment much lower
 - Wider range of capabilities for stations
 - Integrate with current media ecosystem

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Let me just wrap up some of the technical pieces by talking about some of the key similarities of this transition from ATSC 1 transition from analog to ATSC 1. Obviously there's some similarities such as new equipment for consumers. And this new equipment is likely to take a variety of forms, from traditional TV sets to new mobile devices, and potentially even automobile receivers. You will need new equipment at the station to encode the signals and to assemble the ATSC 3 signal for distribution for the lighthouse station, and we covered the key concepts as what that equipment would be. Certainly, one of the key things that we need to focus on is communication and education with our members and our consumers and our viewers. This is all very confusing for us as professional television broadcast sources, so it's going to be really confusing for our consumers and our viewers.

So a key piece there is education and communication with our core audience. However, there are some differences between this transition and the analog, the digital transition. The biggest of those differences is that this is a voluntary transition for stations and for consumers. No one's going to force them to buy an ATSC 3 set. Certainly, stations will make the move to ATSC 3 when they decide to do that.

I think it will be largely driven by the fact that almost all of the consumer electronic manufacturers have come out and said that they're going to build TV sets that have both an ATSC 3 tuner and an ATSC 1 tuner integrated into the same set.

For consumers, this will really be seamless. They really may or may not know that they have a 3.0 capable set. It may be that they replace the TV set, and suddenly now they have ATSC 3 functionality.

Ted Krichels: Dennis, there was a question about that, the conversion to the consumer device. What will it be like? What are the projected costs, I think mainly.

Dennis Wallace: Obviously they run the gamut, depending upon whether you're talking a television set or what we've often referred to as a gateway device, which I think maybe is what the question is about. When we made the conversion from analog to digital, we had a little box, a little converter box, there was a coupon program for people to go and get a converter box. Sort of the modern-day equivalent of that converter box would be, as Eric described, kind of a gateway device that would receive an over-the-air ATSC 3 signal, and convert that to WiFi. And that would be sort of a bridge device that would allow you to use your existing devices or existing tablets and phones to watch the ATSC 3 content on an existing device, and that bridge is made with WiFi.

The modern-day equivalent of a converter box is essentially what we would call a home gateway, which is a device that receives the ATSC 3 signal and transmits it via WiFi to the devices in the home.

Lonna Thompson: Dennis, I was just going to ask the same thing. I've heard my most recent scuttlebutt I heard was it's now, they keep improving, this is apparently is now under a hundred dollars, is that right?

Dennis Wallace: A hundred dollars is the recent thing. We started at \$300 and it's come down to \$100. I think those are reasonable numbers in the beginning of the transition. I'm long enough in this industry to remember when we moved from analog to digital, and we had \$20,000 TV sets, and no one could believe that we'll ever sell TV sets to Americans that would cost \$20,000, and now you can buy them at WalMart for \$159.

The consumer electronics industry will figure out a way to get the price down, and they'll figure out a way to lose money on every single one of them that they sell, and make it up in volume, which has always been the business model there.

The cost for adding an ATSC 3 tuner to an existing TV set is not an astronomical amount. The other thing that I think you need to keep in mind is that Korea is requiring that their TV set manufacturers provide these devices in Korea. So to the extent that Korean equipment manufacturers have to do this anyway, they already have the design, there are very few tweaks they have to make it compatible with North American implementation of ATSC 3. So the cost factor I think is going to be pretty inconsequential when it comes right down to it.

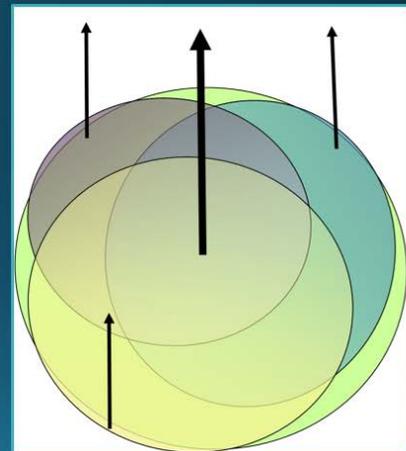
Ted Krichels: Can you address the time factor? There was a question about when the first receivers would come to market.

Dennis Wallace: That was an earlier question. This is a Dennis Wallace prediction, so it's not based on anything other than my involvement, and sort of my guessing here, but I think you'll see a real ATSC 3 product at the CES show next year. Not the one in six weeks or so, but the one in the following year. That is the one where the buyers for all the retailers will buy their initial ATSC 3 product. So the Christmas selling season of 2019 would likely be when you would see the first consumer devices on the shelves.

Ted Krichels: We have a pile of questions, so I don't know if, when you are through ...?

Implementation | Next Steps

- Anticipated schedule
- Repack alignment
- Collaborative channel sharing
 - Lighthouse stations
 - Selected migration
- Patent licensing arrangements
- Single frequency networks
- ATSC 1 sunset?



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Dennis Wallace: Let me just wrap up real quick with sort of next steps, and I think one of your questions was about anticipated schedule, which we just talked about. I think

the key takeaway for stations is there's plenty to think about here, in terms of consumer products, probably Christmas 2019 would be my guess based on today's view of the world, obviously subject to change, and one of the other questions that we obviously get frequently is about repack alignment. Certainly there are going to be commercial folks and markets that make the decisions and move to ATSC 3 as part of their repacking. I think that alignment is more likely to happen in later phases of the repack than it is in earlier phases of the repack, just due to equipment availability, and broadcaster's ability to get those agreements in place in the market. But there certainly will probably likely be phase one and phase two markets that do launch ATSC 3 lighthouse stations.

To the extent that they're aligned, that's certainly possible. I would not walk away from this thinking that you have to make the decision to convert to ATSC 3 as part of your repack work. Those are really separate tasks. To the extent that they align that's great, and it reduces the amount of confusion for consumers, because they only have to re-scan their TV sets once and so forth, but they're really sort of separated from that perspective. Don't forget about it, but at the same time, don't feel like you have to make that decision sooner rather than later.

In terms of next steps for stations, particularly station management, think about how you would implement a lighthouse in your market, and what stations are likely to partner stations that you would want to talk to. Whether it's being a 1.0 host or being a 3.0 lighthouse station, those are all things that you should be talking with your other colleagues at other stations at your market and start thinking about how you would implement those.

One of the other items that we get asked frequently, at least in our shop, is about patent licensing. I'll just say that there is a pool, a patent pool for the required licenses for ATSC 1. I am aware that there is a pool forming for ATSC 3 licenses, so to the extent that the licensing will be very much the same as it is today with ATSC 1, I don't expect any big departures from the patent licensing arrangements that we have with ATSC 1 products today. So I would not anticipate that being a large challenge.

One of the other questions that we frequently get is single-frequency networks, and this is the ability to build multiple transmitters in your market that all operate on the same channel. We've done an extensive amount of work on single-frequency networks in our shop for a variety of clients. And I'm just telling you, the two highlights about single frequency networks are it is a capacity play. In other words, you would want to implement a single frequency network when you get to the point where you have enough receiver penetration that you need to deliver more bits to more devices. It's not a requirement for ATSC 3 that you deploy a single frequency network. Sometimes there's misconception around that.

Single frequency networks are a tool that we use as RF engineers to solve business problems. And the business problem that a single frequency network

solves is the capacity and coverage problem. So until we get a large number of receivers in the market, that's not a problem that we have to solve just yet. Certainly the system is designed to do single-frequency networks, it's a huge advantage for the system, but it's probably not going to do that in a scalable way in the first three to five years, would be my guess. Once we have enough receivers in the market that it makes sense to make that capital investment, then people will move to single frequency networks.

Lastly, just to close out, Ted, before I hand it back over to you: ATSC 1 sunset. I think the commission had a lot of discussion around that, and I think they wisely deferred to make any decisions about that until we can see what the consumer adoption rate looks like. Certainly at some point in the future, and I would hazard to take a guess at that, maybe 15 or 20 years from now, but at some point when we have enough TV sets in the market to have both an ATSC 1 and ATSC 3 tuner in them, broadcasters can make the decision at that point to sunset ATSC 1. I suspect that that will come up and have some commission action associated with it based on consumer adoption.

I think that's probably a 15- or 20-year horizon from today.

Submitting Questions

- Press Q&A button in top right of screen
- At bottom right, choose Q&A
- Under "Ask," select "Host"
- Type question in field at bottom of screen
- Hit send

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Ted Krichels:

Okay. That concludes the actual formal presentation. We do have I think about 15, 20 questions here. We're going to start going through them. I'm going to ask folks from the panel to be concise. I'm going to pick one to start with, and then if you answer it, everybody else will move on to the next one. We still have time to get questions in, we're going to keep going until we do. I know we're scheduled to go until half past the hour here, but we're going to just hang on,

we've got cookies we're going to eat and drink coffee. We're going to be fine; we hope you're okay.

Talia, did you mention that the slides will be posted later for participants to be able to review?

Talia Rosen: Yes indeed. The webinar will be archived on the station management center, we'll put up the slides, we'll put up a recording, we may even put up a transcript. All of it's going to be on there within a couple of days.

Ted Krichels: And if you do not get that because you're not a PBS member, is it fair to say that any public television station can get it?

Talia Rosen: Any public television station.

Ted Krichels: Any public television station can get that. Okay, fantastic.



Eric or Dennis, let's go to Eric first because you haven't spoken in awhile. Can you speculate on some of the data, recurrent past options that might make interconnectivity a reality?

Eric Wolf: I think what we expect broadly in the industry, and this is something that there's a lot of work that has yet to be figured out. I think broadly, what we expect is that pretty much every step that is delivered with ATSC 3 will be WiFi-capable. And that it's highly likely that part of what the industry calls the out-of-box experience that is the [inaudible 01:24:29] when you install that TV, you are

going to be asked or offered the opportunity to register it and connect it to your network.

And what that would mean is that applications that are running on the TV could deliver some data back-up to the server in the cloud. Now I'm going to stop at that and say, there's a lot of work to be done to figure out how that's gonna work, how that's gonna be used. There is built into the standard the ability to capture usage data. The equivalent of kind of using some ratings information about what channel you're watching for how long and things like that, and the ability to deliver that back as well. I think there's a great deal more detail to work and experimentation to be done on figuring out how all that will actually work.

Talia Rosen: You could deliver an interactive HTML 5 game and not having the return data.

Eric Wolf: Yes. You can most build apps that run entirely locally, and don't depend on the return path. That is, for those that want to get into the technical details, you have a full HTML 5 environment, and an HTML 5 rendering environment on the TV set. And so for those of you that are familiar with the PBS KIDS Plug and Play device, which is a little device that we can plug into an HDMI port on the TV and gives interactivity on the TV. That device does not assume that you have a WiFi connection. It just needs a display, and you can play interactive games.

So the same games, in theory, could run on an ATSC 3 TV natively on that television with no back channel at all. But more to be done.

Ted Krichels: I'm going to keep this moving here. How do you see this, Dennis, affecting border space?

Dennis Wallace: In terms of interferences, which I'm going to assume that question is about, in the report order that just came out, the petitioners asked that we treat ATSC 3 just like ATSC 1 for the purposes of interference and coverage prediction, and the commission adopted that proposal. To the extent that stations convert to ATSC 3, they will be protected as if they are ATSC 1 stations, so if you're a station on a Mexican or Canadian border, you would have exactly the same protection that you have today.

Ted Krichels: Lonna, can you give your thoughts on how this increased capability will have to be accounted for in the annual DTV Ancillary Supplementary Youth Services reports, but we have to pay to use our [inaudible 01:27:02] for a non-audio video content.

Lonna Thompson: Yes. So the FCC order didn't directly address the 5% fee that now is placed in all ancillary supplementary "non-broadcast" services, since those services are not to be over the air, they're somehow encrypted or subscription based. It did say that all current broadcast rules will apply to 3.0 services, so our assumption is that the current 5% fee on ancillary supplementary services will apply in the

same manner to the non-broadcast services that are done in 3.0. Now presumably, there may be a lot more non-broadcast services done so that that fee might be more significant, but at this point, that's the existing rule and that will apply.

Ted Krichels: Okay. Dennis, will the conversion to WiFi on a gateway device sacrifice any of the capabilities of ATSC 3?

Dennis Wallace: Right. I think sort of how to delineate that is it really depends on the device. And what codecs the device has in it. If you have a device that has a codecs that's only capable of decoding certain types of video or audio content, it will limit that device's ability to take advantage of certain features in ATSC 3. For example, if you have a tablet that's not capable of rendering high-dynamic range video, then it would not be able to render that. But it's kind of limited to what the current device that you have is. I think that the key takeaway from that is, this is a bridge to ATSC 3, and certainly not expected to last that way forever, and certainly to the extent that folks adopt those viewing habits as device manufacturers are going to upgrade and update those codecs and their devices to take full advantage of the ATSC 3 feature set.

Ted Krichels: Okay. Talia, I have a couple for you here. Does the FCC have any restrictions with commercial licensees and non-commercial licensees hosting or sharing?

Talia Rosen: No. You can share with commercial stations.

Ted Krichels: Good. I like that quick answer. Will closed captioning, Talia, always be a requirement for broadcast streaming in ATSC 3?

Talia Rosen: Yes. To be more specific, the FCC has said they require ATSC 3 broadcasters to comply with all existing broadcasting rules, including foreign ownership rules, political broadcasting rules, children's programming rules, equal employment opportunity rules, public inspection rules, indecency rules, sponsorship identification, [inaudible 01:29:52] identification contact, [inaudible 01:29:53] EAF and accessibility to people with disabilities. So your ATSC 3 broadcast should comply with all of your existing FCC rules, including closed captioning.

Ted Krichels: Great. Talia will read your phone book too, as well. We are between, Talia, 40 to 50 miles away from our commercial counterparts. They are all near each other, but I don't see any one of them wanting us to be their source for anything they broadcast, or share anything that has to cross that distance.

Talia Rosen: Yes. That is an issue that we are certainly well aware of, and we've made the FCC aware of. We even got the FCC in this quarter to include language that talked about this issue, the fact that public television stations are often not sited in same geographic areas as their commercial counterparts, and as a result a number of public television stations may find it very difficult to find a simulcast partner. So that's absolutely true. I would say a couple of things. One, the

distance doesn't matter as much as the population difference. If the population served by you versus them is 3% different, 10% different, that is the real rub, I think, that matters most.

There isn't an easy answer for you. I think it's possible you'll be able to get a waiver from the simulcast requirements that you can flash cut in the coming years when you think it's appropriate. Alternatively, it's possible the FCC will allow you to use a vacant frequency in your market to set up an LPTV station that simulcasts with yourself, essentially, so you're your own partner in 1.0 and 3.0. And it's possible that you leave your facilities in 1.0, but you begin to experiment in 3.0 on one of those commercial stations at a distance, as long as they're in the same VMA, there's no coverage requirement for your 3.0 simulcast. So if that's the way you go, you'd be fine partnering with them. They may not want anything in return, but perhaps you could begin to get familiar with the technology and use it, at least a little bit.

There are options. None of them great, but all worth considering and exploring, I think.

Ted Krichels: Okay, I'll try Dennis. The new 5G cell phone standard delivers up to 100 megabits a second. What datacasting services would you envision the ATSC 3 data-casting delivers that 5G bidirectional devices could not do?

Dennis Wallace: I'm not sure I'm the right one to answer that question.

Lonna Thompson: Actually, I might. This is Lonna. From the little bit of analysis we've done, and by we I mean our consultant John McCloskey at Eagle Hill, it's really a price point. The question is, why would a customer or business be interested in broadcasting, data-casting over wireless 5G. It's cost, is what it is. The wireless 5G is outrageous. There are all kinds of options out there now. Price will be the deciding factor.

Ted Krichels: Definitely something to keep in mind and explore. Eric, what are the implications for delivery to mobile devices? What steps are being taken to ensure that ATSC 3 will be available on mobile devices?

Eric Wolf: Let's distinguish the different types of mobile devices, different situations in which mobile devices might want to receive the signal. One is in the home, and there we're talking about the gateway device, which would put the signal onto WiFi and then you'd have an app on your mobile device, whether it's a phone or a tablet. But the one that we're all really interested in is the question about mobile devices out in the wild, not in your home. And therein is definitely much more uncertain future for how that's going to roll out. I think to the extent that we think it will happen any time in the near term it would be in tablet-sized devices potentially. If you think about who the manufacturers are of televisions, and who has very big interest in ATSC 3. Samsung is huge, they also make lots of

tablets out in the world. Could they introduce a tablet with a ATSC 3 receiver in it? Yeah, they certainly could.

Certainly I, and almost everybody that I talk to, is highly skeptical of the possibility of an ATSC 3 receiver ever being built into a cell phone. We think it's very unlikely. At a minimum, ATSC 3 would have to be very successful out in the marketplace with lots of consumer adoption and lots of vibrancy before the mobile folks are going to take it seriously and get insistent.

Ted Krichels: While I have you, is PBS planning on providing programming for ATSC 3 programs with 4K HDR, data-casting assets?

Eric Wolf: PBS is starting to do some planning and certainly experimentation on the technology processes that are going to be needed, and there's certainly conversations going around about what those content possibilities are. But I would turn it back to the stations and ask, what do you want? Do you want HDR content? Do you want to go 4K? Do you want to go HD HDR? Is interactivity important? We're going to definitely need to engage the station community to start thinking of what your strategy is, how your strategy drives what your product planning is, where your desires are about how to use Next Gen TV, and then we can figure out what content can be delivered to support those.

Ted Krichels: Talia, a few questions. There've been questions, a few, that have come in around the availability of these slides, the content, and the Q&A.

Talia Rosen: The webinar is going to be available on stationmanagementcenter.org. Within the next couple of days it'll be on that site. You'll have the slides, you'll have the recording from the webinar, and I believe we'll also make a transcript, we've usually done that. All of those available for you.

Ted Krichels: When will the FCC accept applications for ATSC 3?

Talia Rosen: Now. You can begin to discuss your simulcast contracts and your license applications, and at any point that you're ready, you can file a, you can execute a simulcast contract with another station in your market, or other stations in your market. I guess now is an exaggeration. As soon as they have the modified form 2100 available, which should be in the not too distant future, you can complete that form and file it with the FCC. I don't think they gave a precise time frame, but I would imagine within the next couple of months, which will be well ahead of when you probably are really ready to do it.

Ted Krichels: As soon as it's approved by OMB.

Talia Rosen: There you go. Yeah, the new form needs to be approved by OMB.

Ted Krichels: Okay. We're powering through here. Dennis, have increased operational costs for stations been considered at all for requirements for simulcast?

Dennis Wallace: Well the simulcast is a requirement to protect consumers. I'm not sure that there is an increased operational cost, other than the interconnect for the STLs for stations. 1.0 transmitter is still going to cost the same to operate tomorrow as it does today. The ATSC 3 transmitter presumably would cost approximately the same to the extent that there's increased operational costs, those are really going to be limited to the fiber interconnections between stations that are doing the channel sharing and the ATSC 3 handoff of signals. But there's certainly no mandate that stations do this, so to the extent that you're absorbing those costs, that you're sort of making a willing choice to accept those fiber and STL costs.

Ted Krichels: One more question for you. It would seem to the questioner that a gateway device would actually allow distribution of the ATSC 3 signal to all devices in the home without the use of physical cable connection, including smart TV. Am I correct?

Dennis Wallace: Yes.

Ted Krichels: Great. Lonna. Should we get through this? Under the business planning revenue slide the words leasing and datacasting were listed. For the leasing to others, if that was done, will a percentage need to be paid to the government similar to the datacasting fees of today?

Lonna Thompson: My sense is that depends on the content being leased. If we're looking at a commercial station paying a non-commercial station to carry its 1.0 signal, SD signal, and it's free over-the-air broadcast, I would think not. It's just like a channel sharing, and it's free over the air. If it's leasing to a non-commercial station for additional programming that has to be encrypted or some other service, then the answer is yes. The fiction the FCC uses is broadcast free over-the-air, which would be the lighthouse approach Dennis was showing us, versus non-broadcast, meaning it's encrypted, only some people can get it through a subscription basis. This wouldn't account for if you get leasing fees in the lighthouse approach. You would not pay the FCC fee then.

Ted Krichels: Okay. This is Lonna, or maybe Talia, but our station is at the end of the DMA we are assigned, but we have a waiver to broadcast to our coverage area in another DMA. Will this make a difference for us in implementation?

Talia Rosen: I think that's a very unique circumstance, and we'd want to talk to you specifically, and possibly to your FCC counsel about that. Because the FCC is specific in the rules about needed your simulcast partner to be in the same DMA. If you have a waiver to be broadcasting in another DMA, it's possible that that could be read to affect who a permissible simulcast partner is, so reach out to us. Our email addresses are all on the slide, and we can talk to you offline.

Ted Krichels: I'll start with Talia. Are you aware of commercial station groups that have a uniform approach to lighthouse plans and all markets.

Talia Rosen: Yes. So there are a consortia forming where commercial broadcast groups are starting to come together and plan to generally, across the country, try to work together. I don't think that anyone has all the answers or has figured everything out, but these conversations are absolutely happening, and if you're interested, it's definitely worth reaching out to the broadcasters in your market, starting to see if you can create those relationships. I think that Univision and Sinclair with ... who was the other one?

Lonna Thompson: NexStar and Northwest.

Talia Rosen: NexStar and Northwest have started to come together in a way that says we're going to see where we can partner. I don't think they're meant to be exclusive at this point, but people want to have options. And those relationships are going to be, I think in a lot of cases, driven by the relationships among the managers at the stations of any given market, because all of these lighthouse arrangements are going to have to be uniquely figured out.

Lonna Thompson: Right. Like Talia says, it's not exclusive. It's interesting because it's two large groups, the spectrum consortium, the members Talia just stated, there's the Pearl Group of stations, and NexStar, for example, belongs to both. Everybody's looking at their options now. We've been in long, long conversations with both of these groups, and we're happy to talk more with you about it if you want to reach out to me at any time. We're certainly going to make sure that public broadcasting is not excluded, but these conversations are important now.

And this goes back to something that Ted and Dennis talked about earlier, we need to start looking at your markets, and you need to help us figure out what works for you in that market in terms of the lighthouse approach, so we can begin moving forward.

Talia Rosen: And back to something I said very early on, if you in your market are interested in ATSC 3, and you think you're going to have trouble finding a viable simulcast partner based on how your tower is located, please let us know in the next month or two. We're going to be working on a filing at the FCC that pushes them for an exemption for non-commercial stations from the simulcast requirement. It's a long shot, but we're going to keep fighting for it. It would open up options and give you more flexibility. And the more examples we have of people who specifically in the market don't see a viable simulcast partner because the differences in coverage, differences in site location, all of that, that would be helpful. We have a few examples, we had a few stations come forward and we did maps of their stations. There's an appendix on our filing earlier in the year. But the more the better, just email one of us on this list that you don't see someone in your market you could possibly simulcast with and cover the significant majority of your population, and we would love to have that information.

Ted Krichels: I've got one here, I'm not sure if I can read it correctly, so help me out. Are stations allowed to broadcast multiple music or audio only channels on ATSC 3?

Got that part. We're not allowed to do that now, are we? No audio without video sync, right Lonna?

Lonna Thompson: Yeah, I'm not aware of that.

Dennis Wallace: You can do an audio only service, in fact there's a station in New York City that broadcasts all the FM stations in the market on their DTV channels. So you can do an audio only service, is the answer to that.

Ted Krichels: Okay. And my last one I have here, will those FCC requirements Talia mentioned still be required if we geotarget video information to specific TVs or other devices using 3.0?

Talia Rosen: I believe so.

Lonna Thompson: Barring all the broadcast regulations.

Talia Rosen: Yeah. If it's still broadcasting you're engaging in, you're going to have to follow all the broadcast rules around indecency, sponsorship identification, captioning, EAS. If it's some other service you're engaging in that's newer and not envisioned, whether that's some sort of interactive gaming or datacasting or OTT service, it's possible you'll get outside of that. I think so far, what the FCC has said, they said very definitively, "We require Next Gen TV broadcasters to comply with all of our broadcast rules" and then they listed a bunch that I went through. I think the answer to that is yes, regardless of what type of device you're trying to reach. That's not really something that's going to get you out of any of those rules.

Ted Krichels: I want to thank all of you. Lonna, Eric, Talia, Dennis, it's been incredibly informative. As we have mentioned, the webinar will be archived on the station management center website, that's stationmanagementcenter.org. We will try to have as much information from this available as possible. I think the Q&A, transcript. Let us know. You can send information to any one of us, questions. We will share that. And we do anticipate doing follow-up webinars as we go along. Your help and what areas you think are particularly troubling would be really helpful for us. So thank you all for staying with us. You get the prize knowing that you have just gone through 101, ATSC 3, Next Gen.

Lonna Thompson: A gateway device.

Ted Krichels: The gateway device. Thank you all very much.

Lonna Thompson: Thank you.