ENSURING QUALITY OF SERVICE WITH NEXTGEN TV "LIGHTHOUSE" ROLL-OUT

WHITE PAPER

testtree™

INTRODUCTION

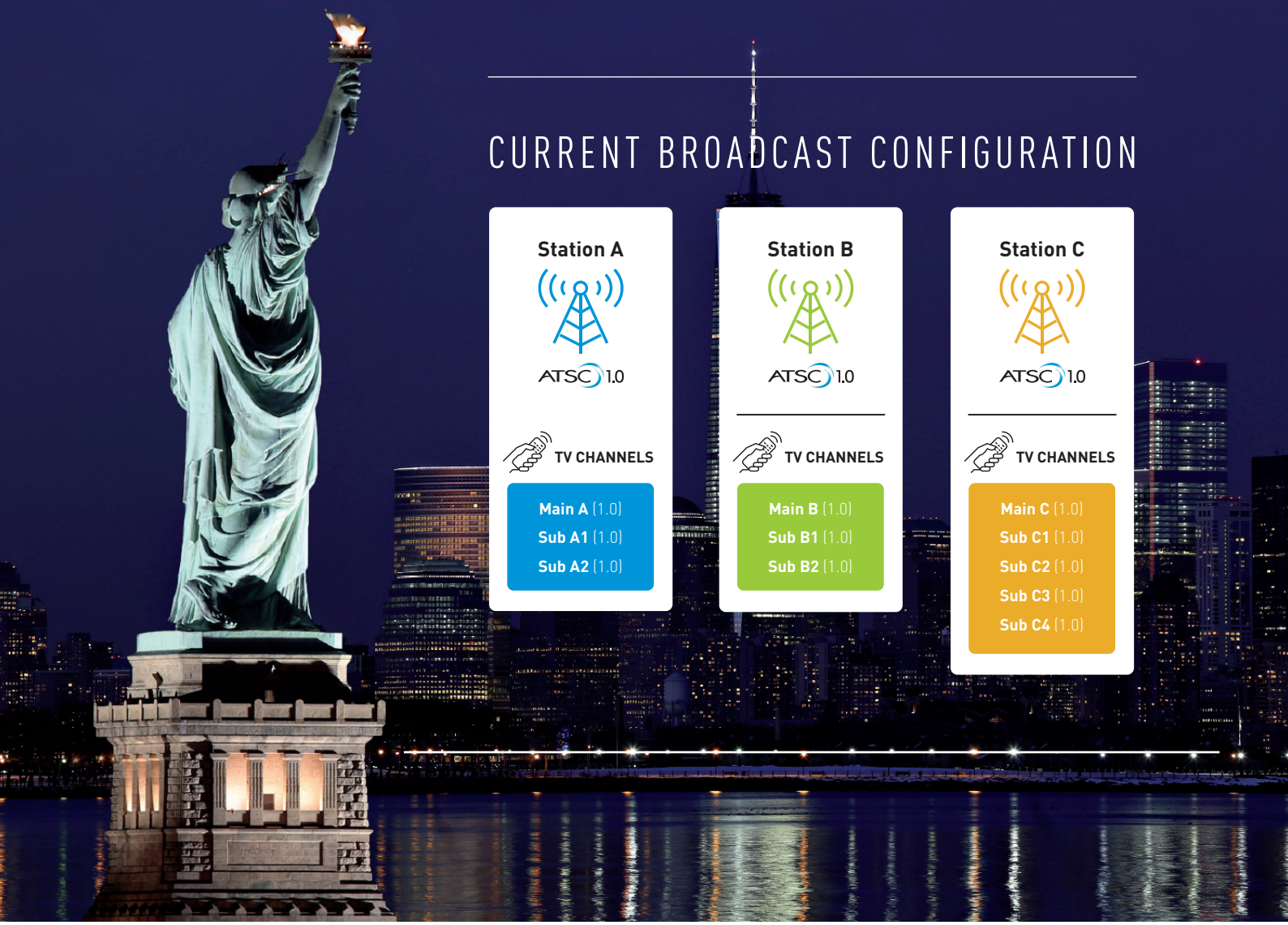
In a modern broadcast and broadband video delivery environment, viewers expect increasingly better quality and availability.

NEXTGEN TV, powered by ATSC 3.0, offers to improve the **image quality** with UHD resolution, brings immersive audio, and opens new business models based on the convergence between broadcast and broadband. Broadcasters will be able to rely on better interactivity with the end-viewer to deploy audience measurements, targeted advertising, and non-real-time content drastically improving viewers' TV experience.

"Image quality"

American TV stations interested in moving forward with the transition to NEXTGEN TV are facing a lack of new spectrum availability. This leads broadcasters to cooperate with one another, and "Lighthouse" channel-sharing scenarios are designed to leverage on existing transmitting infrastructures in order to manage the simulcast between legacy ATSC 1.0 services and NEXTGEN TV ATSC 3.0 broadcasting.

This paper details the challenges faced by broadcast stations in a **"Lighthouse" scenario and explain how test & monitoring is vital for stations both during the transition and once the ATSC 3.0 signal is on-air.**



CURRENT BROADCAST CONFIGURATION

Station A	Station B	Station C
ATSC 1.0	ATSC 1.0	ATSC 1.0
TV CHANNELS	TV CHANNELS	TV CHANNELS
Main A (1.0)	**Main B** (1.0)	**Main C** (1.0)
Sub A1 (1.0)	**Sub B1** (1.0)	**Sub C1** (1.0)
Sub A2 (1.0)	**Sub B2** (1.0)	**Sub C2** (1.0)
		Sub C3 (1.0)
		Sub C4 (1.0)

WHY THE NEED FOR A "LIGHTHOUSE" SCENARIO?

Since the analog switch-off in 2009, digital TV can be received in the USA via cable, internet, satellite, or terrestrial transmissions - also called "over the air" (OTA). One main advantage of OTA is content availability, as the signal is Free-To-Air (FTA). Terrestrial television is more popular than ever, its influence growing with cord-cutters cancelling their pay TV subscriptions - TV-ad revenue is predicted to grow by more than $4 billion in 2020[1].

The COVID-19 outbreak also shows a significant live TV viewership increase on the main US broadcasters (ABC, CBS, Fox, NBC), up to 35% above 2019's results[2]. These studies show that the FCC's decision in 2017 to authorized use of the "Next Generation" broadcast television transmission standard, also called ATSC 3.0 or simply "3.0", went in the right direction.

When compared to the current terrestrial broadcast standard ATSC 1.0, ATSC 3.0 has a number of advantages. In addition to outstanding image and sound quality with the possibility of Ultra HD 4K video, High Dynamic Range (HDR) & immersive sound quality, NEXTGEN TV allows broadcasters to use Broadband (OTT) content combined with Over-The-Air (OTA) signal for Dynamic Ad Insertion as well as audience measurement.

"Stations willing to move forward with ATSC 3.0 will choose a channel-sharing scenario."

NEXT STEP: **NEXTGEN TV**

Unlike the 2009 digital transition, this time the American government will not allocate subsidies to broadcasters willing to take the leap, nor grant them with new spectrum availability. Mobile services are also taking up an increasing amount of spectrum, forcing traditional broadcast services to free up the 600 MHz band (spectrum repack). Scarcity of frequencies then requires that broadcasters optimize spectrum usage.

Therefore, stations willing to start their transition are left with three possibilities:

- **Flash cut from ATSC 1.0 to 3.0**: only viewers with the appropriate decoder would be able to receive the content. In addition, the FCC only allows flash cutting for Low-Power stations and require 5 years of content simulcasting (1.0 and 3.0) for broadcasters. Therefore, this scenario is more adapted to broadcasters starting a new service with NEXTGEN TV.
- **Full ATSC 1.0 and 3.0 simulcast** for all stations separately: as no additional spectrum will be available, this scenario is technically impossible. Moreover, all broadcasters would need to widely purchase new equipment sets.
- **Any other configuration** involving channel-sharing among TV broadcasters: which is exactly the goal of "Lighthouse" scenarios.

Most broadcasters are likely to choose a "Lighthouse" scenario - at least at the level of a DMA - which process will be detailed in the next part of this paper.

However, regardless of the solution selected, the purpose of ATSC 3.0 broadcast is also to improve on the quality of experience, bandwidth capacity and coverage provided by the existing ATSC 1.0 service. What more, should the existing ATSC 1.0 channels be affected by the transition, their service availability and quality must remain unchanged.

[1] https://www2.deloitte.com/us/en/insights/industry/technology/technology-media-and-telecom-predictions/2020/antenna-tv-growth.html
[2] https://www.fiercevideo.com/broadcasting/broadcast-networks-see-huge-viewership-spikes-amid-covid-19-crisis

PRACTICAL GUIDE: HOW DOES ONE BUILD A LIGHTHOUSE?

"Lighthouse" scenarios rely on the fact that ATSC 1.0 transmission can be optimized. Indeed, these scenarios state that no additional RF channel will be allocated for ATSC 3.0 broadcasting, but rather the current ATSC 1.0 broadcast networks must be reorganized, freeing up frequencies for ATSC 3.0. This requires optimizing the ATSC 1.0 channel allocation; broadcasters can, for example, update their video encoders, resulting in higher efficiency compression - freeing up payload capacity to welcome new program streams.

SHARE THE COSTS AMONG BROADCASTERS

If broadcasters are to mutualize resources, they need to identify cost sharing at the station level, through measuring the resource allocation per program stream. If they choose to mutualize ATSC 1.0 facilities, the simple structure of ATSC 1.0 allows them to identify the breakdown by looking at each service inside the Transport Stream's (TS) bitrates. In ATSC 3.0 however, it depends on the frame configuration. In mono-PLP mode, the system is close to ATSC 1.0 and the result is available through the bitrate share inside this PLP. In multi-PLP mode, program bitrates no longer represent the output occupation and broadcasters must look at the spectrum allocation instead[1].

[1] Spectrum allocation computation is based on the number of frame cells used for each PLP or each program, making this measurement a good indicator for cost sharing.

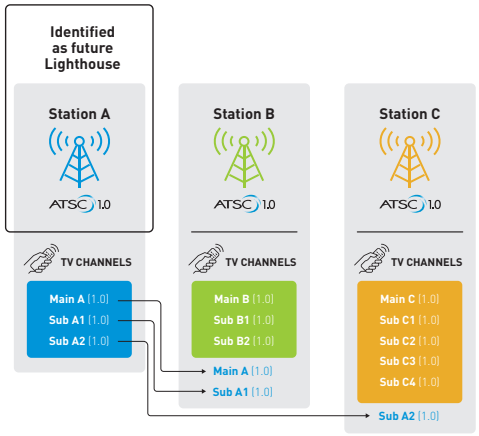
PLANIFICATION & RESOURCE SHARING

The broadcasters involved must identify, at least, one station within their networks to act as the ATSC 3.0 host and the stations involved in the ATSC 1.0 remapping.

Going into more detail, here are the steps to be taken:

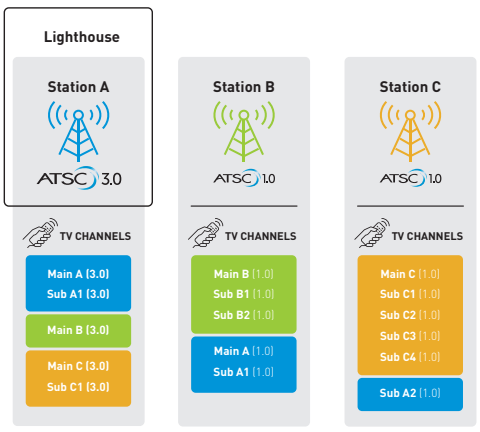
1. Identify the station that will be used as the 3.0 host: this station will act as the "Lighthouse". Migrate ATSC 1.0 channels from the Lighthouse station to remaining 1.0 stations available nearby: frequencies are now available.
2. Upgrade the Lighthouse station and transmitter with ATSC 3.0 equipment.
3. Broadcasters involved can then use the Lighthouse station to broadcast their content in ATSC 3.0, most likely their main channel and a secondary one.

LIGHTHOUSE TRANSITION PLAN



In this case, the FCC imposes certain requirements: if a broadcaster duplicates its content to ATSC 3.0, this content must still be available in an ATSC 1.0 channel and must be similar in 1.0 and 3.0 - only advertising can be different. What more, the resulting ATSC 1.0 coverage must be at least a 95% replication of the original coverage.

AFTER LIGHTHOUSE DEPLOYMENT

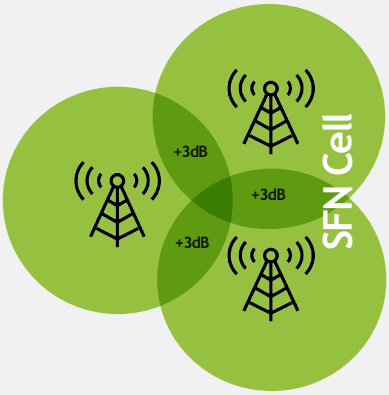


WHAT COULD GO **WRONG**?

Every step of the migration process has severe impacts on the broadcasted signals: network migrations, new hand-over points between broadcasters, new contribution links, equipment set upgrade… The main challenge during the "Lighthouse" roll-out is to ensure that it does not result in service degradation; the most common issues being the loss of video and/or audio, black screens or video freezes.

Aside from complete TV unavailability, other quality problems could arise from incorrect or insufficient configuration. For example, if ATSC 3.0 signaling is not well managed by broadcasters, it could cause set-top-boxes to mix-up TV information and descriptions. In case of a Single Frequency Network (SFN), several transmitters will broadcast the same content over the same RF channel. This requires the transmitters to be accurately synchronized in time and frequency; if not, viewers located in the transmitters' overlapping areas will simply not be able to receive the TV content.

IMPROVE SPECTRUM EFFICIENCY



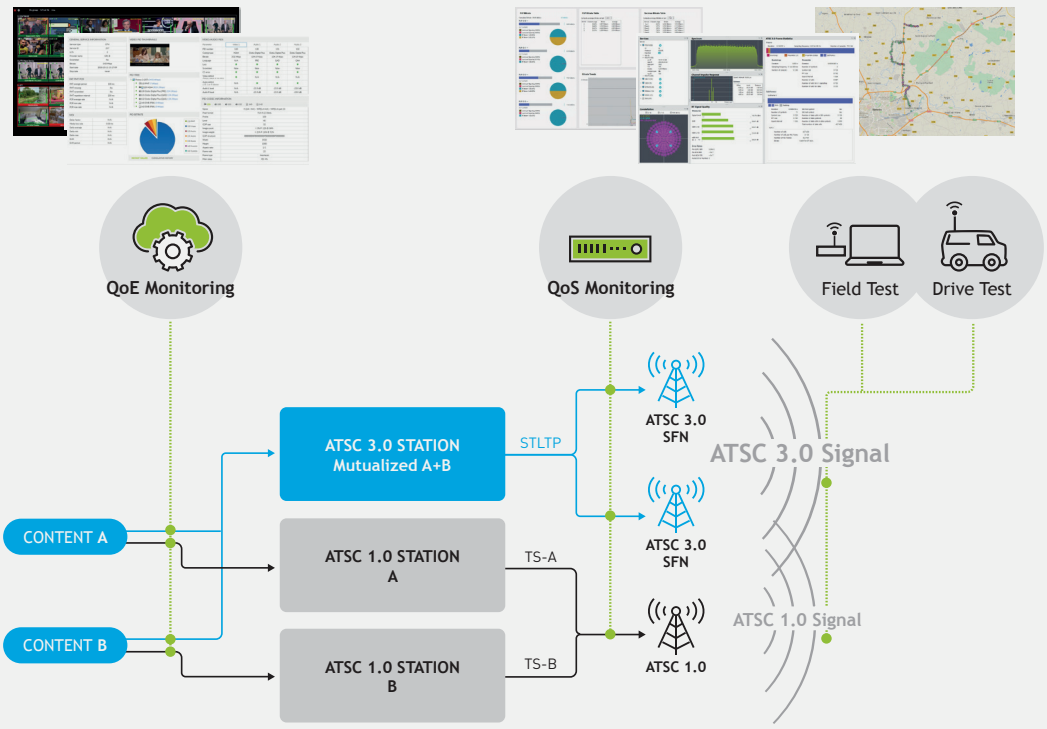
INCREASE COVERAGE

All these unwanted issues would have severe consequences in regard to TV audiences, directly impacting ad revenue and therefore broadcasters' revenue. **The goal of continuous testing and 24/7 monitoring both at transmission and reception is to ensure that nothing goes wrong** and to anticipate potential future issues; what better way to guarantee that customers receive high QoS than monitoring that the signal is both well delivered and well received? As well, since broadcasters will be sharing networks and equipment, they will need a way to calculate shared costs.

HOW TO ENSURE QUALITY OF SERVICE?

If the QoS is linked to the reliability of the broadcaster's set of equipment, it is necessary to ensure that it never fails. This is why broadcasters need continuous monitoring of both ATSC 3.0 and 1.0 services.
This monitoring is assured by external equipment, specialized in the accurate measurement of the station's performance.

What to Monitor in an ATSC 3.0 and ATSC 1.0 Broadcast Network?



ENSURE **CONTENT QUALITY** AT ALL STAGES

Broadcasters must commit to the best Quality of Experience (QoE) from the beginning, when contents are provided by the Networks to the Station. Software monitoring tools are capable of identifying audio and video artefacts as soon as possible, giving time to fix them even before viewers call to complain.
Once processed by the Station, contents are not affected anymore and the focus is at the transport level; QoE is then directly linked to QoS. Therefore, QoS must be monitored at every step up until it is broadcasted by the transmitter: both on the STLTP for ATSC 3.0 and the TS for ATSC 1.0, and in reception areas. In the field, drive testing and RF reception testing capture the quality of the signal as it is received by viewers - with the one and only goal for viewers to experience TV at its best.

ENSURE **ATSC 1.0 REMULTIPLEXING** QOS

As ATSC 1.0 is well established, it is important to ensure that "remultiplexing" it neither impacts the RF and the TS quality nor the existing coverage. Monitoring both at the exciter input and output is necessary, and drive tests must be run with portable analyzers able to provide coverage maps (or RF measurements linked to GPS positions).

Because broadcasters will be sharing ATSC 1.0 bandwidth, resource allocation monitoring must take place to validate the agreements in place.

ATSC 1.0

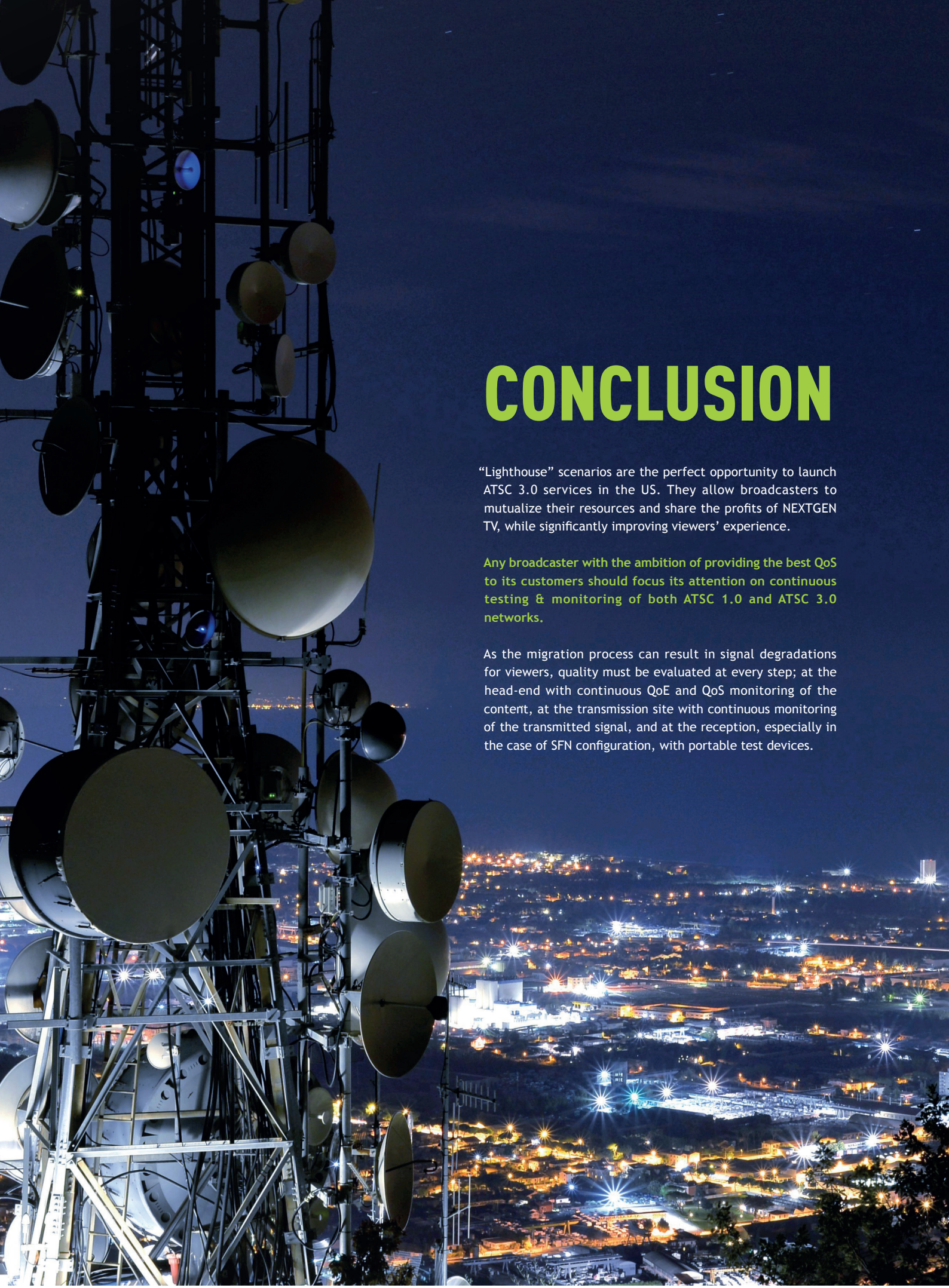
ENSURE **ATSC 3.0 ROLL-OUT** QOS

As NEXTGEN TV is new on the market, its acceptance by consumers will most likely rely on service availability and quality. If the viewer receives 4K image quality with a frame rate of 1 image per second, all the effort will be for nothing. On the contrary, if QoS is guaranteed by 24/7 monitoring at the station for DASH quality, and at the transmitter for both STLTP and RF quality, this type of behavior will be immediately detected by the broadcasters – even before viewers.

Additional coverage testing must be performed with the same kind of portable analyzers as with ATSC 1.0, able to generate coverage maps including QoS metrics, identifying any potential dead zone. This equipment should provide RF metrics such as signal level, SNR, MER (for L1-Basic and L1-Detail information, as well as for each PLP), Channel Impulse Response, alongside ATSC 3.0 frame analysis and configuration statistics to ensure that TVs and set-top-boxes will be able to well receive and decode the content.

As with ATSC 1.0, if broadcasters are to share resource, resource allocation per service must be monitored at all times to ensure the agreement in place is respected.

ATSC 3.0



CONCLUSION

"Lighthouse" scenarios are the perfect opportunity to launch ATSC 3.0 services in the US. They allow broadcasters to mutualize their resources and share the profits of NEXTGEN TV, while significantly improving viewers' experience.

Any broadcaster with the ambition of providing the best QoS to its customers should focus its attention on continuous testing & monitoring of both ATSC 1.0 and ATSC 3.0 networks.

As the migration process can result in signal degradations for viewers, quality must be evaluated at every step; at the head-end with continuous QoE and QoS monitoring of the content, at the transmission site with continuous monitoring of the transmitted signal, and at the reception, especially in the case of SFN configuration, with portable test devices.

TEST TREE

c/o ENENSYS Technologies (Headquarters)
4A rue des Buttes
CS37734
35577 Cesson-Sévigné Cedex
FRANCE

Tel: +33 (0)1 70 72 51 70
Fax: +33 (0)2 99 36 03 84
contact@test-tree.com

www.test-tree.com