Analysis of Proposed DTS Rules Change

Impact on LPTV Stations

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BACKGROUND

The Federal Communications Commission (FCC) has authorized the voluntary deployment of the ATSC 3.0 (“Next Generation TV”) standard. As the industry plans to roll out ATSC 3.0 deployments, some broadcasters are interested in exploring the capabilities of ATSC 3.0 to facilitate the use of Distributed Transmission Systems (“DTS”), also known as single frequency networks (SFN). Single frequency networks have numerous benefits for improving reception throughout a station’s service area, improved mobile reception and more efficient use of broadcast spectrum by reducing the need for television translator stations occupying additional channels.

ATSC 3.0 permits a simplified design for SFNs that makes the deployment of such networks significantly more cost effective. The stated purpose of the DTS rules is to provide for stronger signals near the edge of service; however, the rules severely limit that possibility by restricting the extent of the noise limited contour (NLC) produced by the individual SFN facilities. The rules require that the SFN NLC cannot extend beyond the greater of either the NLC of the station’s “reference facility” or a value given in a table of distances. This limitation makes it extremely difficult to enhance service in the very areas that are supposed to benefit from an SFN deployment. In view of this, a petition for rule making has been filed with the FCC proposing to modify the rules to allow more flexibility by changing the restriction from the NLC to an interference contour limit as described below.

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The petition requests the FCC to allow a station to deploy single frequency networks such that a DTS transmitter’s NLC may exceed the reference facility’s NLC but, for UHF stations, the DTS transmitter’s 36 dBμV/m F(50,10) “interference” contour may not exceed the reference facility’s 36 dBμV/m F(50,10) contour. This value was selected to avoid interference with co-channel Class A and LPTV operations. That is, the UHF service contour field strength of Class A and LPTV stations is 51 dBμV/m, and the nominal desired-to-undesired ratio necessary to avoid interference is 15 dB, resulting in an “interference” contour value of 51–15 = 36 dBμV/m.
Applying the same methodology to the VHF bands, the “interference” contour values will be 33 dBμV/m for high VHF channels and 28 dBμV/m for low VHF channels.

While the proposed changes will allow more flexibility, the deployment will continue to require compliance with the current rules pertaining to predicted interference to other stations as well as the current restrictions on siting of the SFN transmitters. However, the SFN deployment predicted interference rules do not require protection of low power television stations (LPTV) and TV Translator stations. It is envisioned that the deployment of SFNs will in many cases

negate the need for nearby translators and would not likely have any significant impact on distant translators, as well as freeing up additional spectrum that could be used for displaced stations should the need arise. On the other hand, LPTV stations provide a different type of service from TV Translators – often serving the same geographic areas as primary stations but with unique programming -- making their displacement more problematic. Therefore, the potential impact on LPTV stations is the main focus of this study.

STUDY METHODOLOGY

The study was designed to depict a reasonable worst-case scenario including a large sample of LPTV stations and a large sample of SFN deployments.

Establishing Protected LPTV Service

Using the FCC's TVStudy software, the interference-free service points for all authorized LPTV stations in the continental US were determined and stored. In cases where an LPTV station has both a licensed facility and a construction permit, the construction permit facility was used in the study. In addition to establishing the predicted interference-free service points for each of the LPTV stations, a geographic boundary was determined that included the coordinates of the individual service points to allow for a quick determination as to whether further study was needed toward specific LPTV stations based on the distance from an SFN transmitter to the boundary.

Establishing SFN Sites and Facilities

Hypothetical SFN facilities were created for 1,527 full-service stations. For each of the full-service stations, the dipole-adjusted noise-limited contour was determined as well as the appropriate interfering contour as proposed in the rule-making petition.

For each full-service station, four SFN sites were established at points 10 km inside the current noise limited contour at 0, 90, 180 and 270 degrees from the current facility. At each site the terrain elevation was determined, and the radiation center was first set at 50 meters and then at 150 meters above the ground level allowing for two separate analyses. The 50-meter AGL height is typical of existing towers generally, whereas the 150-meter AGL height is more typical of broadcast towers which make up a small proportion of existing towers.

Using the maximum effective radiated power (ERP) for the band (45, 160 or 1,000 kW for Low- VHF, High-VHF, and UHF channels, respectively) the predicted F(50,10) field strength at the full-service interference contour was determined. Based on these predictions, the maximum ERP

and an antenna pattern was established for each SFN facility that would limit its interference contour so that it did not exceed the reference station's interference contour.

It should be noted that since the hypothetical SFN sites are offset a significant distance from the reference station, the distance from the SFN site to the reference station's interference contour in some directions can be significant. Therefore, in many cases the ERP of the SFN facility in those directions will be at the maximum power permitted for the band. In practice, this is unlikely.

The methodology discussed above maximizes the interference potential of each hypothetical SFN facility creating a worst-case scenario. It should be further noted that no determination was made as to whether these SFN facilities would pass the required interference test to other full- service and Class A stations in keeping with this being a worst-case scenario study with respect to LPTV stations.

Interference Study

After establishing the SFN facility parameters and the protected facility data as discussed above, an OET-69 interference study was performed using the previously established service points of each LPTV station where any of its service boundary points were within 300 km co-channel or 100 km 1st-adjacent channel of the SFN site. The study determined the amount of any predicted new interference caused as a percentage of the LPTV's currently-predicted interference-free service population.

RESULTS

The study as described above included 1,527 full-service stations and 2,780 LPTV stations. The total number of SFN sites evaluated for impact to LPTV stations was 5,624. This is 484 less than the expected number of four for each full-service station. The missing 484 potential SFN sites were not considered viable locations in that they were located in the ocean.

The results of the study are broken down into two groups: the first is the impact to co-channel LPTV stations and the second is the impact to 1st-adjacent channel LPTV stations. A 2% threshold for new interference was set as a threshold of significance since that is the level considered as *de minimis* in interference studies between LPTV stations.

Co-channel Study Results

The initial step of the analysis was to determine if an SFN site was within the culling distance established as requiring a further evaluation. The established distance for the co-channel analysis was 300 km, meaning that if any of an LPTV station's predicted service points were within that range a full study of all the LPTV's service points would proceed. Of the 5,624 SFNs evaluated, 4,873 were found to require further study, and these were associated with 1,402 of the 1,527 full-service stations considered. The 4,873 SFN sites that required further evaluation resulted in a total of 18,514 full interference evaluations toward 2,392 different LPTV stations.

For a 50-meter SFN antenna height above ground, the results of these analyses are that 691 cases were found where the predicted new interference was greater than 2% of the existing interference-free service population, amounting to only 3.73% of all the studies performed. For a 150-meter SFN antenna height above ground, the results of these analyses are that 934 cases were found where the predicted new interference was greater than 2% of the existing interference-free service population, amounting to only 5.05% of all the studies performed.

Adjacent-Channel Study Results

The initial steps of these analyses were the same as for the co-channel studies to determine if an SFN site was within the culling distance established as requiring a further evaluation. The established distance for the adjacent channel analysis was 100 km, meaning that if any of an LPTV station's predicted service points were within that range a full study of all the LPTV's service points would proceed. Of the 5,624 SFN transmitter sites evaluated, 3,663 were found to require further study and these were associated with 1,260 of the 1,527 full-service stations considered. The 3,663 SFN sites that required a full evaluation resulted in a total of 7,817 full evaluations toward 2,064 different LPTV stations.

For a 50-meter SFN antenna height above ground, the results of these analyses are that 174 cases were found where the predicted new interference was greater than 2%, amounting to only 2.23% of all the studies performed. For a 150-meter SFN antenna height above ground, the results of these analyses are that 222 cases were found where the predicted new interference was greater than 2% amounting to only 2.84% of all the studies performed.

It is noted that although the power level radiated by an SFN station in the direction of an impacted LPTV stations may be much lower, the maximum ERP (before applying the antenna

pattern) for almost all of the SFN facilities studied was at or very near the maximum ERP permitted for the band. These power levels are well above what would typically be deployed at an SFN site. Therefore, it is expected that in a normal deployment the actual cases of interference will be fewer than noted above.

Conclusion

Based on results of the study described above, it is my professional opinion that the proposed DTS rule changes are not likely to have a significant interference impact on existing LPTV stations. In the cases where new interference is predicted, some of it will be mitigated by the SFN having to comply with the rules requiring protection of other full-service and Class A stations that would necessitate power reductions and/or the use of more restrictive antenna patterns. In addition, some of the predicted interference may be overcome by increasing the power of the affected LPTV stations in that their requirement to protect the full-service station will become easier due to the higher field strengths provided by the SFN facilities.