Broadcast Signal Lab

Report on the Proposal to Operate an FM Transmitter on 94.3
At the Gould Residence in West Bay
Grand Cayman Island

Since Hurricane Ivan, Broadcast Signal Lab has surveyed and evaluated the state of the FM broadcast spectrum on Grand Cayman Island several times. Some issues have been raised and discussed relating to local interference generated within receivers that are operated in proximity to broadcast transmitter sites. In George Town, three stations were relocated to the Northward tower to eliminate their contribution in George Town to receiver-overload-based interference. This is sometimes called "blanketing" interference.

The mechanisms for overloading receivers are well understood in the engineering community, and they are numerous. The term "blanketing" may leave the impression that there is an area near an FM transmitter where all receivers will be blanketed and prevented from receiving all distant FM signals. In fact, the interference mechanisms manifest in various ways, from making hash out of an otherwise receivable signal, to causing a portion of the receiver's tuning span to produce absolute silence, to generating two or more programs heard simultaneously on the same channel.

Inexpensive receivers are more susceptible, usually, to such interference and will therefore manifest such symptoms at greater distances from the offending transmitter than more sophisticated receivers. As one might expect, there are more inexpensive receivers in daily use than expensive ones.

Automobile receivers also offer a range of susceptibility, but in general are more immune to interference than portable and home receivers because automobiles have a constantly changing reception environment.

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Another factor in causing receivers to exhibit interference symptoms is the relationship between the strength of the desired signal and the strength of the undesired signal(s)[1]. As the undesired signal gets stronger or the desired signal gets weaker, the chances of interference increase.

The question before us in this case is whether a tolerable condition results from approving an FM station at one end of the island where the signals of all other stations are at their weakest. The proposed station is at 94.3 MHz. It would initially operate at about 1000 watts transmitter power from an antenna on a tower at the site. A higher power operation at 3000 watts is proposed. The antenna is a four-bay, full-wavelength spaced, circularly polarized model.

The reception environment in West Bay is challenging. Figure 1 shows signal strengths of all the stations as measured at the driveway of the proposed 94.3. The 94.3 transmitter was not on the air.

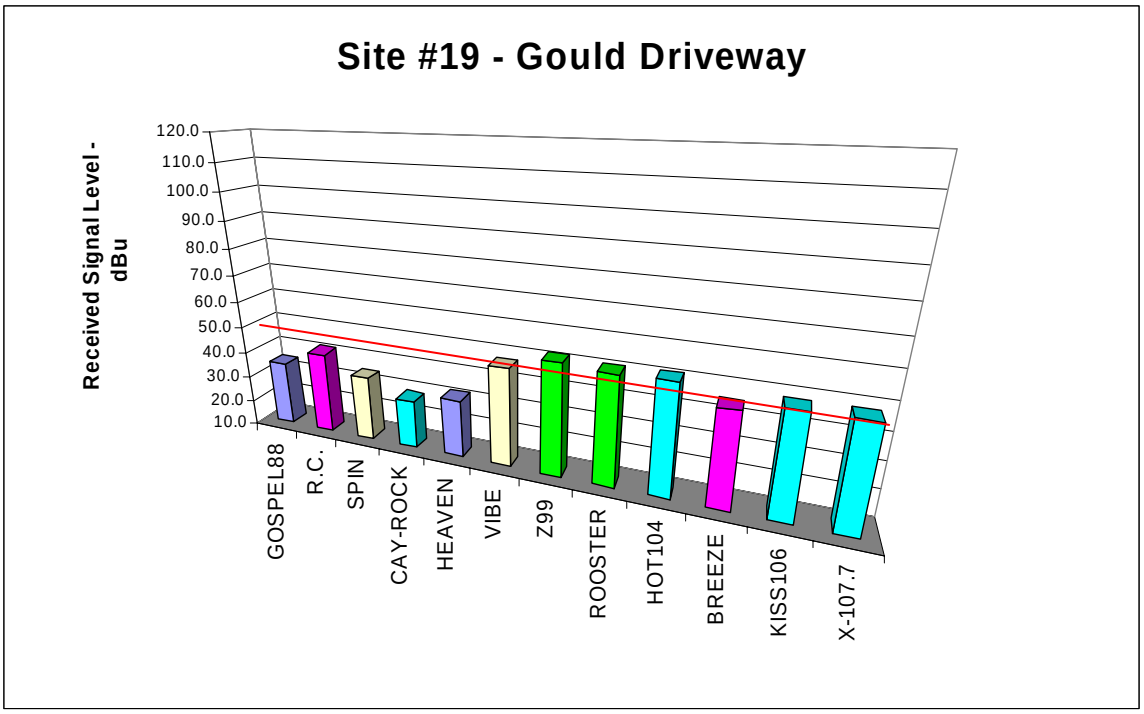

Figure 1

[1] When we refer to a station as “desired” or “undesired” it is not intended as a value judgment. Rather, the desired station is the one we are discussing as the one being tuned in, and the undesired signals are those signals that are not being tuned in but may impinge on good reception of the desired signal.

The graph presents the signal levels tabulated and adjusted to read equivalent dBµ. For reference, the ITU urban stereo reception threshold is 66 dBµ, which none of the stations reach at this location. However, if we employ the 48 dBµ ITU monophonic reception threshold, which is sufficient to be considered useful coverage, then five stations just barely make it – The DMS stations in Northward (104.1, 106.1 and 107.1 – light blue on the chart) and the Hurley stations in Newlands (99.9 and 100.9, in green). The 48 dBµ level is marked with a red horizontal line on Figure 1. In addition to these five stations, Radio Cayman's 105.3 and Paramount's 98.9 are close enough to 48 dBµ to be counted. The remaining stations (all three from George Town plus Radio Cayman 88.9 and Paramount 94.9) are well below ITU accepted levels for good monophonic reception.

These lower level stations happen also to be closest in the spectrum to the proposed 94.3 frequency, creating a double-jeopardy for interference – least signal strength and greatest proximity of frequency, with respect to 94.3. Further, in our 2006 report we proposed two frequency plans that could make most efficient use of the spectrum and maximize the number of FM stations on the island. One plan used the customary four-channel spacing, and the alternative plan, which works best with stations transmitting from the same place or near the same place, separates stations on a three-channel pattern. The 94.3 frequency was applied for in 2000 and time has overtaken the frequency assignment plan. We recommend at the outset that if this station is assigned a location distant from other stations, it should be separated by a minimum of four channels. 94.3 is third-adjacent to the existing 94.9. At least, the proposed channel should be shifted to 94.1.

In 2006, our proposed frequency assignment plan was presented in that report's Table 3. One of the concepts was to begin assigning new frequencies on a proposed assignment skeleton. Existing frequencies may need to be shifted in the future to free up additional channels, but if all new stations are applied to the skeleton plan, then further deterioration in spectrum efficiency is halted. That skeleton suggested that if frequencies were shifted for maximum efficiency, Spin 94.9 would shift onto the 4-channel spacing plan to either at 95.1 or 94.3. In the 3-channel spacing plan, Spin 94.9 would shift to 95.1 or 94.5. The proposal was designed to give incumbents the first opportunity to select their preferred nearest new frequency on the skeleton. For instance, a station might prefer to keep the association with 94 FM by moving three (or two) channels to 94.3 (or 94.5) rather than moving one channel to 95.1.

We describe this thought process to illustrate how to go about adjudicating new frequency assignments in an increasingly congested band. If the ICTA adopts the four-channel plan, 94.3 could remain on frequency if Spin 94.9 were to agree to move to 95.1. If the ICTA seeks maximum spectrum efficiency, including pursuing highly centralized location of transmitters in one geographic area, then the three-channel plan could be applied, and 94.3 could co-exist with 94.9, but only if they were transmitting from the same area on the island See the Broadcast Signal Lab 2006 report for more analysis.

Applying the four-channel plan, and avoiding requiring Spin 94.9 to shift channels, the proposed 94.3 facility would be shifted to one of the nearest available frequencies on the plan, 93.5 or 92.7. 92.7 is optimal because it applies to both the three-channel plan and the four-channel plan. This permits the ICTA to avoid making a decision now about which plan to employ. Also, 103.1 is applicable to both the three-channel and the four-channel plans, and its use would not currently force an existing station to move frequency.

This digression into channel assignment strategy may have been premature. The fundamental question regarding interference potential remains unanswered. In our test, we employed the JVC in-dash car radio that came with the rental car and was employed for other 2007 FM survey analysis. Also employed in the 2007 FM survey was an inexpensive Advance brand clock radio. As noted in our 2007 survey report, the clock radio was much more susceptible to overload than the JVC car radio. Measurements were taken with a spectrum analyzer and reference antenna.

Subjective listening notes are presented in Table 1. The Gould site of the proposed 94.3 station appears twice in the table, once with and once without the 94.3 transmitter on. This listening was performed in the driveway of the Gould residence, so in the case of the 94.3 transmitter being on, it is a worst case example for fixed position reception. Also, the nearby location at Dunlop Drive was a prior test location, so the reception quality notes for that location (without 94.3 on air) are presented for comparison.

The JVC car radio withstood the loading of the 94.3 signal, but the clock radio was so swamped that more than half the radio band went silent. This is a phenomenon where the receiver reacts to the powerful signal in its presence by, in essence, turning down the volume (RF AGC, for the technically inclined). Initial reception of stations without 94.3 present follows the ITU signal

strength criterion marked on Figure 1. The weaker stations are already at a disadvantage in this area. The stronger stations are typically just listenable on the clock radio.

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Green- Northward Orange- George T. Violet- Newlands	**Locale** Site	**Gould (no 94.3)** #19 Gould		**Boatswains Bay (no 94.3)** #1 Dunlop		**Gould (94.3 1 kW)** #19 Gould	
	Freq. \ Radio	Dash	Clock	Dash	Clock	Dash	Clock
GOSPEL88	88.7	OK	Noisy3	**OK**	**Not receivable**	**OK**	**Silence**
Radio Cayman 1	89.9	OK	Noisy2	**OK**	**Barely audible**	**OK**	**Silence**
SPIN	94.9	OK	No	**OK**	**Barely audible**	**OK**	**Silence**
CAY-ROCK	96.5	OK	No	**OK**	**Will not lock**	**OK**	**Silence**
HEAVEN	97.7	OK	No	**OK**	**Will not lock**	**OK**	**Silence**
VIBE	98.9	OK	Noisy2	**OK**	**Noisy3**	**OK**	**Silence**
Z99	99.9	OK	Noisy1	**OK**	**Will not lock**	**OK**	**Silence**
ROOSTER	101.9	OK	Noisy1	**OK**	**Barely audible**	**OK**	**OK**
HOT104	104.1	OK	OK	**OK**	**Noisy2**	**OK**	**OK**
BREEZE	105.3	OK	OK	**OK**	**Noisy1**	**OK**	**OK**
KISS106	106.1	OK	OK	**OK**	**Noisy1**	**OK**	**OK**
X-107.7	107.1	OK	OK	**OK**	**Noisy2**	**OK**	**OK**

Term	Meaning	Term	Meaning
OK	Clean reception	Hard to tune in	Must position tuning wheel just so to lock in station among interference
Mild Multipath	A little reception noise not caused by interference	Will not lock	Interference prevents receiver from locking onto station
Crosstalk	Two or more stations audible at once	Barely audible	Noise overpowers audio
Not Receivable	No program audible on channel	AGC overload	Receiver fully quiet on channel, likely to occur within radius indicated
Noisy1,2,3	Noisy audio, 1 moderate, 2 more, 3 most	Shaded sections (yellow or blue) have strong local signals. Unshaded sections are remote from transmitters.	

Table 1

Subjective Reception Quality Notes

From the overload behavior at the transmitter site driveway, we can infer that there will be similar behavior, if not as consistent or pronounced, near the transmitter site. We drove on North West Point Road listening to the JVC radio, stopping occasionally to try out the clock radio. Within 100 yards of the site, more or less, the JVC radio would drop out reception of stations, more so at the lower end of the band where the stations are weaker and closer in frequency to the undesired 94.3 signal. As interference is always variable, the condition was not consistent on all stations at all positions within the radius, but was certain to occur.

The clock radio was susceptible to the overload behavior (going silent) on all channels to some degree within the first 100 yards, and out to 200-300 yards only on the lower-frequency weaker channels. Somewhere in the 100-to 200 yard range there was a sense that the interference effect on the clock radio peaked, perhaps related to the vertical pattern of the transmitting antenna. Nevertheless, as has been demonstrated in George Town with similar interference issues, interference is still probable well outside the tested radius, just to a steadily decreasing degree. For the 1 kW transmitter on 94.3 we can expect the blanketing radius, per FCC criteria, to be about 1800 feet, and about 3000 feet for the 3 kW transmitter (allowing for antenna gain).

Within 1800 feet we coarsely estimate perhaps 150 residential structures, and perhaps up to twice that out to 3000 feet. These house counts are comparable to those in Newlands subject to similar interference. The difference between Newlands and the proposed site is that the 94.3 transmitter at the proposed site will not reach the entire island, as other stations are expected to do. Also, the new site is presently interference free, creating new interference area. In contrast, the movement has been toward common siting of transmission facilities, lest the island slowly develop into one large interference zone, with many geographically distributed stations.

To illustrate the power difference between 94.3 and the incoming signals, Figure 2 is a spectrum analyzer image of the 94.3 signal with the rest of the spectrum, taken at the Gould site. There is a 60-70 dB undesired-to-desired ratio between 94.3 and the other stations as measured (worst case) in the driveway. The ratio diminishes as one moves away from the site, but remains fairly high within the blanketing area.

If the station were approved, mitigation could include reducing to lower power (e.g. a 100-watt transmitter on this antenna system would produce an official blanketing area of under 600 feet radius and a strong blanketing area about half that radius). Another mitigation method involves installing an antenna, or modifying the present antenna by adjusting the bay-spacing, to minimize downward emissions to reduce the intensity of the potential blanketing effect. Such an antenna change may not eliminate interference, but could reduce its severity where experienced.

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