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FM

Translators

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Shively Labs Model 6812C Low Power/
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You know what you want.
This is how to get it

FM Translators



Lately, the FM translator service has become an important topic for radio broadcasters in the U.S., mainly in conjunction with the AM revitalization efforts being carried out by the Federal Communications Commission.

However, the service has been around since 1970 and was booming even before AM revitalization; and it can provide other benefits aside from helping AM radio stations.

In this e-book on FM translators, we're presenting three articles to help educate you on this important topic. First, we will go over translator basics, using the FCC rules as a starting point. Then, Chris Wygal discusses FM translators within the context of the AM revitalization effort. The third article discusses more about the actual nuts-and-bolts implementation of a translator facility.

Special thanks to contributor Jeremy Ruck, who served as a technical advisor for this project.

We hope you find this series interesting and educational.

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FM Translator Basics: FCC Rules

Rebroadcast keeping these regulations in mind

by **Doug Irwin, CPBE DRB AMD**

The FM translator service is a low-power, secondary service in the FM broadcast band that was originally meant to complement the primary FM service. It was created in 1970 to allow FM stations to provide service to areas that were not served well by the primary service, due to reception difficulties created by distance and/or intervening terrain.

Translators simultaneously re-broadcast the program of their primary station (AM, FM, or HD) on a different frequency, in the FM band (88-108 MHz). They are not authorized to originate programming — except for brief fundraising announcements. (See the third article in this e-book for more details.) Because translators are now allowed to have AM radio stations as their primary stations it is important to note that translators relaying daytime-only AM stations may continue to carry programming of their primary AM station, even when said AM station is off-air overnight.

Translator stations that provide service within the primary station's protected service area are defined as "fill-in" stations. Fill-in translators can be owned by the main station or by an independent entity. Commercial non-fill-in translators (which are outside of the primary station's protected service area) are generally owned by independent entities, with certain exceptions. Noncommercial educational non-fill-in translator stations are generally owned by the primary station being rebroadcast.

FM TRANSLATOR OWNERSHIP IS NOT SUBJECT TO THE FCC'S FULL-SERVICE STATION NUMERICAL OWNERSHIP LIMITATIONS.

FM translator ownership is not subject to the FCC's full-service station numerical ownership limitations. Therefore, broadcasters with full market complements of AM and FM stations may acquire as many fill-in FM translators as they may find.

Translator stations rebroadcasting a commercial AM or FM station (as their primary station) may be authorized on



When antennas from multiple transmitters are in close proximity, the likelihood of cross-coupling is high. Use filtering in the transmitter output to mitigate or eliminate potential intermod products.

Channels 221 through 300 (92.1 MHz to 107.9 MHz), while a translator rebroadcasting a noncommercial educational station may be authorized on any FM channel (Channels 201 to 300 — from 88.1 MHz to 107.9 MHz). The maximum effective radiated power (ERP) permitted for any translator station is 250 watts. It is important to note that, depending upon the circumstances, the ERP will often be much lower. (More on that later.)

FILL-IN TRANSLATORS

A "fill-in" translator by definition provides complementary coverage to its primary, inside of the protected service contour

of its primary. It is required to maintain its service contour within the service contour of the primary station.

For the following classes of FM stations: A, C3, C2, C1, C0 (C-zero), C or noncommercial educational Class B, B1, or D FM primary station, the fill-in translator station must maintain its 60 dBu (1 mV/m) F(50,50) service contour within the 60 dBu contour of the primary station.

The fill-in translator of a commercial Class B primary station must maintain its 54 dBu (0.5 mV/m) F(50,50) service contour within the 54 dBu F(50,50) contour of the primary station. The fill-in translator of a commercial Class B1 FM primary station must maintain its 57 dBu (0.7 mV/m) F(50,50) contour within the 57 dBu F(50,50) service contour of the primary station.

The distances to the primary station and translator station contours are to be predicted using the standard contour prediction method as specified in Section 73.313 of the commission's rules, using as many radials as necessary to accurately locate the contours.

THE COMMISSION HAS RULES REGARDING THE UNATTENDED OPERATION OF TRANSLATORS.

An FM translator may have an AM station as its primary only if the translator's 60 dBu service contour is within the smaller of a) a 25 mile (40 km) radius circle from the AM station's transmitter site and b) the AM station's 2.0 mV/m contour. This limitation applies to all applications being filed by AM licensees for FM translator stations in 2016 and 2017 as part of the AM revitalization effort. (Chris Wygal's article on [page 10](#) will provide more details.)

A fill-in translator station may be owned by the licensee of the FM primary station or by an independent entity. An independent owner of a fill-in translator must secure the permission of the primary station to rebroadcast its programming



Translator equipment should be built into a locked cabinet to keep its operation secure.

before commencing operation. It is important to note that the primary station is allowed provide financial and technical support for an independently owned fill-in translator both before and after the translator commences operation.

Fill-in translators may have their ERPs limited by the need to maintain the translator's service contour within the primary station's service contour, but in any case, the upper power limit is 250 watts. (Non fill-in translators have their ERPs limited by their HAAT, as defined in 74.1235.)

A commercial fill-in translator may receive a primary station's signal via any terrestrial transmission method, including (but not limited to) microwave, internet, and all manner of circuit types provided by local telephone companies. Satellite delivery is prohibited. These requirements also apply to noncommercial educational translators in the reserved band (88 to 92 MHz) that are not

commonly owned with the primary station. A noncommercial educational FM translator, commonly owned with the primary station, may deliver the signal to the translator by any means, including satellite delivery.

Only one channel will be authorized for a translator; and, the translator can have only one primary station.

NON-FILL-IN TRANSLATORS

As the name suggests, non-fill-in translators provide coverage for their primary stations outside of the primary's protected service area. In some cases, the coverage of the non-fill-in translator may lie completely outside of the primary's service contour.

The most important legal aspect of non-fill-in translators is this: Commercial stations, and anyone associated with the commercial primary station, may neither own nor provide direct, or indirect, support to the non-fill-in translator station, before or after the translator commences operation. Interestingly, the commission has added this note to its own explanation of this particular rule: "However, in order to facilitate service to white (or unserved) areas, the commission is favorably disposed toward waiver of this rule to permit a commercial

primary station to support its own translator, or an independently owned translator, which provides service to these unserved areas.” For the purposes of translator station applications, “white area” is defined as any area outside the coverage area of any full service aural service (AM as well as FM). A showing of the “white area” must be presented in the translator application with a request for waiver of the ownership requirement. When locating the “white area” boundaries, the service contours for FM stations shall be predicted using the standard method as described in 73.313. Consult with your communications attorney for more on this waiver possibility.

“Technical support” for non-fill-in translators is a different matter though. The primary commercial FM station may provide technical support to an independent translator station, including services provided by the primary station’s technical staff or compensation for the time and services provided by independent engineering personnel. This support does not extend to the supply of equipment or direct funding for the translator’s discretionary use. Technical assistance by the primary station should occur after the issuance of the translator’s construction permit or license in order to meet expenses incurred by installing, repairing, or making adjustments to equipment.

A special caveat for commercial non-fill-in translator stations: The commission may terminate the operation of a non-fill-in translator station at any time if the circumstances in the community or area have changed such that its application would have been denied if those circumstances had existed at the time of its filing. The notice of termination, when issued, will list a date at least 60 days from the notice date by which operations must be terminated. However, the commission also says, in its own text, that “notices of termination pursuant are rare in practice.”

Non-fill-in translators relaying commercial FM stations must receive the signal off the air, unless a waiver has been granted to feed a “white area” translator by other terrestrial means. (A showing of the “white area” must be presented in the application for construction permit, requesting waiver of the signal delivery requirement.) Independent non-fill-in translator licensees must have secured the written permission of the primary station to rebroadcast its programming before commencing operation.

Noncommercial educational non-fill-in translators operating on Channels 201 through 220 (88.1 through 91.9 MHz) that are owned by the licensee of the primary noncommercial educational station may use alternate means to receive the primary FM station’s signal.

Non-fill-in noncommercial educational translators on Channels 221 through 300 (92.1 through 107.9 MHz) are prohibited from any alternative methods of signal delivery, including programming feeds by satellite. The program feed must be taken off-air.

A significant technical distinction between a fill-in and a non-fill-in FM translator is the power and height limitations on non-fill-in translators. For a non-fill-in FM translator located east of the Mississippi River or in Zone 1, maximum effective power can be limited under FCC rules to as low as 10 watts with antenna heights of 141 meters HAAT and above.

CONCERNS FOR BOTH TYPES OF TRANSLATORS

Naturally, any translator applicant expects that the translator will be built, and after that, will just run by itself, without much in the way of intervention. The commission, though, has rules regarding the unattended operation of translators. For



Translator antennas can be made up of “composite” patterns that include multiple elements. Try to keep them isolated from other antennas to minimize pattern distortion.

example: If the transmitter site cannot be reached promptly at all hours and in all seasons, means shall be provided so that the translator can be turned on and off at will from a point which is readily accessible at all hours and in all seasons. In order to meet the letter of the law, some sort of remote control must be installed, and the control location “must be adequately protected against tampering by unauthorized persons.” Further, the translator must be equipped with an automatic system by which it will be placed “a non-radiating condition in the absence of a signal on the input channel.”

For those readers who are AM station owners, I once again point to rule 74.1263 (b): “An FM booster or FM translator station rebroadcasting the signal of an AM or FM primary station shall not be permitted to radiate during extended periods when signals of the primary station are not being retransmitted. Notwithstanding the foregoing, FM translators rebroadcasting Class D AM stations may continue to operate during nighttime hours only if the AM station has operated within the last 24 hours.”

In other words, you can continue operating your translator overnight, even if the primary AM station is a daytimer. You cannot, however, make the AM dark and continue operating the translator.

If the translator is on a tower or supporting structure that requires lighting under part 17 of the commission’s rules, the translator licensee must make suitable arrangements for the daily inspection and monitoring of the tower lights. This is another reason for providing the translator site with a remote control device.

Difficulties in obtaining a translator license are many, as are impediments to its construction and operation. None is as grave as the interference issue. A translator may not cause predicted nor actual interference.

First, let’s look at predicted interference. A translator construction permit application will not be granted if an objecting party provides convincing evidence that the proposed translator station would likely interfere with off the air reception of a full service FM station, even if there is no predicted prohibited contour overlap. This means that even if you file an application permit for a translator, after successfully accommodating all of the rules, that an outside party, like the licensee of an FM station on or near the frequency you apply for, can derail your application by way of an objection, based on evidence they provide to the commission. In order to counter this threat, use an experienced engineering consultant, and an experienced communications attorney who has succeeded in other cases.

After your translator CP is granted, and you construct the system, you are still subject to interference complaints. Here is the exact wording from the commission’s rules:

74.1203 (a(3)) The direct reception by the public of the off-the-air signals of any authorized broadcast

station including TV Channel 6 stations, Class D (secondary) noncommercial educational FM stations, and previously authorized and operating FM translators and FM booster stations. Interference will be considered to occur whenever reception of a regularly used signal is impaired by the signals radiated by the FM translator or booster station, regardless of the quality of such reception, the strength of the signal so used, or the channel on which the protected signal is transmitted.

A SIGNIFICANT TECHNICAL DISTINCTION BETWEEN A FILL-IN AND A NON-FILL-IN FM TRANSLATOR IS THE POWER AND HEIGHT LIMITATIONS ON NON-FILL-IN TRANSLATORS.

This is very important, because this rule says that your translator cannot interfere with a signal that is already there, no matter how weak it is, if it can be shown that there was previous, regular use of that signal. If the licensee of the signal purported to be receiving interference didn’t derail you in the application process, they can do it now by soliciting and gathering reception complaints from listeners in the interference area, and forwarding them to the commission.

So what can the holder of the CP do in the event that interference complaints are forwarded to the commission?

74.1203(b): If interference cannot be properly eliminated by the application of suitable techniques, operation of the offending FM translator or booster station shall be suspended and shall not be resumed until the interference has been eliminated. Short test transmissions may be made during the period of suspended operation to check the efficacy of remedial measures. If a complainant refuses to permit the FM translator or booster licensee to apply remedial techniques which demonstrably will eliminate the interference without impairment to the original reception, the licensee of the FM translator or booster station is absolved of further responsibility for that complaint.

There you have it: the basic rules of translators. For additional information, I invite you to read the [third article](#) in this e-book, which delves into the construction and operation of translators. ●



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is experience.”**

~Albert Einstein

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AM Revitalization and the Class C and D Translator Filing Windows

Where do I start?

by **Chris Wygal**

AM revitalization is a popular and timely subject in broadcasting circles. It's essentially an FCC-generated opportunity for AM station owners to explore options to make their product more marketable and attractive. The most immediate method for accomplishing this is to simulcast AM radio programming on an FM translator.

Many AM owners have already taken advantage of this opportunity, while others have been more reticent. Should I jump in now? What is involved? Where do I start? What should I look out for?

I recently interviewed Rob Branch, owner of Virginia-based Calvary Technical Management. Branch has nearly 20 years of experience as an engineering consultant and media broker and has worked with countless AM and FM owners who have decided to expand their reach.

His expertise came in handy as I sat down to learn more

about what an AM station owner can expect during a foray into FM translator revitalization purchases, applications and construction.

A MULTI-STEP PROCESS

A sizeable cast of characters takes the stage when an AM owner commits to expanding or improving its service area. Prior to starting the show, the owner needs to consider whether or not his or her station boasts a solid content and revenue model, and if there is enough revenue available in the targeted community to justify the FM translator expenditure.

About 75 percent of AM stations are positively affected by the addition of a translator — if the process is choreographed properly.

WHO SHOULD BUILD A TRANSLATOR?

Some AM stations in very small markets don't feel that they can raise their advertising rates to justify the cost of adding a



Not all remote sites are created equal; this one has its own generator, two ISPs, high-speed data from Telco, and a picnic bench. The site owner has done a great job accommodating its customers.

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translator. For them, the evaluation is tough, and the decision is driven primarily by the potential listening audience they serve.

Branch says AM stations in small to medium-sized rated markets with relatively concentrated population areas are prime candidates. A market like Kansas City is the largest example of a community that can be effectively served by AM-owned FM translators. However, in a market like Dallas, the proposition is more difficult because the majority of the population served by Class C and D AM stations will generally live outside of the added FM translator coverage area. The translator may serve pockets of population but will still miss large areas served by the primary station.

Generally speaking, AM revitalization was intended to allow stations to better serve their current coverage area, not to extend it. In the future, a pending rulemaking may create opportunities for Class B stations to extend translator coverage area beyond what is currently allowed, but within their current AM coverage area.

COMMUNICATIONS LAW FIRMS THAT SPECIALIZE IN FCC REGULATIONS ARE INVALUABLE AND SHOULD MOST DEFINITELY BE A MAJOR ELEMENT IN THIS PROCESS.

Concerning the goals of a prospective translator owner, there can be many things broadcasters want to accomplish.

Branch has seen AM station owners who “just want a translator and don’t know what they’re doing,” as well as owners who have a knowledgeable team, know their market well, own several towers and want to effectively serve the community. Consequently, they hire an engineering consultant with the intent of finding a good frequency and the most effective tower location.

Most AM owners desire to build FM translators because FM simply sounds better than AM. Branch points out that, if one assumes that a translator will stop the “seek” function on a radio, the listener doesn’t know the difference between an FM translator and a 100 kW station. Additionally, many listeners confuse “power” with “loudness.” With that in mind, it is important to invest in FM processing for the new translator that will attract and keep the audience. This is an important consideration.

AM station owners who do not have a translator associated with their AM licenses are eligible to file for new FM translator licenses during this proceeding (described below). For those who think that they will wait to purchase a translator until the

2017 filing window, the 2017 process is expected to be, for all intents and purposes, an auction window. Legal and consulting fees must be considered during this process.

It is important to remember that translator licenses aren’t really being given away by the FCC.

“No FM translators are being given away, unless an applicant files to participate in the 2017 auction of translators and is the only bidding applicant,” Branch wrote in an email. “The fact that translator licenses have been issued in recent months is true, but these are not new authorizations, but rather translators that had to be purchased and modified. All of the amending parties can attest that they did not get the translator for free and it was not given to them. Also, engineering and legal costs certainly make this not a ‘free’ proposition for anyone.”

However, Branch noted, “If a 2017 window is actually held, in which Chairman Wheeler cast some new doubt, with his comments at NAB Show this year, it is an auction proceeding. However, it may look like a giveaway, since many small market broadcasters will find a frequency that no one else will apply for.”

GETTING STARTED: HIRE PEOPLE WHO KNOW WHAT THEY’RE DOING

The most critical decision in this process is the well-researched hiring of an engineering consultant who specializes in translators and understands interference mitigation. Not all engineers have the understanding of the risks and benefits involved with translator license proposals and applications.

A good consultant is one who knows how to locate a frequency that works and can prepare an FCC Form 349 properly for the modification of a translator license or construction permit. For instance, a full-power FM station can change the make or model of its antenna and notify the FCC after the fact; an augmentation of that type is not allowed on an FM translator until the FCC has approved it. Caveats such as this are numerous and knowledge of them, or lack thereof, effectively “weeds out” engineering consultants who are not as experienced with FM translators.

Branch warns that hiring an engineer who is not a knowledgeable consultant can complicate issues concerning frequency selection and mutually exclusive application resolution.

The FCC may grant a license with the understanding that the frequency works on paper; but translators are secondary services and are subject to interference regulation. If there is a bona-fide interference complaint against the translator after construction, the translator owner must mitigate the complaints or possibly leave the air. (We will learn about the complexity and expense involved in mitigating this problem.)

One of the first topics an AM owner should be prepared to discuss with an engineering consultant is the location of the translator tower. Be prepared to accept different options



Shared sites pose many potential problems for translators. Input filtering for off-air reception will likely be needed in addition to output filtering.

good communications legal counsel. Communications law firms that specialize in FCC regulations are invaluable and should definitely be a major element in this process.

FIRST OR SECOND WINDOW?

On Jan. 29, the FCC opened the first in series of long-awaited filing windows available for this phase of the AM revitalization effort.

The first window allows for existing authorized Class C and Class D AM stations each to purchase and move one FM translator construction permit or license up to 250 miles from its current construction permit or licensed location. The translator must be moved within the coverage area of the AM station as defined by applicable FCC regulation. The current window runs for six months.

The second window, which opens on July 29, 2016, runs for three months and allows all AM classes to purchase and modify the FM translator construction permits, provided that AM station did not participate in the first window.

Note that some Class A and B translator buying and selling for has already begun in anticipation of the second window in 2016. In fact, most transfer transactions currently represent this, rather than C&D window purchases, according to Branch.

Concerning FM translator pricing for Class C and D AM stations, the first filing window is more valuable, according to Branch, and should be taken advantage of immediately by eligible applicants, due to the limited inventory of available translators and limited market spectrum available.

Regarding availability and pricing: In the New England states, where a larger concentration of AM stations exist, prices for translators continue to go up and inventory is going down. The Middle Atlantic states are seeing a sharp decline in available inventory. In California, translator inventory appears to be relatively abundant. Midwest states are seeing a recent decline in the availability of translators as well.

As one would expect, across the nation, market location bears heavily on the asking price of a translator, with prices ranging from \$20,000 to \$120,000 for a single translator to move into a sizeable market. These are non-contingent transaction agreements, which we will discuss shortly. Translator prices are generally high in mid-Atlantic and New England states. The lower-priced areas have historically been parts of the Midwest, the southern states and California.

In the last 10 years translator prices have risen substantially, so it effectively comes down to simple competition. Get the translators now, while they're available.

SECURING A SPOT ON THE DIAL

A good engineering consultant can provide a report that identifies the available frequencies in the market. Is there

for the translator's location and do not immediately assume that constructing a translator on the existing AM tower will provide similar coverage FM coverage.

Second, discuss fees for the initial study and actual translator application processes. Beware of petitions to deny that sometimes crop up during the technical modification process, especially in larger markets. This is a period wherein a competing broadcaster, who feels that an applicant's translator will in some way infringe on his or her service area, can petition to deny or informally object to the proposed construction permit. This can result in several thousands of dollars in legal fees and can delay a construction permit by a year or more (assuming the petition is rejected).

By now, an AM station owner should realize the value of

inventory available? Will any frequency work in the market? The consultant should also provide documentation on the following:

- Which stations are eligible to apply for a translator license?
- Which of those have pending contracts to acquire one?

This information will aid in considering the risks involved prior to moving forward in the application process. Branch also suggested that driving the market is a common-sense way to hear what frequencies are potentially available there.

WHAT ARE THE RISKS?

Competitive tensions can rise to a fever pitch when multiple AM owners (and FM owners, for that matter) attempt to find a spot on the dial in their market for an FM translator.

AM REVITALIZATION WAS INTENDED TO ALLOW STATIONS TO BETTER SERVE THEIR CURRENT COVERAGE AREA, NOT TO EXTEND IT.

Two important factors come into play. There are the mechanics of FCC filings and transactions, along with buyers, sellers and brokers who strike up “contingent” and “non-contingent” deals in the translator business. Second, there is the Wild West nature of mutually exclusive filings. It can get complicated, and quickly!

Contingent and non-contingent transactions. After details have been worked out with the engineering consultant, an AM applicant may be well advised to consult a broker. Much like a real estate agent, a media broker has the inside scoop on what translator “properties” are available in the market. These properties include construction permits and licensed translators that are for sale.

Applicants who do not choose to use a broker could instead contact all translator owners within a 250-mile radius of their market. (This could be a very time-consuming process.)

When it comes to pricing, much will depend on whether the deal is contingent or non-contingent.

Nearly all FM translator owners want to sell their translators on a non-contingent basis, meaning that the translator is purchased and the deal closed regardless of the applicant’s prior engineering modification efforts being successful. Securing knowledgeable communications legal representation is critical for this process.

Contingent transactions can cost three to five times more than non-contingent transactions but come with a built-in safety net. Essentially, a contingent deal means that the applicant’s purchase of the translator is not final and does not close until the construction permit is granted for a location acceptable to the applicant/purchaser. Approximately 90 percent of translator purchases under \$100,000 are non-contingent.

Having legal representation or a buyer’s broker to perform the transactional duties is a reasonable consideration if this phase of the process is too complex for the applicant.

Mutually exclusive filings. A mutually exclusive filing occurs when more than one applicant files for the same or an adjacent frequency, in generally the same location, on the same day within a specific filing window.

To prevent delays, added legal fees and headaches, try to avoid mutually exclusive filings, which can ultimately be un-resolvable. The FCC has been very efficient in allowing stations to amend their applications and to request another frequency in the market, which is a sensible and comparatively simple process for resolving mutually exclusive filings, provided another clear and useable frequency is available.

In the Class C and Class D filing window, the FCC will force the two entities that have a mutually exclusive filing to have it remain pending until one party can find a usable frequency. If neither party can find a usable frequency, the license proposals will lie dormant. The FCC does not currently have a mechanism in place to resolve mutually exclusive license proposals, so it is really up to the parties who have locked horns on a frequency to work out a solution within legal boundaries.

NUTS AND BOLTS: EXPECTED COVERAGE AREA

An understanding of translator power levels is important in this proceeding. A translator works where it will fit within contour protection rules. Translators aren’t classified the same as traditional full-power FM stations.

Depending on frequency allocation and market characteristics, a translator could be licensed to operate at 10 watts and be 1,000 feet high on a tower. Conversely, a 250-watt translator could be built on a 30-foot tower. Coverage area is a major concern when deciding on what CP to apply for or what translator to purchase.

Translator coverage area is governed also by the protection afforded full-power stations, other translators and LPFMs as well. The question of whether LPFMs have a more robust existence in a market is answered this way: While LPFMs are not subject to co-channel and first-adjacent channel interference complaints, translators are. LPFM licenses are granted based on spacing from other interfering stations on the FM dial in a market. Translator licenses, on the other hand, are granted based on contour protection of other stations.

An important aspect concerning coverage area is a pending

Notice of Proposed Rule Making issued by the FCC, in which it is contemplating a relaxing of the rules that say the 60 dBu contour of an FM translator must be located within a 25-mile radius, or the 2 mV/m contour of the operating AM station, whichever is least; in consideration now is an extension of the 25-mile radius limitation to 40 miles. The FCC actions to increase the area in which an FM translator can be located is generally viewed by AM station owners as a significant additional boost to AM revitalization.

FEEDING THE TRANSLATOR

Considerations for feeding an FM translator owned by an AM applicant are numerous.

An AM “fill-in” translator can be fed by any method except by satellite. Internet, MPLS or T1, traditional STL links are perfectly feasible means. Feeding an FM translator off-air in this case is counter-intuitive, in that it is simply retransmitting AM fidelity. Feeding a co-located translator directly from the AM control room is a possibility, of course.

Investing in FM processing should be considered, at minimum, for competitive reasons. When compared to a Class C FM station, for example, a translator’s coverage is very limited. With that in mind, special attention should be given to maximizing the translator’s performance as a market competitor. The investment in competitive audio processing is crucial for its eventual success.

WHAT TOWER DO I USE?

A large share of tower ownership in the U.S. is held by Crown Castle and American Tower. Each has stringent rules concerning “who” can perform work on their property. This includes lists of approved contractors, an application process, and building permits.

Because of the costs inherent to equipment installation and leasing, many applicants choose to place translators on their existing AM towers.

If that isn’t a possibility, find a reputable tower owner and develop a working relationship thereafter. The translator owner is putting their property on another owner’s property; just as with any lease or rental contract, it is important to maintain trust and respect among all parties involved — and to get competent legal counsel to protect both sides.

FINALLY, CONSTRUCTION BEGINS

The conversation with Rob Branch was enlightening. The frankly insane amount of paperwork and filing that goes into the front end of a translator project can be overwhelming, which is why Branch strongly suggests hiring a consultant, media broker and qualified legal counsel.

On the other side of things, in the last 10 years I have had the opportunity to build 16 translator sites for a regional

network in Virginia. As I learned more and more about the translator business, I found that the physical construction of a translator is minimal when compared with the proceedings involved prior to actually hanging the antenna on a tower.

Generally, a translator uses little equipment. A 3- or 4 RU transmitter and a 2 RU receiver are typically all that is necessary (notwithstanding the use of bandpass filters, UPSs and other necessities that crop up on a per-site basis). Single-bay transmit antennas and lightweight receive antennas usually go on a tower in one day with an experienced tower crew.

All in all, FM translators will prove to be valuable assets to AM station owners.

Careful navigation through the application process, thoughtful hiring and contracting, patience and a clear vision for how to best serve the audience will manifest themselves as wise steps taken to greatly improve the effectiveness of AM programming in many markets across America. ●

LAYING IT OUT

- Step 1:** Hire a technical consultant and legal representation
- Step 2:** Decide which filing window makes the most sense
- Step 3:** Choose whether to enter into contingent or non-contingent contracts
- Step 4:** Select the target area to be served by the translator with the future in mind (consider also the NPRM concerning an expanded translator coverage radius)
- Step 5:** Hire a broker and make a deal to buy a translator
- Step 6:** File Assignment Application using a competent communications attorney
- Step 7:** File FCC Modification (Form 349)
- Step 8:** The FCC, in most cases, will grant assignment within 90 days, absent objections
- Step 9:** Close the sale
- Step 10:** Build the translator!



Circular polarization is an option for translator output antennas.

FM Translator Implementation and Construction Techniques

You know what you want. This is how to get it.

by **Doug Irwin, CPBE DRB AMD**

Many broadcasters have some experience with the FM translator service. It's been around for years. The original translator manufacturers have come and gone; however, modern options give us a lot more flexibility in the system design and construction. We'll take a look at that in this article.

Before we begin looking at our options for equipment and antennas, let's review some of the Federal Communications Commission's basic translator rules, since, by necessity, our system design will have to fit within its guidelines.

- The maximum effective radiated power for any translator station is 250 watts.
- If the translator is a fill-in translator, the ERP may be further limited by the need to maintain the translator's service contour within the primary station's service contour. Composite antennas and antenna arrays may be used.
- A commercial fill-in translator may receive a primary station's signal via any terrestrial transmission method, including (but not limited to) microwave, phone, internet and dedicated fiber optic cable. Aural intercity relay frequencies may also be used on a secondary basis, after coordination with local frequency coordinating committees.
- A noncommercial educational FM translator that is com-

monly owned with the primary station may deliver the signal to the translator by any means, including satellite delivery.

- An FM translator station rebroadcasting the signal of an AM or FM primary station shall not be permitted to radiate during extended periods when signals of the primary station are not being retransmitted. Notwithstanding the foregoing, FM translators rebroadcasting Class D AM stations may continue to operate during nighttime hours only if the AM station has operated within the last 24 hours. (74.1263 (b))
- If the translator site cannot be reached at all hours and all seasons, means shall be provided so that the transmitting apparatus can be turned on and off at will from a point that is readily accessible during all hours and all seasons; for that reason, some sort of remote control is needed.

PROGRAM DELIVERY

In terms of system design, delivery of the signal to be translated is probably the most challenging part. In many cases, over-the-air reception will work, but it can be fraught with difficulties — not the least of which is inconsistent reception quality. Also, though it is common knowledge that the translator must go off in the event that the "main" station goes off-air, the remote control requirement is not well-known.

Over-the-air reception. It would seem that receiving the station to be translated over-the-air would be simple because most of the time when one travels up to the proposed translator site (in a vehicle) to listen to the targeted station, reception is good.

However, it's almost inevitable that there will be some sort of problem with reception, related to one of four issues:

- The signal to be received is weak because of distance and/or intervening terrain.
- Fading occasionally makes the signal even weaker. This could generate an unacceptable amount of noise in the receiver output and thus as heard over the translator.
- There are strong adjacent channels present. This could lead to noise in the receiver output that is synchronized with the modulation of the adjacent stations, which could also be heard over the translator.
- There are strong local signals present. This could cause your receiver to be "de-sensed."

Consider ways to mitigate these problems.

First, it's likely the signal to be translated is weak, otherwise there would be no need for the translator in the first place. Intervening terrain and distance are problems that cannot be fixed; the only means to address them is by getting as much signal from the primary signal as possible, usually through receive antenna gain and height. And though it presents a considerable amount of work, you may find some physical locations for the receive antenna are better than others. Resist the temptation to buy anything other than a professional grade antenna for reception. It's just as important as the transmit antenna (which we'll cover later).

OPPORTUNITIES TO PUT A BRAND-NEW, NEVER-BEFORE-HEARD SIGNAL ON THE AIR ARE RARE.

Fading of the primary signal can create issues of noise in the translator output at best and outright oscillation at worst, depending upon how close the output frequency is to the input frequency. Refraction, brought on by temperature gradients in the atmosphere, can cause the signal level to vary. Again, the only way to address this issue is by building in as much antenna gain as possible, thus allowing you to develop a fade margin that is acceptable.

The presence of strong adjacent channel signals is likely,

especially if your off-air receiver is located on a mountain or hilltop. Any filter inserted in the transmission line going to the receiver must of necessity be of a very high-Q in order to have any beneficial effect. The IF filtering in your off-air receiver will have the greatest effect in mitigating this problem.

Presence of strong local signals also comes with the territory if the receiver that is part of your translator system is located



Shared communications sites such as this one are often supplied with good connectivity from Telco, thus providing another option for the delivery of programming.

on a mountain or hilltop. Receivers can be desensitized by the presence of strong, local signals, even when they are not that close to the frequency at which the receiver is used. Bandpass filters (which pass the channel you want) and notch-filters (which pass everything but the channel you are trying to be rid of) are effective in mitigation of receiver "de-sense."

Other means of program delivery. From the FCC rules: "A commercial fill-in translator may receive a primary station's signal via any terrestrial transmission method, including (but not limited to) microwave, phone, internet and dedicated fiber optic cable. Satellite delivery is prohibited. These requirements also apply to noncommercial educational translators in the reserved band (88 to 92 MHz) that are not commonly owned with the primary station. A noncommercial educational FM translator, commonly owned with the primary station, may deliver the signal to the translator by any means, including satellite delivery."

The normal means we use for feeding radio stations can all be used for feeding translators (with the exception of satellite feeds for commercial fill-ins). FM translators can also be fed by HD Radio receivers.

FCC rule 74.1231 (g) states: "Originations concerning

financial support (for the translator) are limited to a total of 30 seconds an hour. Within this limitation, the length of any particular announcement will be left to the discretion of the translator station licensee. Solicitations of contributions shall be limited to the defrayal of the costs of installation, operation and maintenance of the translator or acknowledgements of financial support for those purposes.”

This leads to the topic of “store and forward” for translator systems. There are devices available that afford translator licensees a fairly easy way to broadcast sponsorship messages, by sending them out to the translator sites via satellite (or IP). In this way, the messages can be tailored to the specific area covered by the translator.

It’s also important to know that aural intercity relay frequencies may be used on a secondary basis, if the prior coordination process shows that its use would neither cause interference to nor preclude use of the frequency by a full-service radio broadcast station; and a relay through another translator station is only acceptable if the intermediate translator provides a signal to a populated area.

THE TRANSLATOR’S TRANSMITTER

We’ve covered the delivery of program material to your translator site by means of an off-air receiver and other systems known as studio-to-transmitter links (“STLs” for short).

Now let’s talk about how to generate RF on the new frequency, within the FCC’s rules, the most important of which are:

- 74.1250 (a): FM translator and booster transmitting apparatus and exciters employed to provide a locally generated and modulated input signal to translator and booster equipment, used by stations authorized under the provisions of this subpart must be certificated upon the request of any manufacturer of transmitters in accordance with this section and subpart J of part 2 of this chapter. In addition, FM translator and booster stations may use FM broadcast transmitting apparatus verified or approved under the provisions of part 73 of this chapter.
- 74.1250 (c) (1) Radio frequency harmonics and spurious emissions must conform with the specifications of § 74.1236.
- 74.125 (c) (3) The apparatus shall contain automatic circuits to maintain the power output in conformance with § 74.1235(e).
- 74.1250 (c) (4) Apparatus rated for transmitter power



Outdoor cabinets are not easy to keep clean, and soon fill with all manner of insects and critters. Be prepared to make regular visits, and bring what you need to be rid of insects.

er output of more than 1 watt shall be equipped with automatic circuits to place it in a non-radiating condition when no input signal is being received in conformance with § 74.1263(b) of this part and to transmit the call sign in conformance with § 74.1283(c)(2) of this part.

- 74.1250 (c) (5) For exciters, automatic means shall be provided for limiting the level of the audio frequency voltage applied to the modulator to ensure that a frequency swing in excess of 75 kHz will not occur under any condition of the modulation.

Clearly, since the rules allow for many other types of program delivery other than off-the-air reception, it follows that the broadcaster can use an exciter and stereo generator to generate the translated RF signal. The harmonic and spurious requirements vary depending upon the power level.

For translators with less than 10 W of output power:

Distance of emission from center frequency	Minimum attenuation below unmodulated carrier
120 to 240 kHz	25 dB
Over 240 and up to 600 kHz	35 dB
Over 600 kHz	60 dB

For translator powers of 10 W or greater, the rules we’re more familiar with apply, notably 73.317 (a), (b), (c) and (d).

Translator power output power must be maintained so that it is no more than 105 percent of the authorized amount. Therefore any exciter put in to use as in translator service must have automatic power control. Implicitly, this also means that

the licensee should have a means by which this level can be monitored — more on that a little later in this article.

74.1263 (b) says that an “FM booster or FM translator station rebroadcasting the signal of an AM or FM primary station shall not be permitted to radiate during extended periods when signals of the primary station are not being retransmitted. Notwithstanding the foregoing, FM translators rebroadcasting Class D AM stations may continue to operate during nighttime hours only if the AM station has operated within the last 24 hours.”

RESIST THE TEMPTATION TO BUY ANYTHING OTHER THAN A PROFESSIONAL-GRADE ANTENNA FOR RECEPTION.

If you are translating an FM signal via off-air reception, this is easy to accomplish: When the receiver mutes, have the contact closure shut down the transmitter. On the other hand, if you are getting the program material by some other means, your options are to either use a silence sensor listening to the main program that, upon detection of silence, shuts down the transmitter; or use a remote control and shut the translator down in that fashion.

74.1283 describes the means by which a translator must be identified.

The old-fashioned way of doing this was by arranging for the primary station, whose station is being rebroadcast, to identify the translator station by call sign and location, three times per day, in this fashion: once between 7 a.m. and 9 a.m., once between 12:55 p.m. and 1:05 p.m. and once between 4 p.m. and 6 p.m.

A more common way to identify translators is described by 74.1282 (c) (2):

By transmitting the call sign in International Morse Code at least once each hour. Transmitters of FM broadcast translator stations of more than 1 watt transmitter output power must be equipped with an automatic keying device that will transmit the call sign at least once each hour (unless ID'd as previously discussed). Transmission of the call sign can be accomplished by a) frequency shifting keying the carrier not be less than 5 kHz nor greater than 25 kHz or b) amplitude modulation of the FM carrier of at least 30 percent modulation.

Finally, let's take a look at our modulation limiting requirement.

For translators fed over-the-air, baseband filtering will likely need to be applied. Any of the “all-in-one” translator boxes will likely include this as a feature. If you were to use a stand-alone receiver and composite baseband output, likely you will need to add an external composite filter so that noise in the upper part of the baseband spectrum doesn't re-modulate your translator transmitter. If you were to avoid doing that, some of the precious “100 percent” modulation capacity of the translator will be wasted on useless noise.

For systems fed by means other than off-the-air reception, your problem is exactly the same as any other FM system. An audio processor, which effectively limits the modulation to +/- 75 kHz (otherwise known as 100 percent modulation) must be put in place.



Sometimes it is necessary to go on a tower to remove old cables and “junk” left behind by previous users. Before getting quotes from your tower rigger for installing a translator antenna, make sure the place you expect to install your antenna is actually “open” with nothing else in the way.

THE TRANSLATOR TRANSMIT ANTENNA

Earlier we covered the “receive” antenna portion of the translator system. In fact, many of the antennas that work for transmitting are the same as those that work for receiving.

Let’s examine some of the rules the commission has put forth regarding the translator’s transmit antenna.

74.1237 (a) says:

An applicant for a new station to be authorized under this subpart or for a change in the facilities of such a station shall endeavor to select a site which will provide a line-of-sight transmission path to the entire area intended to be served and at which there is available a suitable signal from the primary station. The transmitting antenna should be placed above growing vegetation and trees lying in the direction of the area intended to be served, to minimize the possibility of signal absorption by foliage.

In many parts of the U.S., translators will be on mountains or hilltops. Clearly, though, since it isn’t required that the translator uses off-air signals, the “suitable signal from the primary station” part has become far less important in a many real-world applications.

REMEMBER THAT A “FILL-IN” TRANSLATOR CANNOT PROVIDE COVERAGE OUTSIDE OF ITS PRIMARY STATION’S SERVICE CONTOUR.

Intermodulation products generated by translators are a concern. 74.1237 (e) reads: “Consideration should be given to the existence of strong radiofrequency fields from other transmitters at the translator site and the possibility that such fields may result in the retransmission of signals originating on frequencies other than that of the primary station.”

Bandpass filters installed on the output of the translator transmitter should prevent this from happening; make sure that the filters you obtain can handle the amount of transmitter power authorized. For translator powers of 10 W or greater, 73.317 (a), (b), (c) and (d) applies with respect to spurious and harmonic emissions.

It is practical to install a translator transmit antenna on an AM tower, whether the station is non-directional, or directional. Consider 73.1692 (a):

Installations on an AM non-directional tower. During installation of the broadcast antenna and related equip-

ment, the AM station shall determine operating power by the indirect method. Upon the completion of the installation, antenna impedance measurements on the AM antenna shall be made and, prior to or simultaneously with the filing of the license application covering the broadcast station installation, an application on FCC Form 302-AM (including a tower sketch of the installation) shall be filed with the commission for the AM station to return to direct power measurement.

73.1692 (b) has similar requirements for directional AM arrays:

Installations on an AM directional array. Prior to commencing construction, the broadcast permittee or licensee shall notify the AM station so that, if necessary, the AM station may determine operating power by the indirect method and request special temporary authority pursuant to 73.1635 to operate with parameters at variance in order to maintain monitoring point field strengths within authorized limits. Both prior to the commencement of construction and upon completion of construction, a partial proof of performance (as defined by 73.154) shall be conducted to establish that the AM array has not been adversely affected. Prior to or simultaneously with filing of the license application to cover the broadcast station construction, the results of the partial proof of performance shall be filed with the Commission on Form 302-AM. (Emphasis added.)

Of course, the “broadcast station construction” reference in both of these paragraphs refers to the translator.

74.1235 (f) and (g) are important rules with respect to the actual antenna configuration that can be used for translators. Composite antenna arrays may be used, which is important because based on the actual location of the translator, more ERP may be allowed in some directions than others.

Remember that a “fill-in” translator cannot provide coverage outside of its primary station’s service contour. If said translator is relatively near that service contour, power would be limited in that direction, whereas it could be much higher in a direction facing back in to the primary station’s service contour.

Horizontal, vertical, circular or elliptical polarity may be used for the translator transmit antenna.

UNATTENDED OPERATION AND REMOTE CONTROL

Unless you can reach the translator site under all conditions, during any time of the day or night, at any time of the



Translator antennas should get just as much consideration and expertise for their installation as would any other transmit antenna you install. Take care to allocate a sufficient amount in your budget to satisfy this need.

year, your translator installation will need some sort of remote control. Let's take a look at 74.1234 (Unattended operation). A translator may be operated without a designated person in attendance if the following requirements are met:

- (1) If the transmitter site cannot be reached promptly at all hours and in all seasons, means shall be provided so that the transmitting apparatus can be turned on and off at will from a point which is readily accessible at all hours and in all seasons.
- (2) The transmitter shall also be equipped with suitable automatic circuits which will place it in a non-radiating condition in the absence of a signal on the input channel.
- (3) The on-and-off control (if at a location other than the transmitter site) and the transmitting apparatus, shall be adequately protected against tampering by unauthorized persons.

There's no other way I know of to fulfill those requirements other than committing yourself to drive to the translator site at any hour, day or night — or simply installing a remote control of some sort. Clearly, it does not to be very sophisticated.

SOME FINAL CONSIDERATIONS

EAS. The commission has excluded translators from needing Emergency Alert System encoders. The requirement is not specified in the EAS rules (11.11). In addition, from line 45 of the Memorandum Opinion and Order (95-420) the commission wrote:

We did not intend for FM translators to be subject to the EAS requirements. They were not included in the EBS and we did not propose in the Notice of Proposed Rulemaking (NPRM) in this proceeding to include them in the EAS. We agree with Moody that the Note to Section 11.11 of the Rules is confusing and we clarify it to specifically exclude FM translators from the EAS.

Tower lighting. If your translator is on a lighted tower you have a responsibility to monitor and log the lights. From 74.1234 (5):

Where the antenna and supporting structure are required to be painted and lighted under the provisions of Part 17 of this chapter, the licensee shall make suitable arrangements for the daily inspection and logging of the obstruction lighting and associated control equipment as required by §§ 17.47, 17.48 and 17.49 of this chapter.

If you were not convinced of the need for a remote control, likely you are now, at least in this circumstance.

Building a translator can be an exciting experience for a broadcast engineer because opportunities to put a brand new, never-before-heard signal on-air are rare. Nonetheless, beyond the guidelines seen in this this e-book's [first article](#), there are many details needing to be addressed to make the system legal and successful. ●