All Things Digital

Amateur Radio for the 21st Century

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Robert C. Mazur, VA3ROM
E: va3rom@gmail.com
W: http://www.va3rom.com

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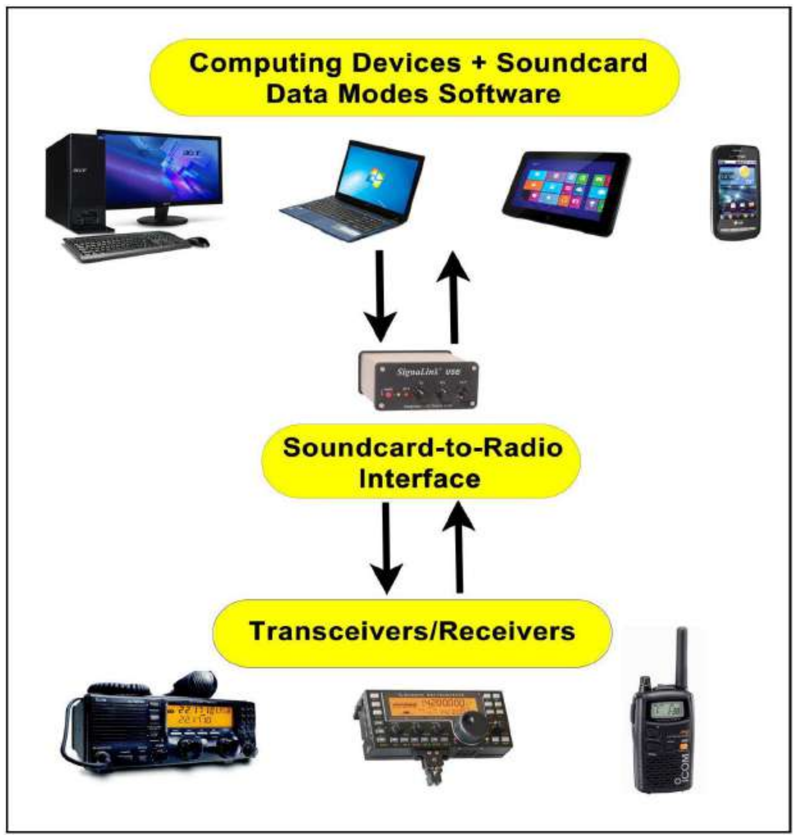
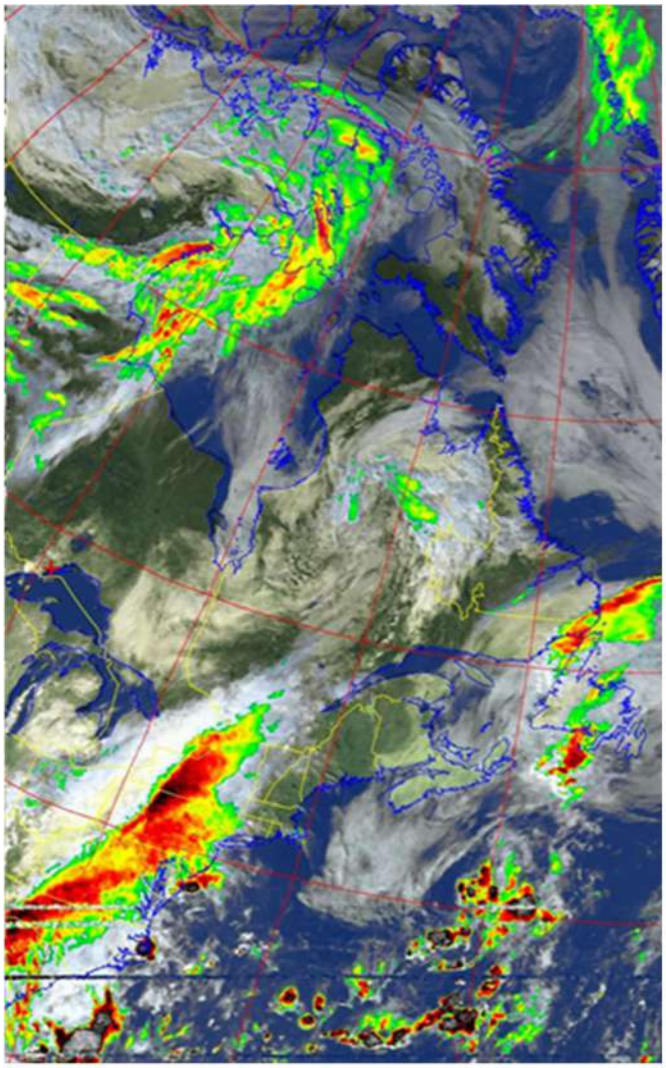
Slow Scan Television (SSTV): Part 2—Morphosis



21st CENTURY SSTV The beginning of this century began the "golden" digital age of Amateur Radio when both computer hardware and software evolved to the point where any Amateur could create a powerful data modes station, and eliminate expensive, not-so-portable, power consuming, and/or ancillary devices. These were all replaced by modern computing devices (desktops to smartphones) running free or low-cost software plus simple soundcard-to-radio interfaces. SSTV and other modes have been adapted by brilliant Amateurs to the latest technologies, giving us the ability to snap a picture, then transmit it to another location using "real" radio when conventional commercial communication systems (Internet, Wi-Fi, cellular, landline, etc.) aren't available. This can be very useful for emergency communications (EmComm) as it was after the devastating spring (2015) Nepal earthquakes and ensuing rescue/aid efforts.



SATELLITE AND BALLOON SSTV
“Ancient” analog automatic picture transmission (APT) weather satellites or “birds” are still flying high in their forever looping polar orbits, continuously transmitting live images back to earth (see left). Their signals are very easy for any hobbyist to receive and decode—more about this in part 3. The data is invaluable to many agencies when they are cut off from regular sources during extremely severe weather emergencies—if the Amateur Radio Emergency Service can provide it. Many Amateur Radio high altitude balloon (ARHAB) flights carry SSTV equipment and send real-time, still images back to Earth during flights often reaching over 30,000 metres!

FSQ SSTV
Murray Greenman, ZL1PBU, a renowned “down under” digital modes pioneer and technical writer, recently announced (QST, September 2015) the new and free Fast Simple QSO (FSQ) soundcard data mode created by Con Wassilieff, ZL2AFP, with Murray’s assistance. It’s a multi-frequency shift keying (MSFK) mode designed as a fixed frequency (channelized) messaging system with public service and EmComm in mind. It can create ad hoc radio-based text mesh networks, and has analog FM narrow band SSTV (NB-SSTV) capability.

For NB-SSTV, the carrier is centred on 1500 Hz with a -200 Hz shift for black and +200 Hz shift for white signal levels, but no frame or sync signals are used. FSQ has been added to the latest version of Fldigi, and a dedicated free FSQ program by Bob Cunnings, NW8L, is also available.

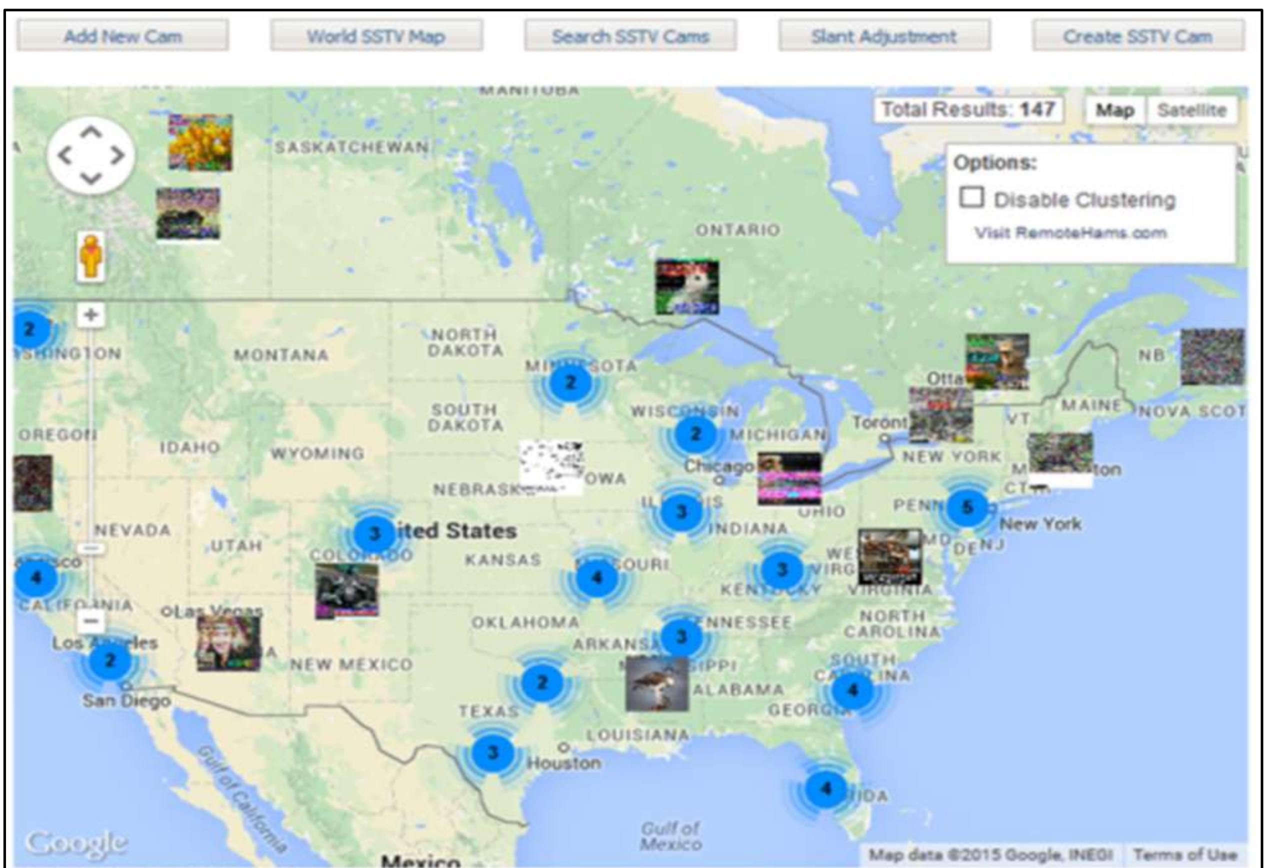
MMSSTV

While there are many standalone programs and software suites with SSTV capability (ChromaPix, Multiscan, MultiPSK, MixW, et al) MMSSTV (image above) created by Makoto “Mako” Mori, JE3HHT, is the most popular among Microsoft Windows users. It’s free, specifically designed for SSTV transceive, image editing, template/overlay support, and logging, plus it works on any “old and slow” XP computer—so don’t throw them away! Displayed is my customized main operating screen, and at a glance, you can see/select incoming/outgoing SSTV images, edit images, templates/overlays, transmit or receive, plus see the incoming signal spectrograph and waterfall displays.

Various black and white plus colour SSTV modes and resolutions are supported but 320 pixels (picture elements or pels) x 256 scan lines and 640 x 496 colour images are the most used. In 2010, after adding the new NB-SSTV modes, Mako stopped further development and released his MMVARI software engine to the public domain so others could integrate SSTV in their own applications. Guy Roels, ON6MU, has done this with his receive only version for hobbyists called RX-SSTV.

SOME MMSSTV FEATURES AND USES

Besides sending/receiving still photographs, images, or video frame grabs, one of the less used but extremely valuable MMSSTV feature is its ability to act as an SSTV simplex repeater, usually setup to cross-band repeat between the 2 and 10 metre FM bands. With an add-on file transfer protocol (FTP) program written by John Benedict, KE5RS, you can create an automatic 24/7 "robot" monitoring station on any SSTV frequency, and upload images to the WorldSSTV webserver and/or to your own web/mesh server (see below). It's a great tool for propagation tests, power comparisons, transceiver alignment, experimenting with different SSTV modes, etc.



Thanks to Brandon KG6YPI for this map view

While working on this article, my 20 metre SSTV monitoring station captured several test transmissions made by Robert Carter, W0QFW, 800 nm (nautical miles) south southwest of my location (see below). Robert could then use the WorldSSTV webserver and/or associated personal webpages to “see” what the SSTV “collective” had to “say” about his transmissions.

By collecting and analyzing received images, you’ll soon discover some interesting things. I’ve noticed as the received image SNR decreases the image disk storage file size increases, so it appears “noisy” SSTV images need far more storage space than “quiet” ones do. There’s also a “power cut-off point” where increasing the transmitter’s power doesn’t significantly improve the [received] image quality.

Received analog images can never be as good as (or better) than the originals because errors are introduced in the image-to-frequency-to- image processing by your soundcard's analog-to-digital conversion (ADC) and digital-to-analog conversion (DAC) processes. Also, analog signals consist of an infinite number of points and can't be digitized with 100% accuracy so some [data] loss occurs. The human eye can't detect data loss until it reaches a certain level because of our built-in "fuzzy logic" processors (eye/brain) which can analyze a noisy image and approximate/interpolate what it should look like, or what it the content "means".

ACTIVITIES, TOOLS, AND TUTORIALS

The international space station (ISS) often uses SSTV mode "PD180" to transmit 640 x 496 colour images and commemorate historic/special space events (see above). The PD SSTV modes were developed in the late 1990's by Paul Turner, G4IJE, and Don Rotier, K0HEO (SK), hence the "PD" prefix, with approximate transmission time in seconds after the mode designator (180 seconds).

Paul also created an awesome free webcam SSTV program you can use to automatically grab a webcam video frame at intervals (beacon mode) then transmit it via radio—no Wi-Fi, Internet, cellular, or landline is required.

Alex Shovkoplyas, VE3NEA, wrote a great set of free SSTV tools you can use to remove noise from images, spectrally analyze signals, and create various test transmissions. Larry Peterson, WB9KMW, produced an excellent series of SSTV articles and tutorials, along with a fantastic web tool to analyze similar SSTV images. I used this to compare the SSTV power test images (on page 4) by W0QFW, and between the 20 and 100 watt ones there is less than a 1% data quality/visual difference— 0.83%, to be precise.

The International Video Communications Association (IVCA) holds weekly Saturday morning (1400-1500 UTC) controlled SSTV nets on 14.230 MHz. The Japanese Amateur SSTV Association (JASTA) is also very active and sponsors many SSTV related events.

SLANT AND SYNC AND SAMPLE RATES—OH, MY!

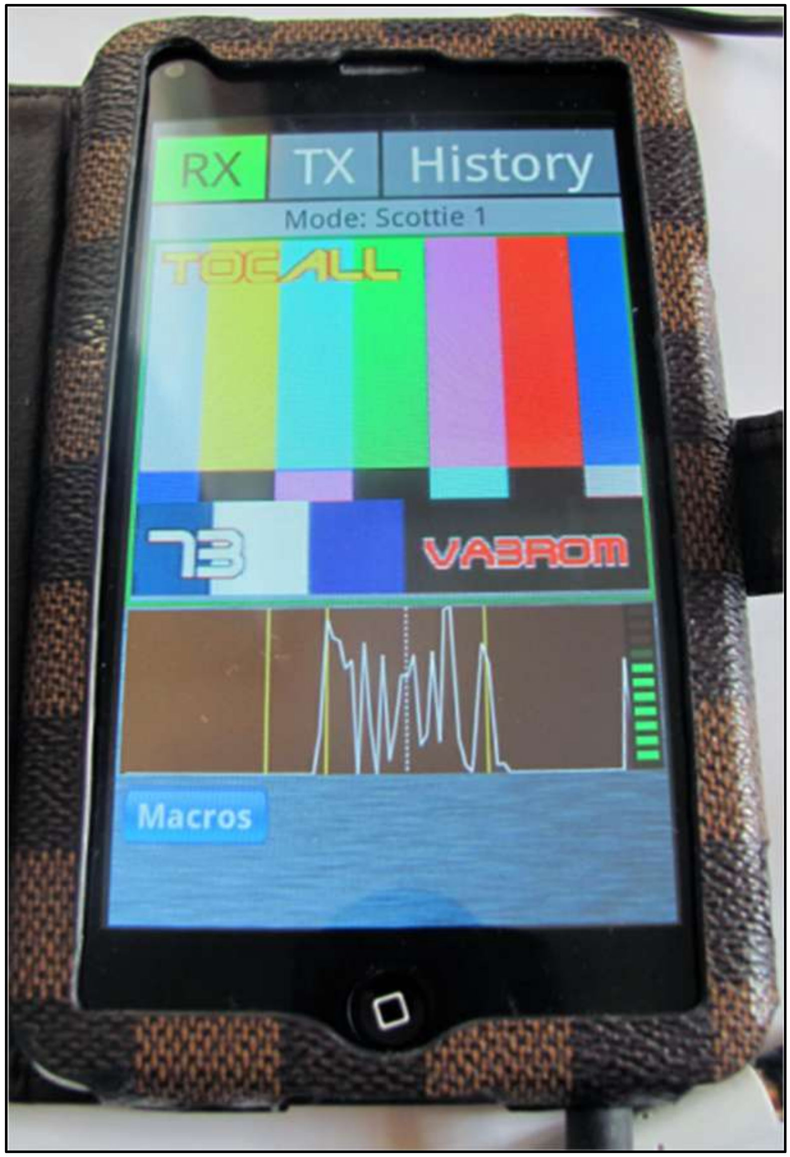
Slant error (in the vertical) and sync error (in the horizontal) is primarily caused by uncorrected soundcard master [crystal] clock oscillator (MCO) frequency or “sampling rate” errors, measured in parts-per-million (ppm). The terms “skew” for slant and “phase” for sync are becoming the more preferred terms used with smartphone imaging software (images next page). A utility called CheckSR can determine soundcard ppm error values, or you can use the time signal correction method (see Slant Adjustment section WorldSSTV website).

Older stock (comes with) computer soundcards usually have a “native” sampling rate of 44100 Hz with only one MCO; audio frequencies up to 22025 Hz (the Nyquist rate or frequency) can be adequately digitized to “CD audio quality”. A sampling rate of 11025 Hz (one-quarter of 44100 Hz) is used for SSTV (or other data modes) and only one ppm correction is required for soundcard input/output using soundcards with a single MCO.

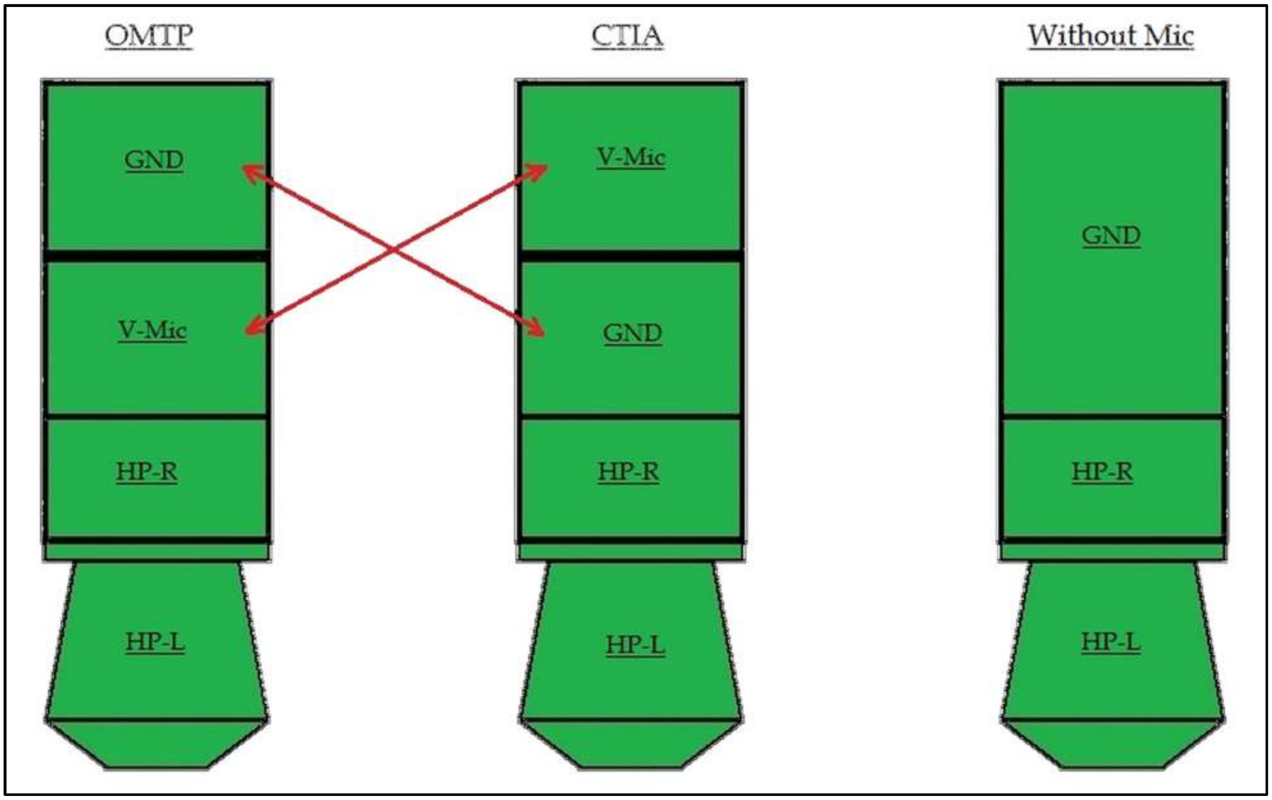
N2EDX was conducting slant tests my SSTV station captured. They nicely illustrate the effects of severe, moderate, slight, and no (zero Hz) slant errors.

MMSSTV (and most other programs) default to 11025 Hz, but today's stock computer soundcards usually have a native sampling rate of 48000 Hz with two MCO's (one for input and one for output). As a result, 12000 Hz (one-quarter of 48000 Hz) is the preferred sampling rate to use. Smartphone internal soundcards are usually fixed at 48000 Hz (they "over sample") and their sampling rates are not [usually] adjustable.

SMARTPHONE SSTV



We can use smartphones with the Automatic Packet Radio System (APRS), the Winlink 2000 (WL2K) Global Radio Messaging System, and mesh networks. Now we can add SSTV applications: one for Android called DroidSSTV by Wolphi LLC, and one for Apple iOS called CQSSTV by Black Cat Systems. Transmission is easy with either app using a standard stereo or tip-ring-sleeve (TRS) audio patch cord plus soundcard to radio interface, but receive is a different matter (see caveats next page). DroidSSTV (image above) is my personal choice because more people use Android smartphones, plus it also works on “obsolete” ones you may have tossed in the “junk drawer”. With it, you can crop a small section of a very large photograph and send that instead of the entire image (minimizes image detail/compression loss). It doesn’t need the vertical interval signalling (VIS) header (see SSTV: Part 1) to lock on to an incoming signal. The Scottie and Martin modes are the only ones supported, but these are the two most popular used by all SSTV software.



There are two smartphone SSTV receive caveats (above image refers):

1. Smartphones use a single combination line/speaker and microphone tip-ring-ring-sleeve (TRRS) 4-conductor plug/jack (2.5 or 3.5 mm) with two different wiring standards: “CTIA“[all Apple] and newer Android devices [Samsung, et al] While “OMTP” is used by another group of Android devices [Nokia and Chinese clones, etc.]. Google Android has mandated that CTIA become the de facto standard, but domestic/local exceptions are still allowed (usually Chinese phone clones).
2. Receive is further complicated by the smartphone’s built-in electret microphone which requires a low-level direct current (DC) voltage (anywhere from 1.3 to 2.0 volts). The soundcard-to-radio interface must take this in to account, plus use this voltage for transmitter keying, and switch the microphone from external to internal input. Note: Once properly connected, a tiny headset + microphone icon appears at the top of your smartphone’s home screen. But, a regular stereo (TRS) headset/speaker audio cable disables the internal microphone altogether and you’ll just see a tiny headset icon, instead.

In a pinch, the acoustic-coupling method can be used; just put smartphone, or laptop/tablet next to your radio's speaker/mic to receive, and use either manual PTT or voice transmitter keying (VOX). This works great for text-based digital data modes, but not so well with SSTV because any background noise will also mix with the signal and distort the image to some degree. However, something is better than nothing, so give it a try!

Note: As an aside, the Fldigi team created a free Android smartphone app called "AndFlmsg". It provides a plethora of data modes, and you can send/receive very small SSTV-like images using the MFSK16 mode.

MY FINAL

In part 3, we'll look up—way, way up at the polar orbiting weather satellites to capture and decode their APT [SSTV] images and embedded telemetry.—73

REFERENCES AND RESOURCES

Argent Data SSTVCAM
http://tinyurl.com/odnpo4x

CQSSTV (SSTV Pad)
http://tinyurl.com/mpql6p

Fldigi & AndFlmsg
http://tinyurl.com/32vguj5
http://tinyurl.com/onao6dd

FSQ Image Mode
http://tinyurl.com/p4em5ud

G4IJE SSTV WEBCAM
http://tinyurl.com/prq64dc

JASTA SSTV
http://tinyurl.com/ngzhylh

KE5RS SSTV
http://tinyurl.com/qcj5q5k

MMSSTV
http://tinyurl.com/6fn5l8y

RX-SSTV
http://tinyurl.com/7tz3ms7

SSTV Tools
http://tinyurl.com/6n6lkff

WB9KMW SSTV
http://tinyurl.com/qg2prmr
http://tinyurl.com/n9eeaxb

World SSTV Club
http://wsstvc.org

VA3ROM: All Things Digital
http://tinyurl.com/og2acxq