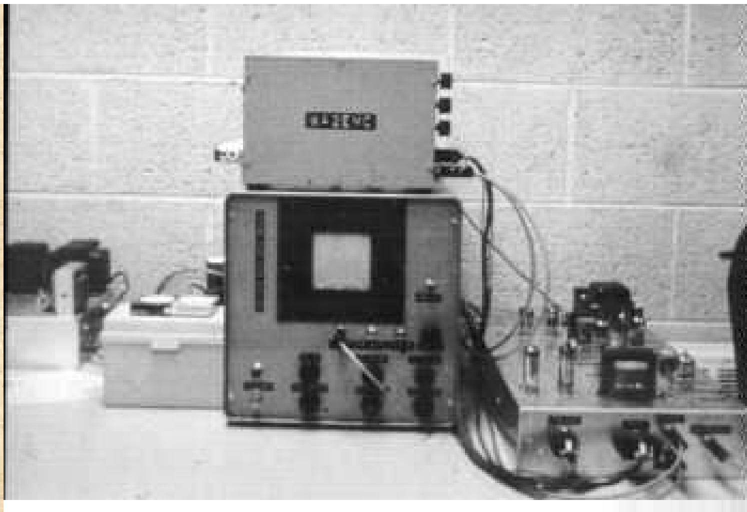
A Little History

Why All those Modes?

It is not my intention to do any in-depth analysis of the various SSTV modes, but, if you want to understand why there are so many SSTV modes, you need to revisit the history of slow scan TV formats.

The Original 8-second/120-line Format

The basic standards for slow scan evolved in the period between 1958 and 1961 (see articles by Copthorne MacDonald in the August and September 1958 and January and February 1961 issues of ***QST***). The equipment to transmit and receive SSTV was vacuum tube analog gear that was both complex, bulky, and heavy.

Shown here, in this case equipment that I built and used at W8SH, the Michigan State Amateur Radio Club, is the more-or-less standard SSTV gear for the mid-60's. The large monitor for image display is filled with tube-type circuits and, despite its size, the large and heavy power supply was external and can be seen on the far left. The is the famous "MacDonald Monitor" and was described in the March 1964 issue of ***QST***. The camera system was described in the June, July, and August 1965 issues of ***QST***. Most of the camera circuits and power supply are on the large chassis to the right. The actual camera head contains several more tubes devoted to the video amplifiers and subcarrier modulator. There were no kits and no circuit boards in those days. Everything, from cutting and drilling cabinets and chasses to doing the huge amount of point-to-point wiring was done by the builder. Today, some people complain about the effort required to install a piece of hardware. Back in the 60's, the price of admission was weeks or months of painstaking planning for the project (there were no standardized layouts for anything), construction, and alignment! Even as late as 1969 there were fewer than two dozen slow-scanners in the entire world, but I think you can see why!

The key to understanding the earliest slow scan standard is the realization that the image could only be displayed in viewable form on a radar-like picture tube with a P7 (long-persistence) phosphor. The circuits would paint the picture, line by line, on the face of the radar picture tube. Once the scanning beam had "painted" a line, that line would begin to fade. After about 8 seconds it would be marginally readable, even in a dimly-lit room. 8 seconds was thus the maximum useful viewing time. Given the maximum rate at which the video could be transmitted and still stay within voice bandwidth limits, and the fact that North America uses 60 Hz power (potential hum problems), the North American line rate was standardized at 15 lines/second (60/4). In other parts of the world, with 50 Hz power-line frequencies, the rate was set at 16.66 lines/second (50/3). 15 lines/second for 8 seconds means a 120 line picture (15 x 8) - the "original" SSTV image standard. Things were slight different in Europe, but the monitors of the time could handle either North American or DX variations because each line of video was triggered by a sync pulse.


This is Art Bachman, **SM0BUO** (Stockholm, Sweden), the world's first SSTV DX station. This picture was received at **W8SH** in 1969 during the first two-way SSTV QSO between the U.S. and Europe, which took place on 10 meters. The honor of the **first two-way DX QSO** goes to Sid Horne, **VE3EGO**, who managed to work Art before we did! Note that the image format is essentially square, to take maximum advantage of the square or round tubes of the period.

The First Color SSTV

I am including this section just to set the historical record straight. Many SSTV "historians", having failed to do their homework, cite the first successful color SSTV as the work of G3NOX and others who added additional memory to early SSTV scan converters in the late 70's. The fact is, the first color slow scan was done with analog gear in 1969 as a result of parallel experiments conducted by Ted Cohen (W4UMF) and Wade Tarr in the DC area and myself in Michigan. The work required to set up a color picture, and then reconstruct it at the receiving end was immense (the basic procedures are outlined in an article by the three of us in the December 1969 issue of ***Ham Radio*** magazine) and it is a wonder that we managed to get any results, given the equipment of the period, but we did!

This is the world's first color SSTV image, produced by W4UMF in 1969, using a technique called subtractive synthesis, involving yellow, magenta, and cyan image data.

My experiments used so-called additive synthesis, with red, green, and blue versions of the image and produced results just a few days after Ted's first success.

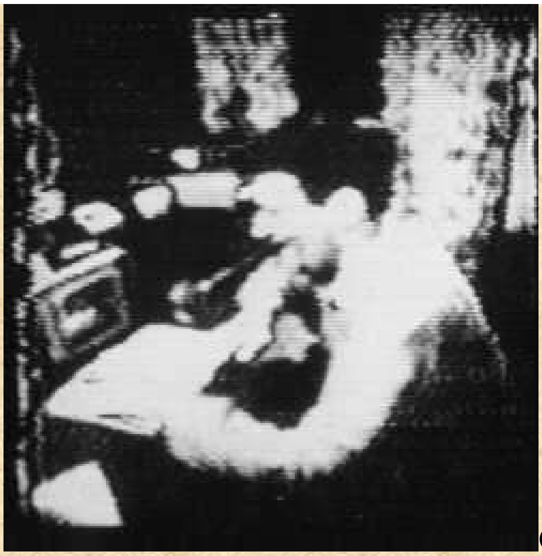
Both of these approaches involved a huge amount of photographic work and many hours in the darkroom both in preparing pictures for transmission and reconstructing the images received. Despite these daunting challenges, Jim Bland (K4YPX) in Tennessee was willing to give it a shot and by late in 1969, the world's first two-way color slow-scan QSO, between K4YPX and W8SH, was history:

K4YPX's picture as received by W8SH and

the W8SH picture as received in Tennessee. It is safe to say that color SSTV wouldn't become really practical until the advent of scan converters, but that's not where it started!

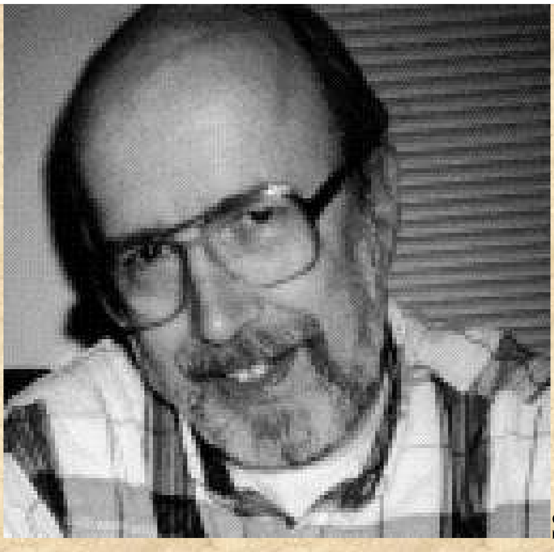
The Robot Model 70/80

The advent of the 70's brought the increasing use of solid-state devices, which dramatically reduced the size and power consumption of monitors, cameras, and other SSTV gear. The use of printed circuit boards also made it much easier to build SSTV equipment. New monitor designs appeared (W4TB, W9LUO, W6MXV) and several start-up companies began the tentative introduction of commercial gear. The most successful of these was a San Diego company, Robot Research, Inc. Their Model 70 SSTV monitor and Model 80 analog sampling camera made it easy to get on slow scan and there was a considerable increase in SSTV-equipped stations all over the world. The Model 70 was a very nice P7 display system and the image format was unaltered except for one small detail. The design of the Model 80 camera made it expedient to transmit a 128 line picture, raising the total frame time to 8.5 seconds - something that all the other existing systems could accomodate with no problem.


Given the resolution of the basic SSTV format, portrait-type shots were the most practical and even simple station shots pushed the limits of available resolution. Here is a transmission from Gene, W1VRK in Massachussetts - and early Robot-equipped station.

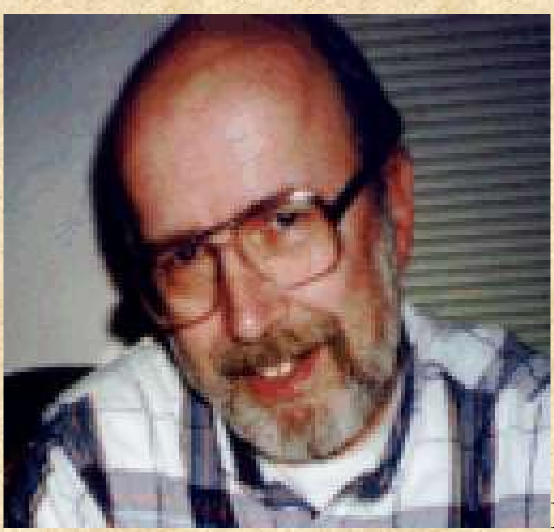
Black and White Scan Converters

As digital circuits became more sophisticated and low-capacity memory devices dropped in price, experimenters began looking at the concept of digital scan conversion. The idea is simple - digitize the incoming SSTV picture and store it in memory. The resulting data can be read out of memory at very high rates, creating a nice, non-fading image on any black and white TV set or monitor. No more semi-dark rooms and small-screen displays! The problem was, even the simplest scan converters required up to several dozen of the low capacity memory devices of the time, but it was possible and new designs began to appear.


Since the source images only had 128 lines and memory was scarce (and expensive), all the early scan converters digitized the signal with 128 pixels per line, creating a 128 x 128 digital format that matched the square aspect ratio of the P7 displays. Each pixel was coded as 4-bits, allowing for the display of 16 grayscale steps per pixel. The resulting images were coarse by todays standards, but it was a treat to be able to use a standard TV for display with normal room lighting! Five and nine inch monitors were common so as not to display the image at such a large size that the faults became too obvious.

This 128x128x16 grayscale format was adopted by the first successful commercial scan converter, the **Robot 400**. Since the 400 also contained circuits to capture or "snatch" an image from a standard b&w TV camera, as well as all the required audio switching circuits, it was literally a complete SSTV station in a modest-sized box! The 400 cost about $800 (and that's in mid-70s dollars!), to which you had to add the monitor/TV and a camera, but is was now extremely easy to get on SSTV, and more stations did!

Digital memory chips continued to increase in capacity and drop in price and soon it was possible to have a total of three memory blocks - enough to hold red, green, and blue image data. Add the circuits to multiplex the image data in RGB, NTSC, or PAL and you had color!


Even at this early stage, different experimenters had their own ideas about how to format such a color picture for transmission and reception - so we get different modes to transmit these 128 x 128 color pictures.

Not to be out-done, Robot enters the fray with the **450C** color scan converter (and the **400C** color retrofit for existing 400's) - but they throw in a whole bunch of new color formats, now to mention higher resolution black and white, and, with the introduction of the famous **1200C**, higher resolution color modes.

Like the 800 pound gorilla, the Robot color modes become the new "standard", but with the now familiar rectangular aspect ratio and 260K+ colors, and VIS codes at the start of each picture so the scan converter could automatically detect the mode in use:

So everybody was happy - right? Hardly! Experimenters, particularly in the U.K., thought that there were better ways to transmit the color and get away from the need to trigger individual lines, not to mention how to handle the lower-resolution color and how to format signals when conditions are poor. Thus are born the **Martin** and **Scottie** modes, implemented via new EPROMs to operate the Robot 1200's CPU! The EPROMS handle the Martin, Scottie, and Robot formats, plus Volker **Wrasse**'s formats, which were still popular in Germany! This relative stability lasts until computers begin the enter the picture.

The Amiga is the first affordable system to do a decent job with color SSTV and the Amiga developers, in addition to handling the wide range of existing modes, introduce a whole bunch of new ones - the **AVT** family, named for the Amiga AVT SSTV interface/software system. The AVT modes are "secret" (no published standards) but eventually they are deciphered and added to the Martin and Scottie EPROMs for the 1200!

When IBM compatibles finally get good enough to handle color SSTV, the poor developers have to include all the many modes that are the result of this erratic history, not to mention newer, higher resolution formats, as SVGA displays permit computer systems to surpass the resolution of the venerable 1200!

So there, in a nutshell, is why we have so many SSTV modes! Do we need that many - not really, but we are stuck with them all until the SSTV community (world-wide) can sit down and pare the list down to its essentials, making life easier for both hardware and software developers. In the meantime, we will just keep dealing with a screen full of options, 90% of which you will never use!