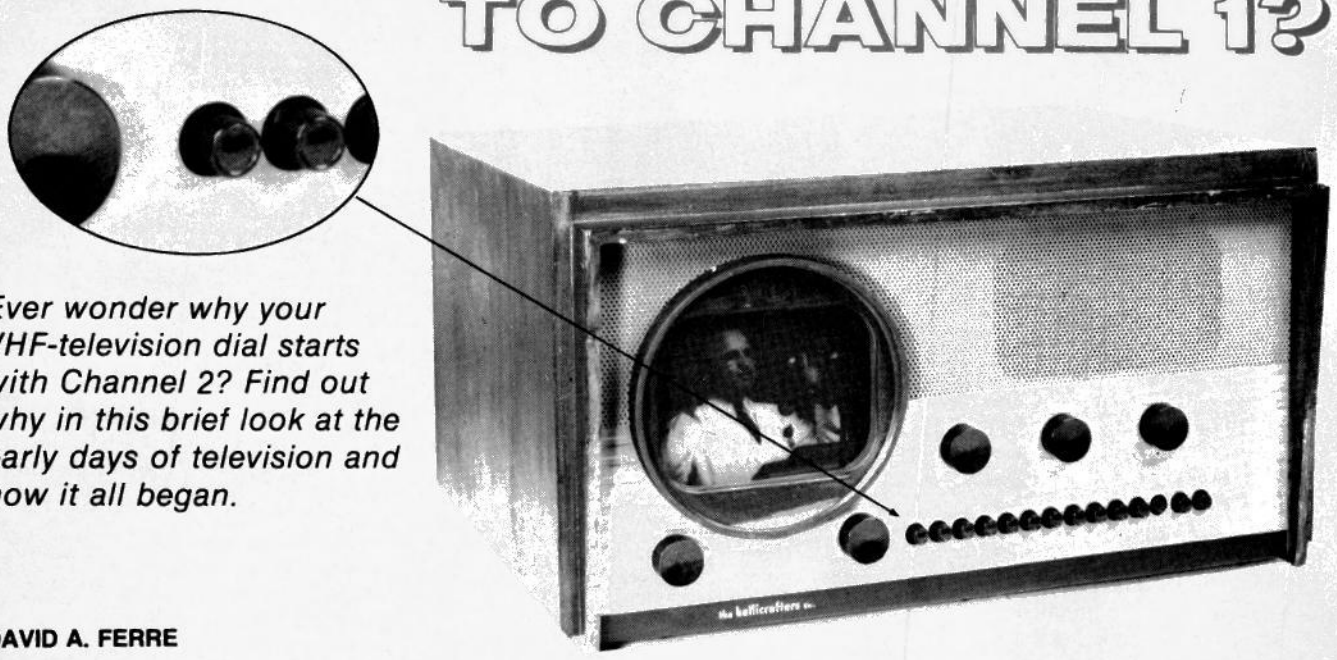
WHAT EVER HAPPENED TO CHANNEL 1?



Ever wonder why your VHF-television dial starts with Channel 2? Find out why in this brief look at the early days of television and how it all began.

DAVID A. FERRE

WHEN A TELEVISION RECEIVER IS PURchased in the United States, you can take it anywhere in the country, plug it in, pull up the "rabbit ears," and tune in a station. That is possible because we have national broadcasting standards that are common throughout the country. Yet, at one time commercial television was going to be introduced to the American public without standards; fortunately, that "experiment" ended before it even started. But let's not get ahead of our story!

Up to 1934

During the first few months of 1933, RCA demonstrated the first successful all-electronic television system. Broadcasts were made from the RCA experimental television transmitter, W2XBS, located at the top of the Empire State Building in New York City. The characteristics of that early all-electronic television system were modest:

Lines:	240
Frames:	24 per second
Scanning:	sequential (no interlacing)
Bandwidth:	2 MHz
Video carrier:	AM modulated, full sideband
Audio carrier:	AM modulated, full sideband

Yet, the results were far better than any mechanical television system had ever accomplished. For those experiments, the video carrier was at approximately 45 MHz.

It may be hard for us to appreciate fully what RCA had accomplished in 1933. But to give you an idea: Many of the experimental television broadcasters were still using frequencies in the 2- to 3-MHz range, and bandwidths of 100 kHz. In addition, the earlier systems were mechanical using gears, motors, mirrors, etc. As television advanced, each step pointed towards non-mechanical systems, and higher bandwidths and carrier frequencies.

The Federal Communications Commission was established by an act of Congress on June 22, 1934. It was about that time that a portion of the VHF radio spectrum was allocated to television for the first time (see Fig. 1). Previously, any frequency above 30 MHz was available to experimenters. Those experimenters included a number of pioneering amateur-radio operators; there were also experimental stations that included television. In 1934, the experimenters were moved to the frequencies above 110 MHz, while television was allocated two bands, 42-56 and 60-86 MHz. There were no channels associated with the allocations, but it was a beginning; television was making its first move.

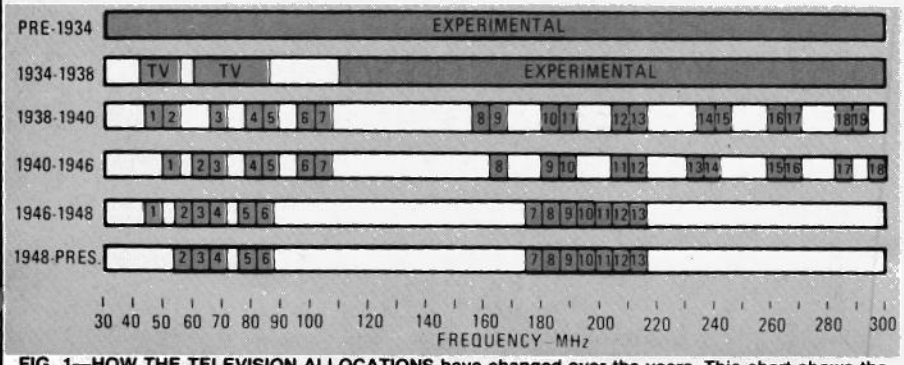


FIG. 1—HOW THE TELEVISION ALLOCATIONS have changed over the years. This chart shows the approximate frequencies of the channels; the exact frequencies are given in Table 1.

1934 to 1938

Progress was slow for television during those years. The depression was at its worst, and even mighty RCA lost

money. But advances were made in RCA's all-electronic system. In June, 1936, RCA announced the start of a massive field test. A total of 100 experimental-television receivers were distributed to RCA employees for placement in their homes and offices (see Fig. 2). RCA then began regular television broadcasts from W2XBS, using their new Radio City television studios. Those studios were linked to the Empire State Building transmitter by an experimental 177-MHz radio link and a coaxial cable. The composition of the television signal used for that test was as follows:

Lines:	343
Frames:	30 per second
Scanning:	interlaced (2:1)
Bandwidth:	5.75 MHz
Video carrier:	AM modulated, full sideband
Audio carrier:	AM modulated, full sideband

On June 15, 1936, the FCC began informal hearings concerning the radio spectrum above 30 MHz. There was an increasing demand for those frequencies and a new word began to be heard at the FCC; that word was standards. The Radio Manufacturers Association (RMA), the trade association for the radio and television equipment manufacturers, had formed a sub-committee on television. They attended the June, 1936 hearings because of their interest in the possible future commercialization of television. In addition to urging definite channel allocations, the RMA had a set of television channel standards to present (see Fig. 3-a). Although those standards were incomplete in some respects, one important recommendation that the RMA made to the Commission was that the bandwidth of a television channel should be 6 MHz—the same bandwidth that is used today. The RMA television standards were:

Lines:	441
Frames:	30 per second
Scanning:	interlaced (2:1)
Bandwidth:	6 MHz
Video carrier:	AM modulated, full sideband
Audio carrier:	AM modulated, full sideband

It is interesting to note that the proposed 441-line standard was beyond the capabilities of any system that had been demonstrated up to that point. It wasn't until eight months later, on February 11, 1937, that a manufacturer (Philco) gave a convincing demonstration of a television system that completely met the RMA standards.

The FCC hearings that had started on June 15, 1936, resulted in the allocation of 19 television channels, each with a bandwidth of 6 MHz. The new allocations, which are shown in Fig. 1 and Table 1, became effective October 13, 1938. The RMA revised and completed their set of television standards, which were essentially the same as the 1936 standards except for one important difference: The video carrier would now be transmitted with a full upper sideband and only a partial lower sideband, as shown in Fig. 3-b. That vestigial sideband system was eventually adopted by the FCC and is used today.

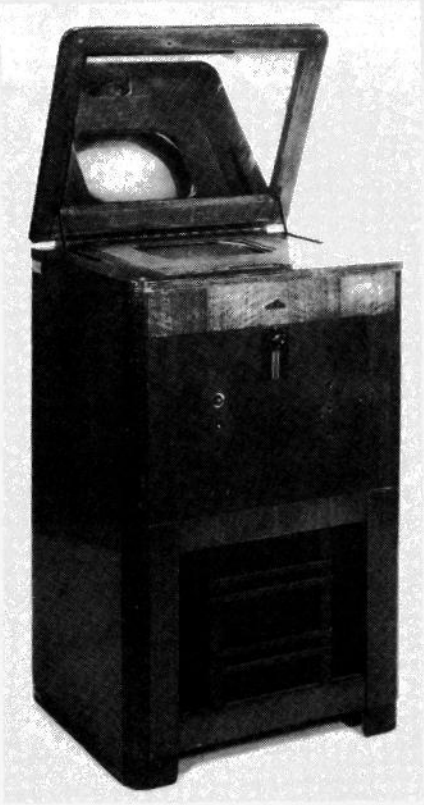


FIG. 2—ONE OF THE LAST in existence, this receiver was one of the ones used in RCA's test of the first all-electronic television system. The vertically-mounted picture tube was viewed through a mirror in the cabinet top.

Television now had allocations and channel numbers. Our mysterious Channel 1 was assigned to the 44- to 50-MHz band as shown in Table 1. RCA's experimental station quickly received a permit for one of those new television allocations and selected Channel 1!

1938 to 1940

The television industry was generally pleased with the FCC allocation of 19 TV channels. They were hoping for a continuous band of frequencies to simplify tuner design, and were somewhat disappointed that 12 of the 19 channels were above 150 MHz; those frequencies were virtually unused, and thought to be useful only for television-relay networks. But the seven channels between 44 and 108 MHz were enough to begin plans for commercial television operation. By then it was believed that the RMA standards would be adopted by the FCC and commercialization could begin. But not everybody agreed with the RMA standards, and the FCC wasn't about to approve any standard unless the television industry was in almost total agreement.

On October 20, 1938, just one week

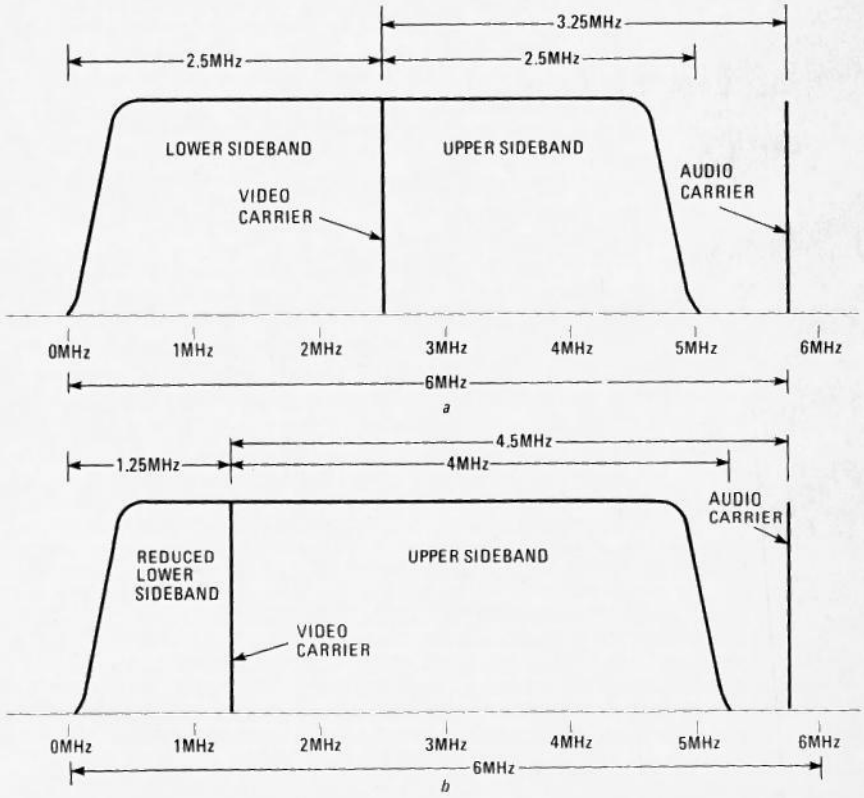


FIG. 3—THE FIRST STANDARDIZATION of a television signal, the system shown in *a* featured full upper and lower sidebands. A later revision, shown in *b*, featured a reduced lower sideband. That vestigial sideband technique is the one is use today.

TABLE 1

Channel	Year			
	1938-1940	1940-1946	1946-1948	1948-PRESENT
1	44-50	50-56	44-50	–
2	50-56	60-66	54-60	54-60
3	66-72	66-72	60-66	60-66
4	78-84	78-84	66-72	66-72
5	84-90	84-90	76-82	76-82
6	96-102	96-102	82-88	82-88
7	102-108	102-108	174-180	174-180
8	156-162	162-168	180-186	180-186
9	162-168	180-186	186-192	186-192
10	180-186	186-192	192-198	192-198
11	186-192	204-210	198-204	198-204
12	204-210	210-216	204-210	204-210
13	210-216	230-236	210-216	210-216
14	234-240	236-242	–	–
15	240-246	258-264	–	–
16	258-264	264-270	–	–
17	264-270	282-288	–	–
18	282-288	288-294	–	–
19	288-294			

after the allocations became effective, RCA announced that regular television programming would begin as a "public service" on April 30, 1939. That date coincided with the opening of the 1939 New York World's Fair. A number of manufacturers began producing television receivers, and by the opening of the fair they were in the stores and ready for sale. The opening ceremonies of the fair were broadcast on Channel 1 by RCA's W2XBS, and featured the President of the United States. After that event, broadcasts were scheduled on a regular basis.

By the end of May 1939, large department stores, such as Macy's in New York, offered as many as nine different models for sale; those were supplied by three manufacturers (Andrea, DuMont, and RCA). Screen sizes for those television sets ranged from 5 to 14 inches, and prices ranged from $189.50 to $600.00. Most of the early sets were complete receivers, but one, the *model TT-5* from RCA (shown in Fig. 4), had no audio section; if audio was desired, it had to be connected to a compatible RCA receiver. Unfortunately, sales of those early television sets were not very good, and by the end of 1939 fewer than 400 of them had been sold in the New York area.

All of the major television broadcasters (incidently, the stations were still considered experimental) had adopted the RMA standards by the end of 1939. That included the stations in New York City, Chicago, Los Angeles, and Schenectady. The FCC was urged to adopt the RMA standards so that commercialization could begin. The FCC responded to the pressure from the TV industry by publishing rules for limited commercialization on December 22, 1939. It was a kind of Christmas present for the television industry.

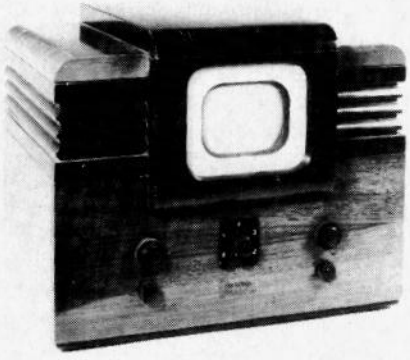


FIG. 4—THIS EARLY TELEVISION SET, the RCA *model TT-5*, was one of the first offered for sale to the general public. It featured a five-inch screen, five-channel coverage, but no audio section; it sold for $199.50 in 1939.

At the time those rules were published, the FCC also announced that hearings would be held in January, before establishing a date for limited commercialization. At those hearings, it was made clear to the FCC that many of the broadcasters did not agree that the RMA standards were the best. Philco urged the FCC to adopt their system of television with 605 lines and 24 frames-per-second. DuMont wanted standards that included 625 lines and 15 frames-per-second. In addition, there was some vague talk about something called color television. Nevertheless, in an order issued on February 29, 1940, the FCC ruled that limited commercialization could begin on September 1, but warned that nothing should be done to encourage a large public investment in television receivers. They refused to adopt any standards, with the implication that each of the broadcasters could use whatever standards they liked best, with the public deciding who had the best system.

RCA responded to the authorization for limited commercialization with full-page newspaper ads in early March announcing the "arrival of television," and ordered the immediate production of 25,000 television receivers. The FCC realized that limited commercialization wasn't going to work, as the sale of thousands of television sets would, in effect, "freeze" the standards, making a change to other standards almost impossible. Within a few days of the RCA newspaper ads, the FCC's permission for limited commercialization was withdrawn.

Television was also about to undergo some more changes. *F*requency *M*odulation (FM) had been introduced by its developer, Major Edwin H. Armstrong, in 1935. Shortly after its introduction, FM was granted five experimental frequencies between 42.6 and 43.4 MHz. By 1940, the FCC had 150 applications for experimental FM stations on file that could not be processed because of lack of frequencies. As a result of hearings held on March 18, 1940, the FCC assigned FM a continuous band of frequencies (that was done to simplify tuner design), and expanded the FM allocation to include the frequencies from 42 to 50 MHz. The new allocation included the 44- to 50-MHz band that had previously been assigned to Channel 1.

But that is not what happened to Channel 1! The TV channels were renumbered with Channel 1 now assigned to 50-56 MHz band and the remaining channels were shifted around the spectrum. But when the smoke cleared, the television industry had lost one channel, leaving them with 18 allocations.

The new FM channels and the changes in the television allocations became effective on June 20, 1940; commercial FM broadcasting was authorized to begin on January 1, 1941.

1940 to 1946

When the revised 18-channel TV allocations went into effect, the television industry was unhappy, to say the least. The limited commercialization plan was suspended; the FCC continued its refusal to set television standards; a television channel was lost to FM, and, because of the changes in the allocations, many of the experimental TV broadcasters had to go off the air to complete extensive transmitter changes. For example, the RCA experimental transmitter, W2XBS, had been operating on the old Channel 1 (44-50 MHz); because of the changes, they were forced to switch to the new Channel 1 (50-60 MHz).

However, soon after that things began to look up. A member of the RMA had met with the FCC to ask just what the television industry could do to win approval of a set of standards. The FCC replied that if the industry could agree on *one* set of standards, they would be

approved without delay. Quickly, the RMA organized the National Television Standards Committee (NTSC). The NTSC was open to all major interests in the television field whether they were associated with the RMA or not. Eventually, over 160 individuals became associated with the NTSC. On July 31, 1940, under the RMA's sponsorship and with the FCC's blessing, the NTSC held its first meeting.

With the opportunity to propose a set of standards to the FCC, you might have expected that the NTSC would simply have endorsed the existing RMA standards, but that is not what happened. Every aspect of the television-standards question was re-examined and discussed at length. On January 27, 1941, the NTSC met with the FCC and presented a progress report. The preliminary NTSC standard presented to the FCC at that meeting closely paralleled the RMA standards. That seemed to indicate that the RMA standards were essentially correct. There was one important difference, however: The audio carrier was to be FM. The FCC had one reservation about the proposed standard—they felt that the 441-line standard recommended by the NTSC was too low. That standard went way back to the first RMA standards of 1936, when both video sidebands were transmitted. It was common knowledge that the vestigial sideband system in use since 1938 allowed a much higher line count and, accordingly, a better television picture. The NTSC agreed to re-examine that question and said that it would present more information at hearings that were to be held in March, 1941.

Those hearings were held on March 20, 1941. The NTSC standard that was presented at the hearing was almost identical to the one proposed earlier, except that the number of lines was increased to 525 lines. (Although the number of lines seemed to be random, it was not. The line count had to be an odd number and to be related to few multiples of odd numbers, such as $3\times3\times7\times7=441$ or $3\times5\times5\times7=525$, for example. That was necessary for generation of the synchronizing pulse.) The new standard was as follows:

Lines:	525
Frames:	30-per-second
Scanning:	interlaced (2:1)
Bandwidth:	6 MHz
Video carrier:	AM modulated, vestigial sideband
Audio carrier:	FM modulated, ±75 kHz deviation (later ±25 kHz deviation)

Virtually all of the participants in the hearings (they went on for four days) agreed that the NTSC Standards were correct and should be adopted quickly. The FCC was convinced that the industry had finally agreed and the NTSC Standards were adopted as the national standard in April 1941. The effective date was July 1, 1941; commercial television could finally begin!

When that "Opening Day" for commercial television finally arrived, only two television stations were licensed and ready for operation; WNBT (NBC, old W2XBS) transmitting on Channel 1, and WCBW (CBS, old W2XAX) transmitting on Channel 2. Both of those stations were in New York City. Soon after (on September 1, 1941) WPTZ in Philadelphia, transmitting on Channel 3, came on the air. By the spring of 1942, a total of four commercial stations were in full operation and 10,000 television receivers had been sold.

Television's growth was halted by World War II, with the Defense Communications Board ordering the construction of new radio and television stations to end. Television programming was reduced to just four hours per week for the broadcasters already in operation (all devoted to war-related activities).

As the end of the war approached, the FCC was faced with a monumental task. The war effort had brought about an extraordinary leap in communications technology. Frequencies that had been thought to be useless were now in tremendous demand. The entire spectrum had to be re-examined, with new allocations made and old ones revised. The FCC began by holding hearings on September 28, 1944. They were promptly overwhelmed. The 18-channel television allocations in effect since 1940 were attacked by one group as being wasteful of the valuable VHF spectrum, yet another group urged an increase to 26 channels. Others urged the FCC to move all of the television allocations to UHF frequencies immediately. But the television industry aruged that television had waited long enough and should develop now, using the existing allocations.

After hearings that were held on February 14, 1945, it became clear that no group was going to get everything it wanted. In the FCC's final decision, released on June 27, 1945, television's allocation was reduced to 13 channels, and FM was moved from the 42-50 MHz slot to 88-106 MHz (the band was later increased to 88-108 MHz). The television interests were very unhappy that they were left with only 13 channels, but the FM interests suffered a major blow because all of the existing stations had to go off the air and switch to new frequencies. In addition, 500,000 home-FM receivers were now obsolete.

The reduction to 13 television channels was accompanied by new and reorganized frequency allocations (see Table 1). Again the broadcasters had to go off the air to switch frequencies.

Our Channel 1 was still around, but it was moved back to the 44- to 50-MHz band that it had occupied from 1938 to 1940. In addition, there was a restriction for Channel 1: It could only be assigned as a community channel, and was limited to a maximum power of 1000 watts. Other TV channels were for metropolitan stations, with a maximum power of 50,000 watts permitted. All channels, except Channel 6, were shared with fixed and mobile services—a fact that left the television interests concerned about interference. The changes became effective March 1, 1946.

1946 to 1948

Even with the reduced number of channels, the boom was on! Manufacturers quickly began producing television receivers, transmitters, antennas, etc. New television stations were being built all over the United States. The FCC had identified the top 140 metropolitan cities and assigned each at least one channel; a total of 400 were to be allotted. The FCC received many more applications than it had available channels. In an effort to provide the public with as many channels as possible, the FCC routinely threw away the "safety factor" of mileage between licensed transmitters. Television-receiver sales were doing very well, with 175,000 sold by the end of 1947. Manufacturers were selling television sets as fast as they could be made, even though the sets were rather expensive. (A typical set with a 10-inch screen sold for $375.)

But problems began to appear. Propagation theories at that time predicted that television signals would not be received over the horizon—but they were, quite readily. So, even with just 50 stations on the air, interference problems were beginning to appear. Meanwhile, the FCC had reduced the minimum distance between stations using the same channel to just 80 miles. An engineering study released by the FCC warned of interference problems if immediate action wasn't taken. That led to an FCC report, issued on May 5, 1948, that ruled that television could no longer share its frequencies with fixed and mobile services, and that the 72- to 76-MHz band could be used for fixed radio services only.

But where could the mobile services be located if they could no longer share the television allocations, and could no longer use the 72- to 76-MHz band? There was only one place to go—the television industry would have to give up another TV channel. But which channel would that be? The American Radio Relay League (an association of amateur radio operators) urged that Channel 2 be deleted so that the second harmonics of the 28- 29.7-MHz amateur-radio band would not interfere with

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CHANNEL 1?

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television reception. The television industry, although not pleased about losing yet another TV channel, agreed that 12 clear channels were preferable to 12 shared channels. If they had to lose a channel, they preferred that it be Channel 1, because its absence would have the least impact on commercializing television.

The FCC went along with the television industry's position, and on June 14, 1948, Channel 1 was deleted from the allocation plan. Channel 1's frequencies were assigned to the fixed land and mobile services. At the same time, the FCC decided not to renumber the channels—that's what happened to Channel 1!

R-E