TECHNICAL PROGRAM - I
Monday, June 27, 1966

CHAIRMAN ARCHER S. TAYLOR: I want to welcome you all to the First Technical Paper Session of this Convention. We have a number of quite interesting presentations. Our time is somewhat limited. I'm going to ask the speakers to confine themselves to approximately 25 minutes and, if possible, we will have a question period. Keep your questions in mind and we will try to give you an opportunity to raise them with the speakers if time allows.

For our first speaker we have Mr. Hubert Schlafly, Vice President of the TelePrompter Corporation in New York and all over the country. Mr. Schlafly is going to speak on the short-range multichannel microwave. Mr. Schlafly.

MR. HUBERT SCHLAFLY (TELEPROMPTER CORPORATION): Gentlemen, it is a pleasure to be with you here in Miami.

About a year ago, at the NCTA Convention in Denver, the project now referred to by the somewhat cryptic name of AML--meaning Amplitude Modulated Link, but more descriptively called "Short Range Multi Channel Microwave"--had already been in active study and/or experimentation for six months.

Today, the result of this conceptual, theoretical, engineering, laboratory, design and construction work is a physically operating system. This system is transmitting up to 12 color grade, standard television channels, modulated on a single carrier, over a six-mile path in New York City, under an Experimental License issued by the Federal Communication Commission.

I immediately hasten to emphasize that we do not as yet know if these experimental studies will lead to a practical operating system--the reason for the experiments is to collect operational, component, propagation and performance data which will help us arrive at an opinion on operating practicality. Furthermore, there is hardly any need to remind an experienced group such as this that the granting of an experimental license by the FCC does not indicate, suggest or even imply that the project will qualify for a commercial frequency allocation or that operators applying for such service will be granted a license. Do not underestimate either one of these two points. The first point is important because we are striking out not only into a new frontier of technique, specifically the multi channel - single transmitter concept, but also because we have dared to push into a portion of the electromagnetic spectrum which is beyond the boundary of today's commercial equipment and components.

The second point of caution is the familiar point of the necessity for the Commission carefully to examine each proposed use of the radio spectrum, and to determine whether it is in accord with the Commission's over-all policy, under the Communications Act of 1934, as amended, of concern for the welfare of the general public.

It is my opinion that the Commission does look with interest upon this experimental project. First of all, the engineering staff of the Commission has always shown great interest in, and given great encouragement

to, anyone who will stick his neck out by investing substantial dollars in a project which extends our knowledge of the frequency spectrum and its efficient utilization. This project involves research, development and engineering which cannot help but extend man's fund of knowledge. Even the telephone company, which hastened to protest any possible future commercial use of the 18 GC spectru, said that it would not oppose pure experimentation. The second reason for FCC interest is that the AML project offers a fresh point of view and new technical possibilities for the solution of some of the problems that the commissions are currently considering.

AML enjoys a means of modulating a microwave carrier and throwing away all of the components of that modulation except one sideband. This sideband contains sufficient intelligence to permit reproduction of the entire range of input information, including the precise frequencies of that input.

Thus, if a conventional CATV coaxial cable, including all of the information and frequencies from 54 to 216 megacycles that are normally carried on that cable is used as the input to an AML Transmitter--then all of these exact same frequencies will be delivered into the coaxial cable that is connected to the output plug of that AML Receiver. In effect, the AML concept permits an invisible coaxial cable, without the benefit of telephone poles, wires, messengers, hardware, amplifiers, power supplies and real estate, to deliver full CATV service from a "head-end" terminal to one or to many "distribution" terminals, which conceivably could be located anywhere within a few miles of that head end.

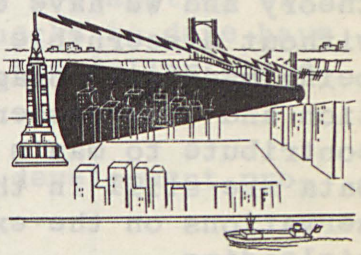
The AML concept does not eliminate cable--as some of the trade publications have speculated by referring to the project as "cableless TV." The final distribution in a local area requires exactly the same cable, and devices, that are used now. AML does permit the full complement of head end signals to be delivered to particular distribution terminals, at one or a large number of locations, without long, costly, or difficult cable runs through unproductive areas. Once a transmitter terminal has been established, with an antenna pattern as narrow or as wide as is necessary to illuminate a desired area with microwave energy--then a high gain, (approximately 1^{o} beam) receiving antenna may be located anywhere within this illuminated area and output converter provided this location has line of sight to the transmitter and exceeds a minimum field strength, allowing for propagational fades, the receiver can immediately obtain all of the CATV signals available at the transmitter site itself.

If this illuminated area includes an isolated farmhouse, or a small cluster of houses in a subdivision, or a substantial suburb across a canyon or a river, each of these locations could have full channel CATV service by the simple expedient of installing a receiver site. Thus, service does not have to be extended in geographic continuity. Service can be delivered immediately to the areas of greatest need regardless of whether or not they are in accord with the construction program for extension of trunk line cable. Furthermore, the equipment necessary to do this job is salvageable. If, for example, signal delivered to a farmhouse were no longer necessary because the people moved away--there would be no loss resulting from an extended pole line installation. Disconnect the receiver and move it to a new location, where it can immediately be productively

useful. The user would not be left with miles of plant which would have to be removed and which would have questionable salvage value.

In a large metropolitan area, such as New York City -- and I happen to have an intimate personal knowledge of the trials and tribulations of installing cable in New York City -- the AML approach would permit delivery of CATV signals--through the air--into one receiver located in each block. Once into the block, normal feeder cables, amplifiers and drops would be made into the dwellings of subscribers in that block. The importance of this approach is that the CATV system would not have to obtain assignments or pull cables through the underground ducts, and its construction crews would not have to enter manholes in the streets, or impede traffic with equipment or subsidiary conduit constructions. We are indeed very sensitive of the fact that during the public hearings in New York City, prior to the granting of a CATV franchise by the Board of Estimate, the counsel for the telephone company opposing such a grant, warned the city that by allowing CATV operators the privilege of using communication ducts in the public streets, they would place 3 million phone connections in jeopardy, risk disruption of civil defense networks and increase the likelihood of another power blackout of the entire east coast of our nation. While we dispute this gratuitous conclusion, we hasten to point out that by removing the necessity of having cable in the streets at all, we have made it physically impossible for such dire predictions to come true. As powerful as this argument may be, I somehow do not have the feeling that we will thereby win the unstinting support of the telephone company for the AML project.

I do have one slide which shows an artist's conception of the metropolitan area usage of AML. Broadcast signals from a tall building, which vaguely resembles the Empire State Building, are received at an AML Head End, converted to microwave and radiated with a pie-shaped beam over a portion of the city where receivers are located on rooftops of buildings in individual blocks receive this signal, return it to VHF and distribute the signals by cable within the boundaries of that one block.



Now let's examine the frequency that was selected for the microwave experiment of AML. Why did we select an 18,000 megacycle frequency. Basically, the reasons were these:

1. Below 12 KMC, the spectrum is already overcrowded with Government, Common Carrier and Commercial Users. Furthermore, these frequencies are allocated to comparatively narrow bands, split up between the services. AML, in order to carry the entire VHF spectrum from 54 to 216 MC, would require 162 megacycles of total bandwidth; this is about 0.8% of the 18 GC microwave carrier frequency. Further efficiencies might reduce this to 100 or 108 megacycles.

Above 12 KMC, there is a 500 megacycle band between 12.7 and 13.2 which might be considered. But this band is already subdivided into 12.5 MC channels for which there is a highly competitive demand in the television pickup, STL and CARS Services.

Above 13.25, all frequencies are assigned to government use including

Radio Navigation, Earth-Space, and Radio Astronomy, until 17.7 GC.

The current Table of Frequency Allocations provides a non-government band for Industrial, Fixed and Mobile use from 17.7 to 19.3. This 1600 megacycles of virgin spectrum (since to the best of our knowledge no applications have been granted for this frequency band) does not have the crowding or the bandwidth limitation of the 12.7 band and seems to have many logical reasons for an AML-type service.

2. The AML service is intended to operate over limited ranges. As presently conceived, transmission distances in the order of 6 miles, possibly as high as ten or twelve miles, seem adequate for extensive utilization. Therefore, the recognized factor of increased path attenuation and weather effects is less bothersome than it would be for a service which desired relay distances of 20, 30, 50 or more miles. Therefore, the future or projected congestion in the 18 GC band is also favorable to the AML service.

3. And finally, the state of the art, as understood and extended by competent engineering groups into the one centimeter wavelength region, has reached a point where sound design and totally reliable equipment for continuous duty service seems likely and practical.

So the three points which influenced this 18 GC decision are--in reverse order:

A. We are confident we can master the technical design.

B. Its propagation limitations are not limitations for the kind of service we contemplate.

C. We stand a better chance of obtaining an allocation for this commercial service at a higher rather than at a lower frequency.

How is the experiment working? I am personally very well pleased with our results to date. We have had no surprises or major deviations from theory and we have demonstratably excellent picture quality on 12 channels without discernible cross modulation or noise. Continuing measurements are being made on propagation characteristics, multipath phenomena, beam defraction and other essential factors which will influence future design and contribute to man's knowledge of this portion of the frequency spectrum. Data are still in the process of being collected--conclusions or even observations on the experiment to date would be premature and possibly even misleading.

Recognition of the importance of these experiments to TelePrompTer and to the CATV industry has resulted in the expenditure of a tremendous amount of dollars, and executive time and thought on the project. The fact that Mr. Caywood Cooley, TelePrompTer's Engineering Vice President, has been assigned full time to this particular undertaking, is an indication of the project's importance in the eyes of our President and Board of Directors.

But while the evaluation of need, the pointing of the way, and the detailed industry application have been supplied by TelePrompTer, the real guarantee of success of the project from the technical point of view, is the total support and major project status given by the executives and engineering staff of Hughes Aircraft Company. This company, since it was convinced of the merit of the undertaking, unhesitatingly committed the

engineering knowhow and facilities that produced the tremendous engineering successes of the Syncoms I and II, Early Bird, and most recently the astounding first-try bullseye of Surveyor. I consider that the Hughes Aircraft Company interest is a sincere compliment to the stature of the NCTA and CATV industry. It is a recognition of growth of a service from the small beginning of individual ingenuity and enterprise towards its goal as a major American industry.

CHAIRMAN TAYLOR: Thank you, Mr. Schlafly. We have a little time for questions, if anyone would like to inquire on the subject.

QUESTION: Does this transmitter broadcast in a omnidirectional or is it a highly directional beam?

MR. SCHLAFLY: The beam shape can be tailored to your needs. In New York City, for example, it is our intent to use either a 15^{o} or 20^{o} pie-shaped beam horizontal, but quite narrow vertical. In this way we don't lose all of the gain in the antenna, but we still have an area coverage rather than a pea shooter-type of operation. The receiving antenna will be extremely narrow. We expect to use the 1^{o} beam between the half-power point that I mentioned in the paper. This directivity will assist us in multipath discrimination and air plane flutter and possibly other situations.

QUESTION: How much will this cost compared to cable?

MR. SCHLAFLY: The dollars seem to make sense to us. We can't answer you specifically because we haven't progressed to the point of final equipment design. We are more concerned at the moment on the propagation difficulties, component design, and so on. But all of our checks to date have indicated that it would be a very practical system from the dollar standpoint.

QUESTION: How long would it take to complete this development project?

MR. SCHLAFLY: Considering the number of variables, I don't really know. The experiments that I have mentioned are under way now. One of the prime factors is the reaction of the Commission. Incidentally they have been quite interested in the experiment.

The answer depends on how lucky we are. It could be as short as six months to a year, or if we run into troubles it could be 18 months before we have commercial operation.

QUESTION: Are they going to demonstrate to the industry in the near future?

MR. SCHLAFLY: I don't think there is going to be an open house. We have, after all, the serious program of collecting data on this set-up that we have operating in New York City now. We have demonstrated the set-up

and I think that if anyone of you gentlemen sitting here had particular interest in it, you should get in touch with me. Some sort of demonstration or visit could be set up. Thank you.

QUESTION: What indication is there to date on the propagation losses over a 6-12 mile path due to precipitation?

MR. SCHLAFLY: The data to date is pretty well in accord with the previous work that has been done in this field and it has been reported in the IEEE and other magazines. Since there is not a great deal of data, we can't compare it broadly. Fortunately we had a tremendous downpour of rain for about 6 minutes a week ago in New York. We have not analyzed and correlated this exact amount of the rainfall with the propagation recording charts as yet. I don't think I am prepared to give you a definitive answer on that, but it is being studied.

QUESTION: What power levels are expected to be used based on the data collected so far?

MR. SCHLAFLY: The power levels that we are using now are quite small. I think the radiated power that we have is in the order of miliwatts. We are taking that into account in the collection of data. The objective, however, is to deliver transmitter power to the antenna in the order of $2\frac{1}{2}$ to 5 watts, somewhere in that region.

QUESTION: What type of modulation? Has there been any work on cascading in these units?

MR. SCHLAFLY: The name itself is descriptive of the type of modulation. It is an amplitude-modulated carrier, with suppression of the carrier and filtering out of one of the sidebands. So its a simple sideband transmission. As far as cascading goes, I am not prepared to say on that. I am most pleased with our performance to date, in terms of cross modulation, but I cannot say how far we could go using repeaters.

CHAIRMAN TAYLOR: Thank you again, Mr. Schlafly. I'm sorry to terminate question on this, but I'm sure Mr. Schlafly would be delighted to talk to you individually afterwards, but we have some more papers.

Next I would like to introduce to you Mr. Richard R. MacMillan, Chief Engineer of the Kaiser-Cox Corporation, who is going to speak on test equipment and methods. Mr. MacMillan.

MR. RICHARD R. MACMILLAN (Kaiser-Cox Corp.): With the introduction of second generation transistorized amplifiers, requirements for longer cascaded systems and better system performance, it is many times necessary to take a second look at the test equipment and test methods being used for equipment evaluation and maintenance.

The CATV industry has not yet standardized on either system performance specifications or equipment test methods and a detailed understanding