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The concept of a local distribution multi channel microwave link to serve as a means of delivering CATV signals from advantageously located head ends or central offices to distribution substations was proposed in early 1965 and implemented through design, FCC licensing on an experimental basis, propagation testing, and now limited commercial use, in a few selected areas.

The system of which I am speaking is the joint TelePrompTer-Hughes Aircraft Company experiments now known to the industry as AML, which is the short identification for the multi channel microwave Amplitude Modulated Link.

The purpose of this paper is to deliver to the industry a current status report on AML.

A very excellent technical review on AML was delivered at last year's NCTA convention in Boston. A rather elaborate demonstration of the working equipment was presented on the exhibit floor, at the 1967 convention in Chicago. And a thorough report on over one year of propagation testing of AML at 18 GHz was delivered as a technical paper in spring of 1967 at the IEEE Convention in New York. Reprints of all of these papers have been widely distributed and are available on request.

It is therefore not my intent to repeat that information here. I do want to tell you where the project stands, to discuss why it is not in common use in the industry today and to project some thoughts on the future course of this most interesting technique of broad band multiple addressee delivery.

There are two very essential ingredients for the success of any electromagnetic radiation device.

1. The technical development of practical working equipment.

2. The authorization of the designated governmental regulatory body for the use of such equipment to provide a desired service.

With regard to the technical development - AML has been working since 1966. A transmitter has been operating under an experimental license in New York City most of the time since that date. Today, the present version of this AML Transmitter is operating 24 hours a day 7 days a week, carrying 12 channels between a cable head end near the George Washington Bridge and two sub-distribution head ends. In accord with a commercial waiver on the experimental license which stipulates certain limitations for its use, AML is actually delivering CATV signals to many thousands of subscribers in New York on a daily basis. At the moment each of these "sub-distribution head-ends" are also complete normal CATV head ends and as part of the continuing

experiment we are able to instantly switch over service from the normal to the AML signal. I do not believe that any of our subscribers can tell the difference in the signal. A trained eye could distinguish a difference with an "A" - "B" test at the head end because the input to our AML system is from a receiving location that has slightly better reception quality than the reception at the sub-distribution head ends. You may be interested to know that one of these sub head end locations does not have direct line of sight to the transmitter. We are using a "bounce" shot from a 6'x 8' reflector mounted on a building in a block adjacent to the receiver site.

Similar experimental licenses with a commercial waiver have been granted at 18 GHz for operation with existing CATV systems in Farmington, New Mexico and in Eugene, Oregon. On February 17, 1969, the FCC authorized such operation in these two locations. Transmitters and a limited number of receivers are available. We are currently in the process of developing the transmitter sites. This includes leasing land, preparing access roads bringing in power and signal and all of the things that those who are experienced in CATV operating systems work on daily. This is an aggravatingly slow process, but we are making progress at both locations.

Here I want to reemphasize that the original intent of AML and the major benefit to the public and to the industry is not "big city" operation but rather rural operation. Delivery of processed multi-channel signals through the air to a relatively simple receiver which then cable feeds small home clusters, possibly even individual subscribers, located within a radius of 10 or more miles from an established cable system - greatly extends the service potential of the whole industry.

The technical operation to date has been successful. We have learned much which would beneficially influence to a commercial production design. As evidence of practicality, an AML transmitter was delivered here in San Francisco last week and is delivering full cable service approximately one mile through the air under a "Special Temporary Authorization" to a receiver in a room of this hotel--through the window and the fiber glass curtains. The VHF output of the receiver is feeding a number of exhibitions at this convention. This is not a demonstration, it was simply done as a service to the industry and as a protection, in the event that local broadcast reception at this building was not adequate for this convention.

Let's now consider the second of those two "essential ingredients"--the regulatory ingredient.

In order to give no false impression or misinterpretation of what I am about to say--I state that I am totally in accord with the power of a federal regulatory body determining the Rules and Regulations for the proper use of the radio spectrum in the

public interest convenience and necessity. This statement is not said tongue in cheek--it is a simple recognition of the fact that without such regulation there would be chaos.

If I have a complaint on this point, it is just that it takes a tremendously long time to determine what is in the public interest--particularly when other respected, but certainly partisan interests play the fear game of "lets don't do anything now because who knows what our needs may be tomorrow?"

At the start of the AML project we selected the 18 GHz band--approximately 2000 MHz of virgin spectrum, without a single license outstanding, which had already been assigned, by international agreement, to industrial use, fixed and mobile.

We sought specific Rule Making, to allocate a small portion of this band to local terrestrial distribution of Multi-Channel, Broad band signals, originally asking that 448 MHz be allocated to permit opportunity for nation-wide competitive services. Later this request was reduced to approximately 250 MHz, allowing for two 20 channel competitive systems in the same geographic area and relying on technical means, cross polarization, beam directivity, shielding and other means for permitting multiple operations in immediately adjacent geographic areas.

Here let me digress a bit to make a technical point. One of the principle features of AML is its economy in the use of Radio Spectrum. The system employs single sideband, suppressed carrier Amplitude Modulation--not the most sophisticated modulation method--but for the purpose of local distribution of Broad band signals where relay operation beyond one or two repeats is not contemplated--is quite adequate for the job. The beauty of this feature of AML is that the ratio of the modulating frequency band to the RF spectrum occupied is 1:1. Thus a 6 MHz television channel does not require more than 6 MHz of the Microwave spectrum. More sophisticated methods of modulation undoubtedly can boast of greater fade margins and lower noise--but they pay for this by occupying radio spectrum which is 5 to 10 times greater than the modulating band width. If these extra performance features are not required for normal local distribution service, why, we reasoned, jeopardize the possibility of obtaining FCC authorization for the service.

But even the 1:1 modulation ratio of AML was not sufficiently persuasive. In May 1968 the FCC, without prejudice, denied the Corporation's petition for rule making to allocate permanent frequencies for the AML Equipment. The basic reason for such action, as I understand it, was not opposition to the service but rather a desire to review the possible international needs and broad service category allocation of the entire 18 GHz band for satellite transmission. The time table for this review included suggesting the subject be part of the agenda of the World Radio Conference which is scheduled to be held in late 1970 or early

1971. While I believe that that conference will give due recognition to necessary terrestrial services as a vital adjunct to space communication, I do comment that that is a terribly long time to wait to find out if we can satisfy a demonstrated present day need.

That is a dark picture--but I am happy to end this report on an optimistic note. When it became apparent that allocation action at 18 GHz might be long delayed--we carefully examined other portions of the spectrum where AML might be successfully applied. We had earlier examined the band from 12.7 to 12.95 GHz where CATV operation had already been approved and rejected it. We rejected it on the basis that the band was too narrow, too fragmented and with rules too directed towards inter city service, to be useful for our purpose. I believe the thought of that beautiful 2000 MHz of unused spectrum at 18 GHz may have clouded our vision.Now we re-examined that the CARS band and on November 26, 1968 Hughes Aircraft on behalf of Theta Com filed a request with the FCC for an advisory opinion as to whether AML equipment could be licensed under existing rules in the 12 GHz band. On Feb. 14, 1969 the FCC proposed rule making and invited the filing of comments looking toward the modification of the applicable rules to permit use of AML equipment in the 12 GHz band. Comments supporting and opposing the proposed rule making were filed March 14, 1969. Reply comments were filed by April 14, 1969 - Now it is up to the Commissioners. At last we are getting action--and we are very optimistic.