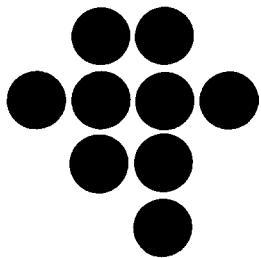


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THE FIBER OPTICS LOCAL LOOP FIELD TRIALS
EXPERIENCES TO DATE AND FUTURE POLICY QUESTIONS

September 21, 1989

Seminar Notes

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Seminar Notes

John R. Palladino, Bellcore
Robert Pepper, Federal Communications Commission

Pierre Humblet, M.I.T. (session moderator)

Antonio J. Botelho, M.I.T., Rapporteur

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This session of the Communications Forum dealt with the complex economic, policy and regulatory issues arising from the near term deployment of local loop fiber optics. The speakers also addressed the relationships between technological choices, the pace of deployment and policy issues. Numerous questions were raised about the trade offs between regulation, diffusion and pattern of competition.

Pierre Humbert, Associate Professor of Electrical Engineering at M.I.T. opened the session and introduced the speakers.

The first speaker, John R. Palladino, District Manager, Optical System Deployment Studies, Bellcore, gave the audience an overview of the multiple issues involved in the near term deployment issues: 1- services, 2- architectures, 3- technology, 4- engineering and OA&M, 5- economic, and 5- regulatory. He pointed out that his focus was on the so-called fiber to the home (FTTH) local loops, which would also include small businesses in nearby residential areas.

Palladino opened his presentation with a brief description of the kinds of services the loop will perform: Plain Old Telephone Services (POTS), Video (Broadcast or Switched), and combinations of both. He remarked that the combination of POTS & Video & Upstream video as well as Future Services would not be covered in his talk, because it is not seen as a near term possibility. He noted that the average residential customer would not need

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most of the capacity currently available, and that probably the only service that would require this capacity would be video, the real service driver for bringing fiber to the home.

Palladino went on to comment on architecture, remarking that the focus is on the distribution part of the system. Beyond the two generic architectures, bus and star. Palladino mentioned that there is fiber-to-the-home and fiber-to-the-curb scenarios. The advantage of the latter is that you can get some sharing among a small group of customers, bringing cost per customer down. The most important consideration here, he remarked, is that the system not only be inexpensive but also upgradable to provide future broadband services.

He went on to note that a variation of the bus is the ring, which has the advantage of survivability. However, he noted, its high cost would preclude its use in the distribution network. He pointed out that star architectures allow combinations, giving as examples the one and two fiber star (refer to exhibit 1). He then briefly explained two kinds of bus architecture: coupler/service access point and bus service access point (refer to exhibit 2). The later has the advantage of allowing for a larger bandwidth per customer. He went on to point out that here one can compare the advantages of switched over broadcast video, with the former limiting the bandwidth requirement but also limiting the number of channels that can be viewed simultaneously. But switched also provides billing and privacy advantages,

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and is a gateway to the video library concept. He suggested that you can also have a hybrid.

Next, Palladino briefly compared the star and bus architectures, pointing out that they have contrasting advantages and disadvantages. For example the operation of a bus architecture is more costly and complex than that of a star architecture, while the fiber cost per customer of a bus is smaller than that of a star. The bus is also at an advantage in the cost per customer for the remote terminal.

Palladino went on to contrast the fiber-to-the-home with the fiber-to-the-curb architecture. He showed that the former is more environmentally stable and more easily upgraded. In contrast, fiber-to-the-curb has low installed first cost (IFC), a powering advantage to the subscriber (primary and backup powering are provided by the network), and reduced regulatory issues.

Palladino moved on to briefly discuss the technology. He remarked that broadcast offers greater channel selection flexibility, larger simultaneous channel availability and somewhat higher reliability due to the absence of switching equipment. In contrast, switched technology offers greater network control, allowing options of pay per view and billing arrangements, almost unlimited system channel capacity and lower source/receiver requirements. He moved on to contrast analog and digital, remarking that the laser itself favors digital, which has long term network objective

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compatibility because less demand is made on the linearity requirements for digital. He then briefly touched upon the advantages of FM and AM.

Next, Palladino provided the audience with a short discussion of the engineering and OA&M issues. Palladino remarked on the importance of existing planning tools and support systems (inventory, service orders, maintenance, etc.) used with FTTH and that these must be capable of being upgraded when the system is upgraded.

Palladino went on to a discussion of economics, setting the stage for the next speaker. He cited some cost considerations to be weighed in the deployment of FTTH. He initially remarked that the fiber has to be put in at a cost that is on par with copper and offer existing services. He summarized his point by stating that fiber has to go in at a cost that can be supported by today's revenues with the ability to upgrade at a reasonable cost to provide services that will generate additional revenues.

He stressed that telcos cannot put in fiber at a cost that exceeds the level of today's revenues speculating that in the future they will provide CATV service or advanced services.

Palladino showed that the installation fixed cost (IFC) is a function of several factors. It is dependent on architecture and on the technology deployed. Palladino also remarked that there is a trade off between a

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desert "start" and a rehabilitation/reinforcement of existing systems. He went on to call the audience attention to the fact that the total cost includes the IFC plus ongoing maintenance and administration costs and that this should be covered by total revenues. He stressed that it is the profit that has to be looked at. He proceeded to talk about the long range costs of fiber alternatives, showing that they will be roughly equivalent in the future, but that, however, capabilities and timing vary considerably. That is as fiber deployment increases costs will come down because of the fiber optic system learning curve. He noted that fiber broadband access costs \$5,000 dollars now, but that its projected cost would fall to almost one-third.

The last set of issues addressed by Palladino were regulatory issues. He noted that CATV industry is an unregulated service whereas telephone services are regulated, and that as these services are brought together it will raise a series of cable cross ownership regulatory issues. Related issues raised by Palladino were ownership of the optical network unit (ONU), how are primary and back-up powering optimally provided, and privacy.

In his concluding remarks, Palladino sought to answer the question "are we ready"? His answer was that yes, we are ready. He mentioned that several trials by a variety of vendors deploying different architectures and technologies are under way providing a range of services (refer to exhibit 3). He signaled that because we are here talking about communications for

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telephone and television, multimode fibers will not have any place in the telephony communications world of FTTH. In relation to that, Palladino went on to stress that if we want to get down the learning curve due to volume deployment we cannot rely on "desert" start; we have to get on rehabilitation and reinforcement business. It is not yet clear how best to do that.

Palladino summarized by saying that even though all these trials were not the cheapest way to go, they were not made on a cost consideration only basis, because they mostly provided for learning about technology, about developing new partnership arrangements (between CATV companies, contractors and telephone companies), and about the engineering side of installing the system. It is also getting the regulatory bodies to begin thinking about some of the issues and concerns to be handled in the delivery of video services over fiber.

Wrapping up his presentation, Palladino emphasized once more that economics is the key to achieving mass deployment and that in this context rehabilitation is the key. He also emphasized in the guise of summary that architectural choices impact economics and upgradability, that services definition is significant to the architecture choice, that operations technology must be part of system design, and that finally, regulatory issues may significantly impact costs and revenues.

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The second speaker, Dr. Robert Pepper, acting Deputy Chief, Office of Plans and Policy, Federal Communications Commission (FCC), former director of the Washington Program of the Annenberg School, focused his talk on two sets of issues driving the question of fiber optic deployment in terms of the public policy debate: 1- policy and regulatory issues affecting fiber optic deployment in the loop, and 2- regulatory and policy issues arising from fiber deployment.

Before going into his presentation, Pepper introduced a footnote to expand on Palladino's list of Bell Operating Company FTTH trials, by saying that the most notorious trial, at least from the CATV industry perspectives was the GTE Cerritos, California trial.

Pepper opened his remarks by stating that there are two issues driving the policy debate in Washington. First, the question of infrastructure. The issue here is of how to modernize our telecommunications networks in order to keep the United States competitive. The second issue driving the debate is what has been characterized by an industry observer as the unregulated cable monopoly. The question here is what you do about real or perceived rising cable prices, poor cable service quality. Pepper then mentioned that here one of the options being discussed is increased competition. He went on to assert that these two issues are coming together in the fiber debate.

Next, Pepper, said that in addition to the economic questions and barriers

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Palladino talked about he would address two sets of barriers: regulatory barriers and competitors using the regulatory process to their own advantage. He observed that the regulatory process has an overabundance of process, which essentially allows opponents to slow competitors through administrative procedures.

Pepper then stated that there are a series of regulatory barriers to the Fiber to the Home (FTTH) deployment. First, regulatory measures limiting local network modernization/replacement. Here, he said, state regulators have depreciation policies and requirements for state regulatory approval that may slow the deployment of technology. In this regard he cited the cases of California and Florida, where the CATV associations went to state regulatory commissions with Bellcore numbers for the cost of fiber in the loop to oppose local telephone companies deploying fibers. In short, he said, these CATV people are making use of depreciation procedures and regulatory proceedings in trying to create as many obstacles as possible.

Pepper, in contrast to what Palladino had said earlier, stated that future services are very important, because telcos will have to make the case to state regulators on the basis of future services. To support his assertion, Pepper said that one has to look at history where new capacity and functions, not necessarily new services that have often failed, have led to new services. In this respect he offered the example of direct-dial long distance services, by saying that it would have been almost impossible for

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telcos to justify that service today on a strictly cost basis.

In the context of state regulatory commissions, the next issue Pepper addressed was that of who pays for fiber optics? How do you protect rate payers? His answer was that Paladino's model (which says that incentives for deployment must be compensatory, that is, you cannot do this until you have the services that generate the revenues that cover the cost), is the old model where the rate payer bears the burden. In the new model, he elaborated, the burden should be turned to the firm, to the shareholders. Here companies should be bearing the risk, they have to believe that investing in infrastructure today will lead to increasing future revenue.

Pepper went on to describe an additional set of regulatory barriers, including the cable/teleco prohibition and the MFJ BOC line of business prohibitions.

He first summarized the evolution of FCC's Telephone/Cable Crossownership rules, stating that essentially these rules state that telephone companies can only provide transport and cannot provide cable services directly. The phone company cannot even function as a banker to the cable company and may not engage in any other sort of partnership arrangement with local cable companies. Furthermore the transportation services provided by the phone company must be at an compensatory basis, that is the telephone company cannot operate it at a loss.

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Pepper stated that although cable companies could in principle lease transmission from the common carrier, which would be cheaper than building their own system, in reality this does not happen. The reason is the common carrier obligation to provide access to anybody, which means competition. Thus, he argues, it is irrational for the cable company to ask the phone company to put in place a fiber optic network that will create competition.

In relation to the MFJ BOC line of business restrictions, Pepper cited information service and the issue of what is long distance service. Here he gave as example Justice department's blocking of Bell South's operation of a satellite dish to receive interstate video signals for local cable system, arguing that it was long distance service. The solution found in this case, forced Bell South selling the dish to the local cable company which receives the interstate video signal and hands it back to Bell South, would not work on a large scale.

Pepper went on to address another regulatory barrier employed by competitors, the FCC's Section 214 Certification Process, an application for authorization of service. He remarked that Section 214 provides another opening to competitors to forestall competition through a slowdown in the approval process. He then concluded that the regulatory process in itself can become a barrier to entry to telcos wishing to provide video transport service to cable operators or video programmers.

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He stressed that the next barrier was perhaps the greatest barrier to competitive offering of video through a phone network, thus dampening demand for a broadband fiber loop. That is, the requirement that all video programmers delivering services to local subscribers must have a local franchise. The requirement is rooted in the old technology where the cable system, the video provider and the transporter were one and the same. In the future, however, Pepper indicated, this would not make sense because the provision of video programming would be merely dialing up and accessing line. He believes that the franchise requirement for programmers leasing common carrier transmission probably is unconstitutional in that world and may be overturned. But, he remarked, that today the requirement is still in place blocking the entrance of new video programmers. that would for example want to provide a nationwide dial-up video access through a fiber network. The company would have to go to more than twenty thousand communities across the country!

Next, Pepper, moved to players and their stakes. He started by saying that the only incentive to telephone companies to put in place a new broadband fiber network faster than the average rehabilitation rate of 2 percent per year, is to provide new services that will generate new revenues. The question is, he noted, is who is going to "prime the pump". The telephone industry has argued that there needs some ability on the part of the local exchange carrier business to prime that pump. That is upsetting the cable companies because the telephone companies would like to move beyond the

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"traditional carrier/user relationship in providing video programs.

Pepper added that there also question of within region and outside region. Here he cited the case of PACTEL, which wishes to buy a CATV systems in Chicago, but will have to get approval from Judge Greene in Washington.

He noted that this ties up with the question of buy versus build or the question of a shared monopoly. If telcos are permitted to buy existing CATV companies, how does that increase competition? Will we see greater competition among local CATV companies and telcos fiber in the loop or will we see nice cozy deals between these two industries and a consequent reduction of competition?

Pepper then proceeded to explain why CATV industry has most to lose from FTTH. First, in the short term, the CATV industry has the winning competitive advantage over the telephone industry, because they are vertically integrated and have much greater marketing experience, particularly lacking in the telephone industry. In the long term, however, what upsets the CATV industry is how to manage Wall Street. He explained that with new competition CATV company market price for a system might decline to close to replacement cost per subscriber, against 3 to 4 times replacement cost today, and neither the shareholder nor lenders will be happy to see that happen. Pepper noted that the CATV industry is moving, and that there have been a number of recent proposals in Congress to

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reimpose rate regulation. Pepper believes such regulation would inhibit infrastructure deployment and cable industry upgrade. In this regard, he cited estimates that one needs production volumes of 1 million optoelectronic units a year to move the loop technology cost curve to the point where it crosses with copper.

Secondly, Pepper hinted that the out-of region telco deals are in fact the flipside for the CATV companies, because they will sell to the telcos at high prices, and thereby reduce the incentives for telcos to introduce competitive networks on their own.

Pepper then stated that the one group which is the wild card in all of this are the broadcasters, who have fought CATV for years. Broadcasters are still a single channel video provider in a market that has become a multichannel market. It is very difficult for them to compete. The "must carry" rule proposed by broadcasters has been overturned by the Courts, although there may still be some attempts in Congress to revive it. Broadcasters see the opportunity to bid CATV against telcos and try to get a better deal. Yet, they are scared about the possibility of a telcos' TV. Pepper noted that some observers have said that the broadcasters are really programmers and should be happy to have alternatives pathways to the home. Broadcasters very much fear increased competition, that might reduce their scarcity values. In general, broadcasters have favored competition from telcos where there are CATVs, but not where there are none.

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He moved on to briefly describe other players in the arena: Hollywood producers and distributors, mainly independent ones; large and small users; and equipment manufacturers, who depending where they are in the production range will have different interests.

Finally, he talked about the regulators, at federal and state levels. He said that he does not believe that the way regulation is done today is sustainable in a future of integrated fiber networks, with video transport being the first service. He argued that we may see states preempting municipalities where there is an integrated fiber network system in place. Or we could see bifurcated regulatory regimes, split between municipal, state and federal levels, but with nobody regulating the provision of content per se.

The problem, he pointed out, is how in the future digital world will one be able to say what is audio service, what is text service, what is video. All are bit streams that will be reconstituted in different forms. It will be very difficult to have different rules.

The next set of issues covered by Pepper were regulatory issues arising from FTTH: state/federal jurisdiction and cost allocation and pricing. In relation to the first set Pepper said that it raises issues of channel service approval and network modernization. In relation to the second set, he mentioned problems of jurisdictional separation, cost allocation and

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pricing.

Pepper stated that jurisdictional questions of who gets to decide are going to intensify. He believes that the way we do business today will change in the future with integrated networks. For example, digital pipelines controlled by users, analogous to electric services, will raise the problem of defining the service, deciding who approves that service, how and who assigns cost, and determines pricing. And through the jurisdictional separations process how do you figure out what is an intrastate cost and what is an interstate cost. Some of these issues have started to be tackled in relation to narrowband ISDN, and these problems will be exacerbated with broadband network.

Pepper then stated that the questions of safeguards are crucial. How do you prevent discrimination and cross subsidies. He explained that the FCC approach has been to take the telco at its core as a common carrier with related obligations. He noted however that the only question here should be whether the telco can also be a customer for its transport service. Under the current rules, telcos are obliged to provide transport to any video programmer who wants access, what would discourage bundling of content and transport as it occurs today in cable.

According to Pepper, that leads to another question of to what extent, if any, common carriers have First Amendment rights. He said that may lead to

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a catch-22 situation. wherein because cable is not regulated, if phone companies are allowed to get in we may not be able to regulate them as a comon carrier, so we may be better off not to let them in at all.

Finally, he briefly mentioned the question of audiotext censorship. In the audio world, telcos do things that cable companies do not do in the video world, i.e., they become agents of government to censor adults programming. One reason the cable industry is successful is that they can show movies that are not cut up. Their right of speech protected under the first amendment when adult in nature, whereas such movies are banned from broadcast as indecent. He added that copyright here is a major question; e.g., does the compulsory copyrighting pertain to the telephone industry?

Pepper concluded by saying that he believes that the political policy debate will ultimately turn around the social policy questions. Today, the burden of proof is on the telephone industry to show that there are all these new services and benefits. This is in order to protect rate payer; i.e., why should the user pay for something he/she does not want, do not need, do not care about. That goes to the point made above about state regulatory arenas approving the deployment of the technology. He asserted that it may become a social equity question, if new services develop why not everybody, in the inner cities and old suburbs beyond the "desert areas" where technology was first deployed, can get these services. He thinks that the overriding policy question in relation to fiber is whether we are going to be

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able to move forward or forced to stand still, and how will it affect national infrastructure and national competitiveness.

In the folowing question & answer period, Pepper in reply to a comment on the relationship of cable/telco and on open architecture, said that one-way video is not covered by current rules of Computer II and III. He said that in cable/telco we talk about ONA-like or Computer III-like safeguards. His next reply to a comment about the broadband applications, for example the possibilities for educational services, was that we will see a lot of it. including medical services and in the commercial side, personal advertisement as already done in print. He foresees viewer-specific information in an interactive way using very high quality imaging. Palladino added that you already have ability to do local advertising in local television.

The next question explored the analogy of the bus architecture with the old telephone party line, to ask which level of technology do we need to start it, arguing that perhaps the video equivalent of party line can be good enough. Palladino, replied that the analogy is not perfect, because in the bus the user has 100% availability of POTS, and that did not occur in the party line. Pepper added that if the only reason for fiber is video entertainment, it is not a good one. He said that the real question is how fast will fiber be deployed.

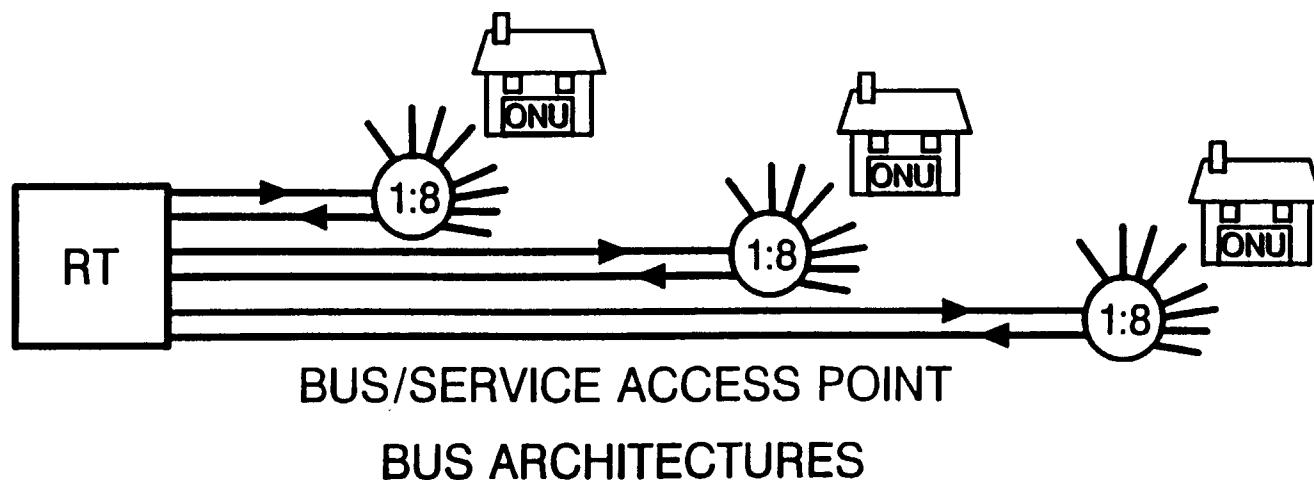
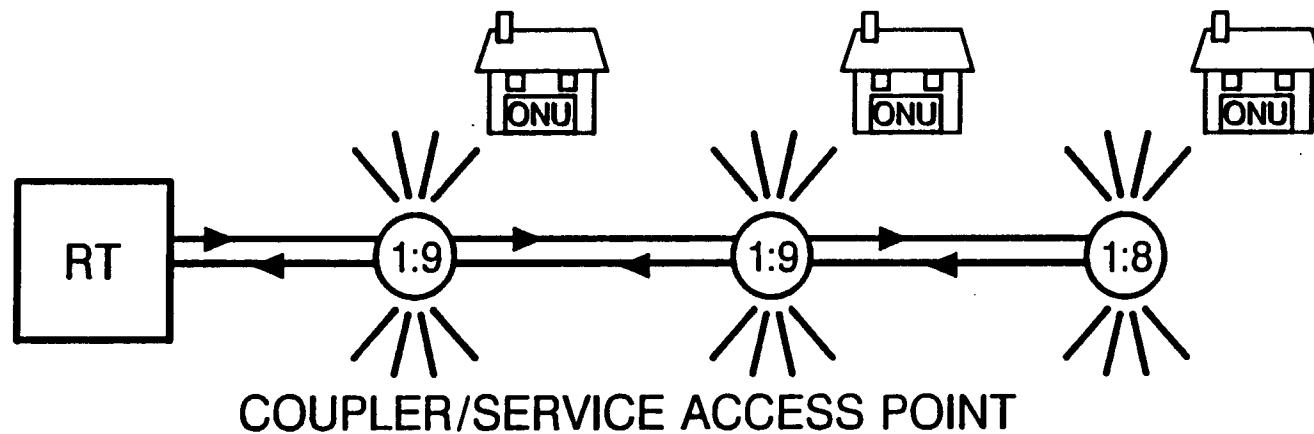
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The next question asked how can you put an infrastructure that allows you to experiment with new services? Pepper's response was that it was also a risk sharing risk bearing question: who takes the risk? The telephone industry has argued that one of the reasons that you need fiber that can only be provided by the phone companies is that you really need "true video on demand". a huge jukebox on the sky. The question is whether near-video-on-demand is enough to satiate demand. Responding to a further question, Pepper stated that choice versus price is the real question in this debate. He said that since CATV can provide near-video-on-demand at a lower cost than telcos. which may affect potential revenue streams and the timing that could lead to the so-called jukebox-in-the-sky by telcos. In response to a question about standardization of fiber, Palladino said that we have to differentiate between standardization and generic requirements. He also argued that at this point the danger of standardizing too fast and too far is that we could stifle vendors' innovativeness.

The next question addressed the regulatory issues of a special type of fiber-to-the-curb, which allows the customer to use a cordless phone to make calls based on a remote terminal broadcast radio sitting at the curb in a residential area serving 8-20 homes. Pepper commented that such regulation could probably be overseen by several bureaus within FCC.

Fiber To The Home

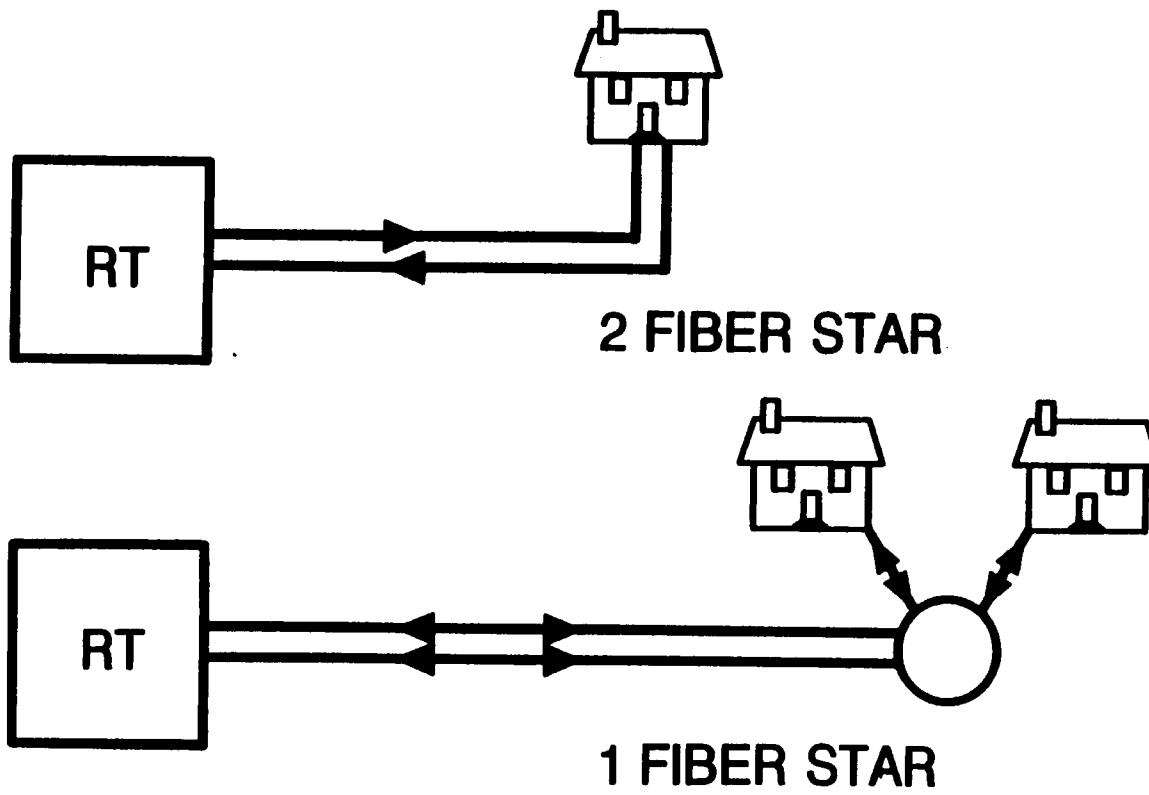
Architecture



MRE89 CJP233.005

Fiber To The Home

Architecture



STAR ARCHITECTURES

MRE89 AJP233.006

Fiber To The Home

Trial Activity

<u>LOCATION</u>		<u>FIRST SERVICE</u>	<u>VENDOR</u>	<u>SERVICES</u>
Southern Bell	Orlando, FL	4Q86*	AT&T (1)	CATV Transport
	Phase 2	2Q90	AT&T (2)	POTS & CATV Transport
Southwestern Bell	Leawood, KS	3Q88*	AT&T (3)	POTS
Southern Bell	Orlando FL	3Q88*	NTI	POTS, ISDN
	Phase 2	3Q89*		CATV Transport
New Jersey Bell	So. Brunswick, NJ	3Q88*	AT&T (3)	POTS
South Central Bell	Memphis, TN	4Q88*	AT&T (3)	POTS
U S WEST Communications	St. Paul, MN	3Q89	AT&T (3)	POTS
	Scottsdale, AZ	3Q89	AT&T (3)	POTS
	Phase 2	3Q90	AT&T (2)	CATV Transport
Bell of Pennsylvania	Perryopolis, PA	1Q89*	Alcatel	POTS,CATV Transport
New England Telephone	Boston, MA	4Q89	Raynet	POTS

* In Service as of 9/1/89

(1) AT&T prototype (2) AT&T "Phase 2" (3) AT&T "Phase 1"

MRE89 CJP233.009