

The Policy Implications of End to End

December 1, 2000

Stanford Law School Center for Internet and Society,
Stanford, CA

Panel 1: David Eisenberg and Scott Bradner, Harold Feld and
Francois Bar and Bob Pepper

LARRY: Excellent. So we are now are going to start with our first panel. And the first panel is going to be David Eisenberg and Scott Bradner, Harold Feld and Francois Bar and Bob Pepper.

Okay. Now the objective again of these first four panels is to work through particular problems as they apply to the structure. And the general question we're going to be asking through this is a question that I wanted to ask Jerry, but it was already enough to ask him to give this impromptu speech. Why do we want to organize it in this particular way. what is it we're getting from it. And one set of those why's is answered by technical things. And another set — I'm sure the policy of the lawyer types — we'll see a bunch of policy reasons why it's a good idea to organize it like that.

But that's a set of questions we're going to be talking about here. Now, the first panel is discussing this question of how to supply voice communications over Internet protocol technologies. And we're going to start with Scott, who's going to lay out for us two models for achieving this functionality. And relate that to the e2e argument. So Scott Bradner.

SCOTT: Okay. I'm going to use out of the Internet Engineering Task Force activities. Because in the IATF, we actually have example of both models being standardized at the same time.

The models in a simplistic way can be said to be core driven or edge driven. The traditional telephone world, the traditional telephone network consists of large switches or smaller switches — which is PBX's. But let's talk about the large switches first.

Class five type switches and then telephone central offices. And very stupid instruments sitting on the edge that are connected to these large switches. Your telephone can talk to that switch and that's about it. it can also make funny little noises which can go through the network to the other end. But that actually seems to have been a mistake.

They were supposed to go to the switch and then get stopped. But technical reasons actually made them go through. So, we have this model of this large switch which is being run by an organization such as a telephone company. And these very dumb instruments at the edge. So the instruments are a capturer of the large switch.

When you're rooming [phonetic] to voice-over IP, you can replicate that environment. And the Megaco [phonetic] activity — the Megaco working group in the IATF which is also in parallel to an ITU activity in study group 16 — has produced such a model. It is a very large server which talks to relatively stupid phones through gateways. And they're not terribly intelligent gateways. When you pick up the phone, it connects to the server and the server does your bidding.

You command the server to make a call and the server places the call. In this model and in the other model — which I'll get to in a second — the signaling of who you want to talk to or what command you want to give to the switch, are separate from the data path.

The data path is actually encapsulated voice. They are separate things. In the Megaco model, the signaling goes to the phone switch. And the data goes directly to whoever you're talking to. Or to a gateway if it's going to the rest of the PSTN world — the regular telephone world. So the Megaco model is large servers talking to dumb phones.

Another model is the SIP model — the Session Initiation Protocol model which is actually almost identical as this level to the ITU's H23 model. And that is that the phones themselves are intelligent end points. They don't require large servers. Though they can be constructed to use them, they don't require them.

So, for example, in net meeting in Windows, you can talk to somebody else using the net meeting machine without anybody in the network being aware that you're doing so. The signaling goes e2e and then the data goes e2e. This can be facilitated by servers in the network which can be from very lightweight ones which — if I want to talk to you, my telephone contacts that server which will re-direct it to you based on time of day or the phase of the moon. Or whatever your mood or whatever.

But they don't require that. It's an e2e — the zip model, HP23 model can be totally e2e with nothing in the network being aware that this is a phone call going on. The Megaco is that the phone talks to the server. The server then executes the command.

And that's the course picture. And just to repeat just a little bit that the zip model — the zip technology could be used in either model. The zip phone could be set up so that it only talks to a large server which then executes and forwards on the commands.

So with zip, you could have both models. With Megaco, you can have only the centric based model.

QUESTION: So with the smart ends, they can pretend to be dumb. But the dumb ends can't pretend to be smart.

SCOTT: Actually, it's not so much that the zip phones can pretend to be dumb. It's that they can relay all of their requests through a agent which can then interpret or modify or restrict them.

QUESTION: Now, David Eisenberg, smart and dumb is something you talk about a lot. Why would we prefer one model over the other from a technical perspective?

DAVID: Maybe I'm a little bit jet lagged. Why would we prefer...?

LARRY: Talk into the microphone, David.

DAVID: Okay. If you have an intelligent center, it came about because through — well, the current intelligence center of the telephone network came about through a long series of historical accidents that started at the very dawn of switch telephony [phonetic] where you had a human operator sitting there and making a physical copper to copper connection.

And that grew up around this one application of fundamentally voice conductivity. And everything that a telephone company did following that was emulating that expensive job of call set-up. So it went from an operator based call set-up where an operator could do fifty — maybe a hundred calls an hour to an electro-mechanical switch and then to a stored program control switch.

But the whole system design had the application — the application was pre-conceived, pre-wired. It became very difficult...

[UNRELATED DISCUSSION]

DAVID: It became — let's put it this way. Given the focus on one-to-one voice conductivity that grew up — that formed the core value proposition of the telecom industry, any other innovation such as the ability to do e2e touch tone signaling using DTMF tones — which Scott's absolutely right. That happened entirely by accident.

But it allowed a customer at one end to directly control a device at the other end of the network. That was an accident. So were

modems from the point of view of this centralized architecture. But human creativity conquers even centralized architectures. But it can't conquer them quite as effectively as if you'd designed the architecture for flexibility in the first place.

QUESTION: So, from a technical perspective, you're saying that by non-centralizing the architecture, you enable lots more — as you said — human creativity about how to use the technology.

DAVID: Right. Exactly. And so if you look at, for example, the kinds of innovations that the telephone company wanted to do that they've been working on — a picture phone, for example, since 1962. And picture phone still isn't a killer app [phonetic].

But because somebody in the telephone — or a lot of people in the telephone company thought that — well, if you can listen, then looking and listening has to be even better. And there has to be even more money in there. But, in fact, no matter how hard they work on it, picture phone still hasn't become a killer app.

Meanwhile, there's this whole other parallel thing that's happened in the internet where, because it's de-centralized and relatively [??] thanks to David Reed and Jerome Saltzer and David Clark, among other people who had the foresight to keep the middle simple, stupid — we've been able to discover new totally unanticipated applications like e-mail. Completely unanticipated.

Web browser. Completely unanticipated. HTTP and more recently, things like audio on demand and p2p and perhaps video on demand.

LARRY: Okay. The design of this is not that these are the only people who have to talk. So, if people want to push the other side of this or jump in, please let me see this. Jerry, did you...?

[UNRELATED DISCUSSION]

JERRY: One of the things that this paradigm raises is the question of where are the ends that we're going to apply. And in both of your designs, you described the idea that you're working on...

DAVID: They're ends.

JERRY: The internet is in the middle. And from the point of view of the bottom two or three or however many layers you want to describe the internet as, everything is all at the end. That is the — in one case, it's switches talking to switches over the internet, but the internet's [??]. And in the other case, it's computers talking to computers and not switches. So the application of the end argument is not immediately obvious. Already it has been

applied to the function has been pushed out of the internet and is at the edges. And so the question that's being raised is slightly different — mainly once we've gotten up into higher layers, should we re-apply this end argument again?

QUESTION: Is there a principal here that should be applied at a higher layer?

DAVID: I think there are probably different edges of the network, depending on which layer you're talking about. But I have a hypothesis and I'd love to have it knocked down because I haven't explored it very deeply.

My hypothesis is that the edge of the network is where the payload of the IP packet is opened. And the contents operated upon.

QUESTION: This problem of ends — several dozen of the features in the [??] which today are the benefit [phonetic] of the FBI and for wire-tappers. And these are lawful, legitimate ends. We may not like them, but they are definitely ends. And our Congress — yours and mine — passed a law requiring similar intelligence to put in a wireless network so they could do locator technology. Just as a technical matter — and I'm not arguing about whether these are good ends or we ought to be promoting them — I would like somebody to tell me exactly how your intelligent edges, dumb middle will let the director of the FBI go after the people who they're lawfully allowed to go after. Doing his end [??]

[UNINTELLIGIBLE]

PANELIST: That actually makes a nice segue into something I wanted to bring up. Which from a policy perspective is the law of unintended consequences. The entire idea of wire-tapping is an outgrowth of the original historic centralized architecture where it was discovered early on that you could insert a listener in between. And could hear what was going on.

And what quickly was sort of an interesting feature of the old system became embedded in the legal and policy structure so that now we find ourselves living with a consequence where we are forced to sort of graft this feature of the old system onto the new system.

In answer to your question from a technical perspective, I'll leave that to others. But from a policy perspective, I think that one of the questions that arises then is how much and in what fashion are these laws constraining the development of the technology — and that's a question that we're all I think wrestling with.

LARRY: Scott, did you want to answer the technical part?

SCOTT: Yeah, the technical part — if the law says as it does, as you described, that there is legal intercept, the e2e model does not make that easy. And at whatever stage you're talking about. The closer you get to the consumer, the harder it is to find a place where you can pick up all the information.

Even if you can find a place, the e2e argument for it — my intelligent phone talking to your intelligent phone — those intelligent phones can do encryption. So even if you could find the data in the middle, you still couldn't necessarily take it apart.

And remember as I mentioned, the signaling takes a different path than the data. So even in the Megaco model, there isn't a place — a single place where you can go and watch the data go by. Watch the voice go by. You can get PIN [phonetic] trace information from the server — from the Megaco server. Or from a zip proxy.

But you don't have a single place in the network or even a number of single places in the network where you can go do that lawful intercept. So there is no question that this model makes that type of activity much more difficult. And the question that can be turned around — should a requirement for being able to do that enforce a particular technical architecture on the network?

LARRY: Barbara, did you want to...?

BARBARA: It's not in direct correlation to this, but I thought that maybe I would ask you what types you — find out what the [no mic]. And the provider of the service. And if you start, for example, with the application development in the centralized model, if you want to change the way callers [??] or you want to add a new feature, then if you are someone who is not related to the phone company or the voice provider, it's very difficult to have that because all the functionality is sitting in the middle and is controlled by a centralized organization. Whereas in the more centralized model, everybody could change his or her own software [phonetic] on the smart [??] device. [no mic]. And this is one of the reasons why there are people saying that an [??] model does [??] innovation.

PANELIST: This is a very important point. Mark Gaynor was sitting here as a PhD student at Harvard and is looking at this in his thesis. There is a — certainly a ease of experimentation in the edge model. There is not an ease of management in that experimentation. What that yields in parlance of some — Virginia Pastral [phonetic] and her book "The Future and Its Enemies" — talking about this as chaos. It yields chaos. It yields unpredictability.

The planning cycle in telephone companies used to be ten years, twenty years because they knew just what was going on. That phones were growing at the rate as people do. They don't grow that fast, so very predictably in all of that — and the set of innovations are rarely completely defined by a small keypad with no particular other activity. So you've got a very good clean and careful definition of what voice is.

If what we were trying to do is continue that definition of voice, then where the service was being offered and the difficulty of doing innovation wouldn't make any difference. But we're not doing that.

We're in an environment where we're re-defining what voice is. We're re-defining what voice service is because we're no longer confined to a twelve button keypad. We are now having internet conductivity in there. We've got browsers. We've got a lot of other things that can re-interpret what the voice world is. What the very fundamental definition of a voice service is.

And that model — in order to have rapid development of alternatives to what that new voice service is, you need to be able to innovate. And it is clearly much easier to innovate at the core. But it's more expensive to manage it. So there's a dynamic there.

QUESTION: I'm sorry. It's much easier to innovate at the edge.

PANELIST: Yeah. Sorry. At the edge. And David is showing his red card.

LARRY: David and then Francois.

DAVID: Getting back to Peter's question which I think everybody raises, one of the really important questions here. It's important that — when I think about the e2e argument, it's important to think about the function as a function, not an implementation. It's not the means that — and quite often, this becomes the problem with regulation.

I don't know how the wire-tap law is written, but I suspect it's written as a means based regulation as opposed to a function based regulation.

PANELIST: Means based versus...?

DAVID: In other words, that in fact it says that switches should be defined so that there is a physical point in the network where you can extract PIN register information or voice data. That has the property and if you read the end argument, it's got this rather strange language that basically says if the function cannot be implemented in the network but can only be sort of at a higher level in the application — and in fact, the wire-tap

requirement cannot be implemented in the network — even in the old network. That if the interception requirement [phonetic] because if someone encrypts the phone call or uses relays that are entirely compatible with the old phone network, they can avoid the wire-tap and intercept.

And you might argue well, they won't do it because it's too expensive. Well, it's not too expensive anymore. It was when those regulations were put in place. And it didn't anticipate the change in cost of encryption, the change in being able to do encryption in software devices [??] and so forth.

So, in fact, even for the original architecture, this is kind of where I think the technology re-raises an old question and makes it harder. Even in that old regulation, the regulation was written without anticipating the change. So if you still want to implement that — even in the Megaco or zip thing — there's really no change in that situation. So you'd get to sit back and say who are the ends in this? The ends in that [??] definition of the application include the law enforcement function. They're another end in any conversation that has the — presumably the potential opportunity to intercept.

And what they intercept is the voice conversation. So I'm not going to take up...

PANELIST: Not necessarily.

DAVID: They don't want to intercept the bytes that the voice happens to be sent in because those may be — there might be 300,000 kinds of coding — all of which the FBI doesn't want to learn how to de-code.

So the problem is actually always around. And that end argument is merely an argument. This is why it gets tricky to conflate policy with technology closely. e2e argument still applies in both architectures. Where are the ends and where should we implement the function if you wanted to implement the function reliably — even in today's telephone network, you'd want to put the requirement at the phone instrument.

And basically say the FBI should be able to put in every microphone [phonetic]. The ability to send the signal back to the FBI if you really want a good implementation of that. And that wasn't practical in the original regulation. And, in fact, it might not have been through a policy means, practical because it recognized something that sounds much scarier than putting in a switch.

But, this is the point. Technology changed — even changes the old means based regulation into something that doesn't work

the way that [??] that it does. Actually, the real critical version of this is the wireless network where we create a legal fiction that we pretend not to listen to each other's cell phone calls, even though they pass through our physical [phonetic] environment.

LARRY: Francois?

FRANCOIS: In just quick reaction to this, the Andy's review [phonetic] his brain, right? So why shouldn't we let the FBI [no mic].

I wanted to come in on the earlier discussion about innovation. And maybe I'll take a slightly contrary position here in order to help myself, at least, understand better what this is about. I have a little bit of problem with saying there is a system that's centralized and that doesn't favor innovation. And one that's de-centralized and favors innovation.

I would be happier with a description that says there's a centralized system that favors certain kinds of innovation. And a de-centralized system that favors other kinds of innovation.

I have a hard time stating that nothing has been invented in the phone system between 1876 and 1969. And all of a sudden, in the '60's, innovation blossomed because we invented the internet. Maybe there is something about the intra-network which is just a reaction. Middle to middle network. And we have not explored those issues in the past. Now we're exploring them. Maybe we'll run into the end of the innovation potential of this. And at some point we'll say that we're willing to empower those middle guys because they have lots to teach us.

PANELIST: Those middle guys are there and they're empowered. It's the issue as was pointed out, is one of impactive innovation. In order for — if you're serving a hundred thousand customers on a box, when you want to change that box, you have a potential impact of a hundred thousand customers. You're going to be very careful about doing that.

And if the box has got seven million lines of code in it, it may take a while for you to code in some new feature. And the feature conflict resolution in phones which is a very big problem.

Whereas on a phone at the end, you might be able to download a Java applet [phonetic] which could provide an entirely new functionality very quickly and very easily. But it doesn't scale terribly well. But you can easily do it.

So it's not that the big companies are impossible to innovate with — it's just that they have to be more laborious of an innovation.

LARRY: More conservative.

PANELIST: More conservative.

QUESTION: But let me just follow up one particular part of this — if you were to distinguish between the kinds of innovations that are enabled by centralized systems and the kinds of innovations that were not enabled by [??], what's the distinction you're trying to draw?

FRANCOIS: I'm not sure what it is, but it has to do with system making innovation that's maybe — things that have to be coordinated among very complicated parts in a way as opposed to things that can manage themselves in a centralized fashion.

To take an example from another industry, I don't think you could create Concorde — to take a French example — an e2e model. That needs some kind of coordination.

LARRY: It needs better tires.

FRANCOIS: Yeah, exactly. And if you de-centralize the tires, you get into trouble.

COMMENT: I'd really desperately like to make a point at this stage.

[UNRELATED DISCUSSION]

COMMENT: But one of the issues that was brought out in this conversation that for me as an advocate is very important is not just an innovation in the technology, but a question of where the innovation on the — advocacy innovation or consumer concern — where that dialogue is going to take place. In a centralized core system, one of its advantages and disadvantages is it becomes very easy to make certain kinds of policy with centralized decision making. Now, that's sometimes very bad.

On the other hand, if you are an advocate, sometimes that is very good. In the old days, telephony advocacy used to be very simple. You cared about rates, you cared about universal service, you knew exactly where to go to have your issues addressed.

You went to the FCC or you went to your state PUC and the world was very ordered. In a de-centralized e2e universe, a lot of very interesting things happen about advocacy. Some of which are very good and some of which are very bad.

One of the interesting things that happens is you don't need as much central planning because suddenly if everybody is empowered to make their own decisions — as long as there's a basic functioning system that has that universal service characteristic, then I can leave it up to the individual consumer if he wants to get the video phone or the smart phone with its dozen features that interacts with his PC or whatever.

And all I've got to worry about is things like anti-trust concerns to make sure that there are enough good units out there for the people to buy and be empowered.

The bad thing, though, that happens is there are still certain kinds of advocacy issues that arise where suddenly there is a profusion of — and experimentation going on where it's not really sure where you should be directing your energies.

As an advocate looking at some of these things, you ask yourself — well, okay, I've got a limited set of resources. There are a lot of interesting applications going on. And each one, I might have something interesting to say and bring into that debate. But how do I know where to spend my resources and spend the capital that I've got to have the most valuable contribution?

Okay, so it makes it harder both for advocates and regulators to control the de-centralization.

COMMENT: No, it creates opportunities and challenges both in either architecture. But it's a very different set. For example, one of the problems in the core architecture for an advocate is very frequently the game becomes rigged because you have large players who know each other with much greater resources. You have certain leverages. But you end up in a situation where it becomes hard to effect certain kinds of changes that isn't true in an e2e.

So it's not good, bad, yes, no. But it's a change in the environment that needs to be considered.

LARRY: Okay. David Clark.

CLARK: I held up my confused card because it seems to me in this discussion of innovation, [no mic] of competition. And the simplistic interpretation of the end model means that it [??] the people who are committed to experimenting [no mic]. If in fact you have a player who has managed to interpose a server in the middle such that you can't bypass the server, that player is prevented to innovate and may be able to invent other innovations.

And if they're not mindful of the advantages of innovation or the [??] business as being served by failure to innovate, you don't necessarily make as much progress. It's important to understand that the layer model has a lot to do with this because part of what we did by standardizing the internet layer is to stifle [phonetic] certain sorts of innovation down there. And the advantage of that is that you can then trust it as an infrastructure of which you can innovate in a higher way.

LARRY: Trust it? What's the threat?

CLARK: Probability of evolution of the service on which we're standing. Innovating on shifting sands is very scary.

LARRY: But is it just shifting or is it strategic shifting that you're worried about? The sand acting against you?

[UNRELATED DISCUSSION]

CLARK: The sands from a paranoid perspective. But it has to be paranoid to be nervous. Quicksand doesn't kill you because it hates you. It kills you because it's indifferent. Indifference is enough to kill innovation and you can't trust it. So I think...

LARRY: Okay. Mark and then I want to see what the policy perspective — I mean, the regulator perspective is.

MARK: David it seems to me is taking a point similar to Francois. There is an economic literature and a long-standing economic debate over precisely this point. Right? You might sort of summarize it as arrow [phonetic] on the one hand and [??] on the other hand. All right, asking the question how are we going to get innovation?

Are get going to get innovation because we compete to do it and so lots of different people throw ideas at the problem and the best one sticks? Or do we get innovation because one company is in charge and coordinated and therefore has the economic incentive and the monopoly power. Right?

Now, I mean, this is not a debate that has an easy answer. It's been going on for a long time. Part of the answer is — and I think this is where Francois is going — it has different answers in different contexts. And the way we look at it in the pharmaceutical industry may be very different than the way we look at it in the software industry. And the way we look at it within one part of telecommunications may be very different than the way we look at it within another part of telecommunications.

I confess to being a committed Arovian [phonetic] or Arrowhead or whatever it is. But it seems to me that the way to think about it is to ask ourselves well, where is it that standardization's most important? And where is it that free flowing innovation is most important?

LARRY: So at the IP layer, standardization was David Clark's point, was critically important. Standardization was...

[no mic]

COMMENT: Good point. Yes.

LARRY: So that means you have to define.

MARK: The basic structure of the debate is — and I'm radically simplifying — Arrow says...

LARRY: Ken Arrow is a Nobel-prize-winning economist.

MARK: ...at Stanford says you get innovation through competition. That monopoly tends to make people lazy. It stifles innovation. And the way we get...

[Talk Over]

LARRY: Policy regulator perspective. Now, you've heard two very interesting things I want to pull out of the discussion so far. One is we can talk about e2e and its relationship to innovation, but we've seen already the ambiguity about whether it's technically e2e or whether there's a principle of e2e that's being applied to a higher layer in the application layer, for example. So there's — it's not even clear that we can talk just about the technical question. And we've also got to talk about the set of policy values that the e2e argument creates that might exist at any particular implementation or for any particular implementation.

As a regulator — and Bob Pepper has that role in some moments of his life, how do you think about this trade-off? And I want to keep it narrow again to IP telephony because obviously this innovation question is going to be haunting us the whole day.

PANELIST: One of the problems of regulation in this environment is that the legal process in terms of writing laws and then the regulatory administratively implementing them tends to be an incremental process. And that works fine when you're in a relatively stable technology environment. The technology environment that was stable from the 1870's or 1880's up through the 1980's.

Then you hit situations that are sort of non-incremental changes in the underlying technologies that creates all kinds of pressures that then either de-stabilize, which could be very good — existing law and regulation.

But then the problem is if you still have the existing law and regulation, it can then become a constraint on the innovation and technology and the applications. For example, the commission in the 1980's in the computer series — Computer 1, Computer 2, Computer 3 — rule makings created this constructive basic and enhanced. Basic was regulated; enhanced was not.

In '96, Congress did something sufficiently close and analogous to that that the Commission basically said it's the same thing —

and that was the Congress created to concepts information service which was unregulated and telecommunications which was regulated.

And we have this incredibly blurry boundary between information and telecom service. And it's not clear what the legacy regulation based upon legacy networks means. So, can I draw a picture?

LARRY: Please, draw a picture.

[UNRELATED DISCUSSION]

PANELIST: If you want to think about this in terms of the layered world, you've got sort of basic which is regulated, right? And then you have enhanced, which is not.

And in the traditional world, you had transport and voice tied together, inextricably linked through circuit switches. I mean, it's the way you got your enhanced service was by having a modem scream at another modem across this basic service where you're going over this voice network.

You've got TCPIP and then you've got your application link. Well — and that's sort of the legal constructs that we've been operating with. And it's been workable. But what happens when in the next world — in fact, voice just becomes one application. And so we're running this basic thing down here that's regulated. The stuff up here that's enhanced and not regulated.

Voice is now running as an application. Why should we be regulating voice at all? Right?

QUESTION: Because the FBI wants us to?

QUESTION: Because millions and millions of people depend upon it?

PANELIST: No. In fact, the question that you're raising is — you're making an assumption that voice provided over this is going to face a market failure and therefore the millions of people who depend upon it are going to somehow be let down if it's not regulated.

QUESTION: No, I'm not.

PANELIST: There's no empirical evidence for that.

QUESTION: I am not making that assumption at all. I'm sorry. What I'm saying is that one of the reason why we traditionally distinguished between things that were basic and things that were enhanced was we had core services that we regarded as so essential that we needed to protect them. We wanted to be this diverse.

QUESTION: Protect it against what?

QUESTION: Bob, this is really in your domain. Once again, I want to bring this back to real stuff that happens in Washington. About two hundred dollars per household, twenty billion dollars a year of money sloshes through the system...

PANELIST: You're right.

QUESTION: ...because of access charges. They're assessed a class four switches and they can be assessed there because they're a bottle neck and they're easy to measure, okay? That's quite a bit of money for a lot of people. That basically built the phone system of Alaska and Wyoming and a lot of rural areas.

So, nobody yells at me. I hate access charges. I think they're an abomination. But that's completely beside the point. I mean, we have, you know, 89 senators who want that two hundred dollars per household to keep moving. Who dares — technologist or otherwise — to say well, that's illegitimate and...

PANELIST: You're absolutely correct. But see what's happened — this goes to the issue of not incremental — you're confused.

[UNRELATED DISCUSSION]

PANELIST: But this is exactly the point where you have established [??] so the legacy universal service system with the internalized subsidies, long distance to local, business to residential, etc. — you know, sixty, eighty years, right? And sort of plod along.

They're on an incremental path to reduce the subsidies collecting access. We have this new proposal to take access charges down to about half a cent a minute on either end as compared to fifteen years ago when it was about seven cents on either end. It was fourteen cents to about a penny.

It's still arguable how much of the half cent [phonetic] is still subsidy or not, but it's getting smaller. The point is that this sort of technological, not incremental change, puts additional pressures on the legacy mechanisms of collecting and distributing the goodies.

And therefore, what fundamentally is going to happen is if we want to continue to maintain the social policies of subsidies, then we're going to have to think about the different way to collect and distribute. But, I mean, you're right, if you have the '89 senators — I'm not quite sure how you end up with an odd number. That meant some rural senator of some state...

[UNRELATED DISCUSSION]

PANELIST: Just for example, to foreshadow, we've been doing some thinking about this and we're going to be making — you know, one of the things that we do are working papers and we're going

to be releasing very shortly some working papers that take — so all the legacy economic thinking about cost causation and beneficiaries of the network, so the economic models for interconnection pricing — take that and turn it on its head.

Because in fact, I think there's some very significant and very fundamental questions that have to be raised about what we've done for the last sixty years. And we're at a point now — voice over the internet. And there's a difference whether it's voice over IT, voice over the internet — I'm not going to even define terms.

But the extent to which that's happening — it's been slower than the dire predictions of those who feared it was going to somehow undermine and subvert universal service because of a variety of reason. Including that access charges are coming down, the quality of service isn't up.

But at some point, it's going to tip and it's going to be a non-incremental change and then the social policy issues that you've identified are absolutely front and center. We already saw a foreshadow of this three years ago when there was — we called it the Stevens Report — but it was a report to Congress. Stevens was concerned that voice over IP would result in not enough money going to Alaska to support very rural telephone companies.

Well, we looked at that. And we had some decisions — we can talk about that. but this is not a new issue. It's began that it's only going to get bigger. And depending on your perspective, either worse or better. You're absolutely correct. It's going to be non-incremental change.

QUESTION: I want to make sure it's clear. Because I think there was something about the [??] dichotomy that often gets trapped [no mic]...which is a very technical decision. It's a very technical distinction. And they use technology to define when a basic service [no mic].

But I think the important policy that was made are viewable in modern, in the current year, in an economic context which is when is something a monopoly service — an actual monopoly that cannot be provided by competitive — you know, the analogy then is no, IBM provided data and processing. Why was it important that it was data processing?

Well, in my modern view, it was important because anyone else can provide it and you didn't have to own a large network across the country to do so. That's why you keep that distinction and [no mic] in modern era [no mic] or you can view the very

economic parts of it and say that there really is a very applicable modern...

LARRY: Wait. I have the floor. I own these mics.

PANELIST: Gatekeeper.

LARRY: I'm winding this down. And we're going to move on to the next one. But I want to just highlight what I think that's come out of this which is the question is what are the values that you're trying to advance by these different kind of architectural issues?

And one set of questions might be that they're economic issues that are at stake. And because there are certain kind of monopoly characteristics. That's why there's got to be a certain structure related to it.

The second set of issues aren't really economic only. Harold's points about social value issues that might be implicated by the different ways this architecture is implemented. But the first issue that really when we are focused on the very boring technical question that I wanted us to focus on this morning of different ways to implement IP telephony.

The other issue that came out of that was even if you implement IP telephony in a perfect — you can implement these two architectures of IP telephony in a perfectly e2e compliant way. Unless you think e2e is a value that should be applied at a higher layer in the analysis. So you would argue against the centralized model that Scott described.

Because it didn't give us certain opportunities for innovation even if it was perfectly compliant with e2e from a technical perspective.

QUESTION: I take a small exception to that which is that just about the definition of the e2e argument.

LARRY: Louder.

QUESTION: The definition of the e2e argument sort of says that at some level, you can apply it. And I've seen this confusion happen because the most striking application of it is that the IP versus application level in the internet — people identify the argument with that level. And so when you say that's not the e2e argument, the higher level stuff, that's not correct.

LARRY: Well, I think one of the ambiguities...

QUESTION: But what you are saying is something that I think is correct is that e2e argument applies at many levels and the decision whether to do it — and the benefits are quite [??]

PANELIST: I would like to answer the question you put to me at one point,

though, which is protect against what? Which I will just answer very simply by pointing out — I forget who it was who made the point about the freezing of the innovation at the IP layer as a means of providing stability. But I would argue that there is a similar notion — it's actually one that's in favor of the e2e in many ways because when you push things out and encourage innovation, you can do it without a catastrophic collapse at the core.

But the thing that worries me about arguing that we're going to essentially migrate out of the basic enhanced model in addition to the economic things that my colleague Cheryl Leanza was pointing out is that when you have basic centralized services that are important to a large number of people, there is a need to guarantee a certain level of stability which encourages pushing experimentation out. But you have to maintain the certain level of stability.

PANELIST: I never said get rid of basic enhanced or telecom information, but...

LARRY: These issues are going to survive the rest of the day. We're going to shift to a different set of issues raised by the next panel. So, thank you this panel. We have the next panel — is Hans Kruse, Bill Yurcik, Gary Larson, Doug Van Howling [phonetic] and Michael Kleeman.

[UNRELATED DISCUSSION]

LARRY: So we're going to go through this panel. The idea was to keep these panels from between thirty-five and forty minutes. And then we're going to take a break. But we've got to get through the four panels this morning or else we're in real trouble.

So here's the second panel. It's raising a different set of issues.