

IEEE 802.17 RPR Working Group Meeting Minutes
Plenary Session, March 12-15, 2001
Hilton Oceanfront Hotel, Hilton Head Island, SC

Reporter: B.J. Lee and Mannix O'Conner

Attendance Summary (as of March 21, 2001):

- 166 individuals from 89 organizations signed the attendance book.
- 123 individuals from 60 organizations becomes voting members.

Note: All the presentations are available on the web:

<http://www.ieee802.org/rprsg/public/presentations/mar2001/index.html>

March 12, Monday

- 1:00pm: Welcome and Introduction, Mike Takefman and all
1:05pm: Agenda Scrub, Procedural and Organizational Issues
1:10pm: January meeting minutes approval

Motion: 2001-03-12-01

Motion to approve meeting minutes from January 12-14, 2001.

(M) Bob Love

(S) Kahlid Ahmer

Notes: Minutes not intended to record everything about meetings per 802 rules. Attendance list will be added to the minutes.

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1:20pm: Other objectives and 802.17 Administration, Mike Takefman

- We must vote on objectives at the end of this week.
- We must agree on some Terms at the end of this week.
- Next interim meeting is May 14-18, 2001 in Orlando, FL.
- For the Interim Meeting we need to determine how many days we require.
- IEEE 802.17 administration rules can be found at
http://www.ieee802.org/rprsg/public/presentations/mar2001/mt_admin_01.pdf

1:30pm: **Presentation - IETF IPoRPR update, Albert Herrera, Cisco**

- IPoRPR WG is approved in IESG on February 2, 2001
- Only deliverable is to make framework document, and the first draft is due March 19, 2001
- Current focus is IP over 802.17
- There are interests to look at IP over other ring approaches.

Q: How do we interface and share documents?

A: Limited access to individuals that participate in 802.17

Comment: Open up the floor to modify the charter of the IP over RPR

1:40pm: **Presentation - IEEE 802.17 A Carrier's Perspective, Shannon Silvus, Global Crossing**

- Global Crossing wants be in metro areas of all 250 cities
- Need new revenue generating services
- Want industry based standard with 10 year life cycle
- Want 802.17 with QoS IP over RPR with point to multipoint
- Want per customer and per flow protection by percentage based
- Want customer separation and customer specific QoS
- Three types of SLA
 - . CIR, tight delay within metro (a few ms)
 - . CIR, loose delay bound (100 ms)
 - . available bw, no delay bound

- More than 50ms protection is an additional baggage for the sales
- Want weighted fair allocation of bw for burstable traffic
- Want "distributed sw" in the congestion management context
- Want frame level (L2) statistics, also would like to monitor jitter for customer reporting
- Want delay and jitter within 10ms for VoIP
 - Q: Consider multi-pt to multi-pt vlan SLA?
 - A: Will result in geometric explosion
- Want 1-2 ms fixed delay across the ring

Q: What is the jitter measurement metric you require?

A: 1 microsecond for jitter or delay on a per hop basis, and end-to-end under 10 ms.

Q: How many flows do you expect in a ring?

A: Don't know at the moment. It could be at minimum the number of ports GC sells. But if the customer is present on 50 other rings then he alone needs 50 flows.

Q: Number of nodes per ring?

A: No idea

Q: Do you sell multicast solutions?

A: Yes, but customers don't buy it.

Q: What service interface to the box?

A: Not interested. Will put circuits to go over TDM infrastructure

Q: In the case of ring failure how do you envision using burstable bandwidth?

A: When the guaranteed traffic is low then burstable gets their fair share. Weighted fair queuing.

Q: What kind of SLA on point to multipoint services?

A: Expect to have a pt to pt type-like SLA contract

Q: How do you want to monitor customer flow?

A: Want to monitor each flow that is guaranteed

Q: How will you do VLAN tagging?

A: We are flexible. Want VLAN or IP precedence or IP protocol tag, and would like to use all of these.

Q: Do you expect to aggregate customer traffic?

A: Can treat core on an aggregate level, with Red, Yellow, Green, but per flow on the RPR at the edge.

Q: Will support pure TLS services?

A: Don't know if we will use a router on the end of the ring or not

Q: What about end-to-end real-time traffic delay?

A: Will sell real-time, VPN, overlapping mapping to portfolio of products but delay must be under 10 milliseconds total. 1-2 ms in RPR and 1-2 ms per router hop. The aggregate needs to sum to 10ms.

Q: What other services are you offering, VOIP or what else?

A: No jitter guarantees today. First step with marketing is to tighten the tolerances on the delay guarantee. Today no method to collect delay statistics on IP traffic. Ping between two routers is insufficient.

Q: What WAN port do you expect to hand off to.

A: MPLS today. Later this year other vendors that will monitor on per customer basis.

Q: Will you deploy on SONET or Ethernet PHY layers for framing structure on PHY?

A: Most of our traffic is SONET (TDM) today. 2-5 years from now it will be 80%. As Ethernet grows then Ethernet will be more interesting.

2:15pm: **Presentation - SBC Priorities and Objectives for RPR Development, George Young, SBC**

- Have bought into the premise and promise of RPR - SBC executives get it.
- Priorities for RPR
 - . Ethernet PHY is important for bw efficiencies for a subset of customers
 - . Allows SBC to migrate away from circuit administration
 - . MAN and WAN administrators will take over for Circuit administrators
- 85% of the network today is SONET
- An overlay is recognition of changed traffic types
- There will be transition phase where things will be done in phases.
- RPR over fiber, SONET and DWDM
- What will it take for 802.17 to be delivery vehicle for Carrier-Class functions?
 - . Carrier class requires a regime operational standards including T1 and ITU-T
 - . There will be overlap with other telecommunications standards.
 - T1X1 - SONET done there and it is moving fast today
 - Study Group 15 doing L1 stuff today, T1M1, T1A1,
 - SONET Interoperability Forum - ATIS Network and Service Integration Forum (NSIF) www.atis.org/pub/atis/
- Must develop interoperability to minimize back-to-back problems
 - . ITU-T (GFP) - can be the SONET PHY layer for RPR to consider
- Interested in lower rate SONET payload mapping (STS-3c and higher), see T1.105.02
- Priorities in terms of Ring Topology and Architecture Functions
 - . Multi-node ring topologies dominate
 - . Should emphasize maximizing bw utilization verses arbitrary topologies of mesh architectures.
- Rather see RPR focus on maximizing utilization of packet efficiencies not TDM traffic

Q: You said Ethernet PHY would be preferred but you have mostly SONET,

why?

A: The costs of Ethernet PHY are compelling and it may be appropriate for some subsets of the network. Looking for both solutions and will use as appropriate given the services SBC is offering.

Q: LCAS in context of RPR for bandwidth provisioning or alternate protection scheme?

A: Not looking for moving TDM to RPR but wants the ability if economics are good. Need to be able to allocate bandwidth easily between RPR and the remaining TDM Mux.

2:40pm: **Presentation - Excite@Home View of IEEE 802.17, Bruce Johnson, Excite@Home**

- 3 million subscribers worldwide
 - . Broadband Cable Company
 - . Backbone is with ATT with lambdas in their pops
 - . Today it is 5 Gig and moving to OC 192
 - . Focus has been regional networks
 - . Operating over the MSOs with the exception of Time Warner
- 5,000 -150,000 Homes Passed in Head Ends
- Cost is important at the low end.
- Head End has and Ethernet switch and servers for proxy and CMTS (L2 & L3)
 - . Light them traditionally as fast Ethernet and gigabit Ethernet
- Headend connects to the backbone
- Low price of admission to the ring
- Size is a premium in the equation
- Need fast recovery
- Dumb pipes are not better
 - . Can take a lot of smarts to configure dumb pipes
- Ability to aggregate parallel links
- 10Gig
- Redundant ingress/egress points
- 2,000 km ring circumference
- Support 80 km on spans between nodes with 30 nodes per ring
- Redundant egress/ingress i.e. Chicago with 1M customers on ring
- 3 Ways to Approach Solution
 - . RPR - but proprietary
 - . All optical - but expensive
 - . TDM over SONET - but complex and expensive
- Alternative Architecture
 - . Layer 3 Switches at head ends and DWDM with multiple point-to-point systems in between
 - Disadvantage - L3 convergence is slow but for \$29.5/mo is OK
 - Connection Complexity
 - No real fairness
- If RPR could address multiple parallel nodes then it would aggregate links at L2.
- Don't build artificial limits into the protocol that preclude higher data rates

- QoS support is important, IP Multicast, L3 Function, PSO Tributary connections, MPLS
- Want L4 functions (control of individual flows)

Q: What level of interoperability is appropriate?

A: It is a terrible problem because of QoS and VLANs and provisioning etc... so interoperability is important for anything that is addressed by the standard.

Q: Do you want to support non-homogeneous rings?

A: Yes.

Q: Should packets be dropped at L2 - L3?

A: We don't care today but in the future may want to control.

Q: What integrated L3 functionality is required, switching or routing?

A: In the same product we need L3 but not on the ring port necessarily.

Q: What percentage is the network growing?

A: There are two key components. If you take a base line it is 100% in 10 months. But we feel there will be a shift within 24 months. We don't multiply 3Mbps x 3mil users. We are oversubscribed. Usage patterns are going up, almost vertical.

Q: What do you require for QoS?

A: You need to build in what ever is required in the MAC. CoS vs. QoS. CoS is a tag in the packet which you need for QoS which is an end-to-end service guarantee.

Q: What do you require for VOIP/RPR?

A: We don't really sell voice services even though there are a lot of voice services on the line. We feel we cannot charge much for it.

Q: Over provisioning verses network requirements within 24 months?

A: We will always need bigger pipes but the architecture I described is not ideal, no fairness, no fast resiliency.

Q: What is the reasoning for including L3 on the node?

A: We need L3 when traffic gets on/off the ring, controls for security and other things. The cost for the ring is good at L2. The higher cost of L3 coming onto or off of the ring can be sized to smaller increments and is therefore more cost effective.

Q: Does most of the traffic stay on the ring or go elsewhere?

A: Most goes off the ring but pt-to-pt and caching we can move up from 30% local to over 50% local. This needs to be since we can't order enough bandwidth from the LEC.

Q: Are you looking for private line services?

A: No, we would probably just add a lambda to get the functionality.

Q: Are you proposing an IP SEC or what for security?

A: Just not in the same security domain.

Q: Would you own your own fiber? Would it change your architecture?

A: Not really. We would like a 2Gig Ethernet spec.

3:15pm: Break

3:30pm: **Presentation - SRP Use Within SprintLink, Ted Seely, Sprint**

- Growth problem for Sprint - IP is growing too fast
- . All transport is going to IP within Sprint

- Problem: no way to know traffic pattern as you add nodes to the ring
- Made each point only 2 hops from any other point
- Router replacement is much easier
- There must be tools to help people operate the equipment
- The site techs don't know how to do much
- Idiot proof buttons and knobs are very important for network deployment/management
- Stub Node: Traffic is not going to go up any more
- 273 TeraBytes of Traffic a day - Must overprovision
- Sprint will be forced to replace network again in 2 years
- Like the fact that there is a fairness algorithm on the ring
- NOC operators are not able to troubleshoot enough issues.
 - . Intelligence must be built into the network.

Q: Can you elaborate on end-to-end jitter and delay on the network?

A: Sprint must consider source and destination regardless how far the distance. The core just transports packets and the traffic is too high to read packets in the core.

Q: Do you want a fairness algorithm that is minimal?

A: We want a fair number of knobs to control what the providers have access to.

Q: To what degree do you oversubscribe and what kinds of services you offer?

A: Can't say on oversubscription. Build cycles are 12-18 months out. Out that far we have scaling problems, too many boxes. We provide traditional dedicated private lines.

How do we offer VOIP? We are a long-distance provider and don't offer it. A lot of customers are using this with VPN and doing it themselves with IP-SEC for example. It saves their backbone costs a lot when they use Internet telephony.

Q: How much traffic is self contained in the ring?

A: Unknown, we use SRP for aggregation and multiplexing

Q: Do you have Class of Service

A: No, none on the network today

Q: What are the requirements for Fairness on the ring?

Q: How much traffic is preemptable?

A: Zero, 70 ms coast to coast, based in SLAs

Q: With asymmetric box capacity on the ring, did you observe fairness problem?

A: Not so far.

4:05pm: **Presentation - A LEC Perspective on RPR Requirements, Steven Wright, Bell South**

- Current transport network relies on SONET
 - . Also offer 10/100 LAN services
- RPR must provide SONET - like OAM&P diagnostic and OS
- RPR also must provide lower cost and variable protection schemes
- RPR should understand MPLS
- RPR needs to support a group of QoS types - no new types needed

Q: Can you explain how RPR should be scheduling cost agnostic?
A: Link schedulers and queues on lines etc should be independent of that design.
Q: How do you propose to wrap around a fiber break?
A: Best to consider a guaranteed bw in the protect path that could be 100% or less.
Q: Do you need more than 2 traffic types on the ring?
A: Yes, you will need more than two but less than 8 for example.
Q: Should the MAC have more than 2 queues or the system?
A: The systems may determine this, but the MAC will require more than a high or low.
Q: Are you considering bandwidth, delay and jitter?
A: Yes, except guaranteed jitter is probably not required
Q: Is the link utilization efficiency important?
A: Likely.
Comment: SLA can be met either at 10% utilization with less QoS mechanism and overprovisioning, or at 90% utilization with good QoS mechanisms.

4:25pm: **Presentation - Virtual Private Lines, Roy Bynum, MCI Worldcom**

- Non Commodity Revenue Services
- Problems of the industry is one of getting caught short
 - . During a boom carriers could make money of most of their services
- Competition is increasing pressure on pricing and margins
- ILEC bypass is an important phenomenon
- VOIP and VOATM is happening and we are eating our own children
- The price of the fiber plant, hire the people and buy the equipment is going up
- Need some service, e.g, IP centric MPLS architectures to generate better revenue?
- Private Line vs. VPN - what is the distinction?
 - . It comes down to search warrants. Private Line and Virtual Private Line require a search warrant before you can look at the data. But VPN customers know that their data must be checked for performance information, queuing, QoS, etc. Therefore the FBI can deploy "Carnivore" spuriously. When they find something interesting they get the SA DA and get warrants. But "Carnivore" looks at every packet.
- Data Reliability is important too. 10 to the minus 8 on a full duplex Ethernet but the public internet has a data loss of 5% (10 to the minus 2). Therefore we need networks that are essentially lossless to have more value add services
- Data Stability - Latency variance, jitter - 100-200ms on the "internet." 100Mbps on Ethernet switch is 10ns to 7ms through the switch and this can deliver a very high quality service. Ethernet over SONET is 50ms per port and is non-additive architecture.
- The more store and forward buffers you go through on your network the higher the latency.
- If we are going to generate higher margin business then we must take into account of busy hour traffic. Demographics determine when the

- busy hour peak is.
- Service Degradation During Fault or Maintenance Events
 - . You can't degrade the service in the event of a fault or maintenance event.
 - Scalability
 - . Rings to manage fiber faults and meshes to groom the traffic.

Q: How can we lock out observability when data can actually be viewed?

A: Frame Relay is run on a Routed IP router. The DLCIs do not get invaded or looked at in any fashion and therefore requires a "search warrant." Therefore RPR must encapsulate data to insure security.

Q: Is 100ms jitter is the requirement for all traffic priority levels?

A: Yes.

Q: Is most of the high priority traffic non-TCP traffic and will perform better?

A: True but for example video is udp and it cannot stand lossy networks.

Q: Do you see the Private Line isolation being part of the RPR?

A: It depends on where the service provider demarcation is located. A leased line goes from the CO to the demark of the Service Provider. Banks, Legal institutions, etc, are very concerned about this.

4:50pm: **Presentation - Requirements of RPR for Optics, Ital Busi, Alcatel**

- TLS (Transparent LAN Service) are big revenue generators
- Web access is important
- Want maintenance and protection based on BER for hard and soft failures
- Services to be provided on RPR Network
 - . QoS
 - . Non-guaranteed with minimum bw and burst capabilities
 - . Best Efforts
- Metro fiber cuts are every 10-20km/yr
- Want to use 1Gb and 10Gb data rates and STM-1, STM-4, STM-16, SMT- 64
- Want steering in a protection event.

5:15pm: **Presentation - Fairness on 10G Ring of Ethernet Switches, Khaled Amer, Amernet**

- Simulation results on the question of Why not use Ethernet switches in a Ring?
- Focus is on fairness, bandwidth utilization and end-to-end delay.
- Model using Opnet with 8 nodes, 100k circumference, 10G data rate and 1250 Bytes packets.
 - . All stations sending to a hub and all stations sending to the next hop
 - . Generic store and forward switches and look at throughput and end to end delay

- Conclusions

- . Node closest to the hub gets full bandwidth while others get worse performance.
- . Ethernet switches exhibit unfairness problem with end-to-end delay and unfair access to bandwidth.

Q: Do some of the modern Ethernet switches have RED and other mechanisms that may improve some of these behaviors?

A: Possibly.

5:30pm: Closing Remarks, Mike Takefman

- Everyone has signed the attendance book.
- We have 135 people attending.
- We will start at 8:00am promptly Tuesday morning.

5:40pm: Adjourn for the day.

March 13, Tuesday

8:00am: Welcome and Agend Scrub, Mike Takefman

8:10am: **Presentation - Fujitsu 802.17 Requirements, Bob Sultan, Fujitsu**

- RPR requirements for TLAN services over RPR
 - . aggregate rate guarantee model with a source throttling mechanism
 - . RPR ring interconnect issue
 - Want frame carries ingress and egress bridge ID
 - . protection, steering versus wrapping
- No requirement
 - . jumbo frames, TDM/Circuit emulation, different link speed, explicit support for 802.1D/Q, SPT

(Refer to the presentation slide for the summary list of requirements)

Q: L2 bridging with ingress/egress bridge IDs poses scalability problem?

A: Customer need exists for certain cases.

Q: Is the bridging interoperability with 802.x required?

A: We did not see such a need yet.

Q: Aggregate rate guarantee model may lack flow specific provisioning?

A: yes, but there is also a need for aggregate model.

8:45am: **Presentation - RPR Scope and Requirements, Steven Wood, Cisco**

Q: How do you provide customer segregation and security capability?

A: Do it at L3.

Q: 2 priority QoS mechanism for ring transit in SRP not enough?

A: Considered adequate, but may need more study.

Q: How about the fairness issue under asymmetric traffic load scenario?

A: It is a traffic engineering issue.

Q: How about 48 or 64 bit MAC address issue?

9:20am: **Presentation - RPR MAC: Distributed Cut-through Switching, Frederic Thepot, Dynarc**

- Cut through switching won't work with differing span capacities
- Implement no rescheduling at intermediate node
- Provide DiffServ support
- Implement fairness using distributed token distribution
- Provide decoupling of data and control planes

Q: Is there a room for the combination of wrapping and steering?

A: The answer is deferred to a presentation in the afternoon.

Q: Do you also support circuit switching approach?

A: No.

10:10am: Break

10:25am: **Presentation - RPR MAC: Data Path Objectives, Harry Peng, Nortel**

- Maximize ring performance with minimal design complexity

Q: Due to single MTU buffer insertion, delay pushed up to the access point?

A: Yes, but it simplifies MAC silicon design and ensures scalability.

Q: How about potentially high access delay for high priority traffic?

Does it point to a need for transit buffering with multiple queues?

A: We need active bw management for low priority traffic.

11:00am: **Presentation - Different Span Bandwidth Issues, Pankaj Jha, Cypress**

Q: If different segments support self-contained connectivity, why RPR?

Q: MAC is for shared medium, and this model breaks this definition?

11:15am: **Presentation - TDM services on RPR system, Raj Sharma, Luminous**

- There is a need for TDM traffic support over RPR.
- RPR only requires access arbitration between the add and ring traffic. Ring bw allocation is a system issue.
- 802.17 standardization focus should be bounded on ring operations, e.g., frame, topology discovery, congestion signalling, while the MAC control intelligence is left for vendor specific, e.g., QoS and fairness

Q: How to handle discard precedence of IETF DiffServ?

A: Use of the term diffsev is liberal in this presentation.

1:05pm: **Presentation - Requirements from RPR for WAN/MAN Systems, David Zelig, Corrigent Systems**

Q: Carrier class PM seems to contradict RPR level PM?
A: RPR PM is required for trouble shooting and performance, not contradicting. Carrier class PM can be supported at the box level
Q: Granularity of QoS/CoS?
A: At least 3 levels at RPR.

1:20pm: **Presentation - RPR Rings vs RPR over SONET Rings, Shahid Akhtar, Cyras**

1:45pm: **Presentation - The Need for Supporting Lower than OC-48 rates in RPR, Offer Pazy, Native Networks**

2:00pm: **Presentation - Objectives, Requirements, and Strategies, David James, Lara Networks**

2:35pm: **Presentation - Truth of GFP, Harry Peng, Nortel**

- For details of above presentations, see
<http://www.ieee802.org/rprsg/public/presentations/mar2001/index.html>

3:25pm: **Presentation - Ring/Mesh Network Configurations, Pankaj Jha, Cypress**

Q: It is meant as L2 routing protocol by saying enhanced L2 topology, but discovery convergence time, etc, is not being addressed?

A: It is for the future study.

Q: Implication of ring/mesh combination w.r.t bandwidth management, etc, is also not mentioned?

A: Acknowledged.

Q: How would you handle multicast as in a ring?

A: Do not know at this point.

3:45pm: **Presentation - Transit Path Requirements, Harry Peng and Nader Vije**

Q: In this model, the access delay for high priority traffic can be quite large, e.g., in the order of round trip delay?

A: Not necessarily.

4:00pm: **Presentation - Cyras RPR overview and a steering protection Algorithm, Jingsong Fu, Cyras**

Q: Supporting multicast in TLAN service using MPLS LSP can be challenging?

A: Difficult, but not impossible

4:20pm: **Presentation - Protection Issues, Pankaj Jha, Cypress**

- Pankaj simply stated that he prefers the wrapping to steering approach.

4:21pm: **Presentation - Ring Protection: Wrapping vs Steering, Necdet Uzun, AuroraNetics**

Q: Wrapping incurs more packet reordering which are considered lost.

A: yes, but considered preferable.

Q: For wrapping, TTL needs doubled?

A: Yes

Comment: Out-of-order packets are normal phenomenon in IP world.

4:50pm: **Presentation - A Study of Protection Switching: Wrapping or Steering, Sanjay Agrawal, Luminous**

Comment: Packet misordering problem has been dealt with in 802.3ad Link Aggregation, and needs to be looked at.

A: Misordering is usually handled by receive buffers at the hosts.

Comment from SprintLink: No dropped packets are allowed, rather misorder.

5:20pm: **Presentation - RPR Protection Switching, Lars Ramfelt, Dynarc**

Q: Single MTU insertion buffer implies large access delay for high priority traffic?

A: It can be avoided.

6:00pm: Mike Takefman assigns the following homework for the evening, 802.17 group

Assignment 1: Group discussions/brainstorming on Objectives

Assignment 2: Come up with a list of Terms and Definitions

6:15pm: Adjourn for the day.

March 14, Wednesday

8:00am: Welcome and Agenda Scrub, Mike Takefman

8:10am: **Presentation - Interoperability, Nader Vije, Lantern Communications**

Q: How do we test fairness?

A: Fairness will be manifested across all layers some of which are exposed and some of which are not exposed interfaces.

8:30am: **Presentation - Requirements for RPR Interoperability, Andrew Brown, Cisco**

- MAC encompasses frame format, topology discovery, protection switching, and bandwidth management.

Comment: Optional features are sometimes required but don't work well with interoperability requirements.

Q: Upgrade span by span by splitting the ring that breaks the ring and you lose connectivity for a period of time.

A: You still have connectivity because you are still in wrap node.

Q: Can you still have connectivity between hi and low speed links?

Q: Node fairness is important in a MAN hubbed environment which means everyone gets the same bandwidth even in cases with nodes that are large or small. At the aggregat level you have node fairness across

dissimilarly loaded nodes?

A: Yes, and we would entertain another approach and more discussion is required.

Q: When you upgrade a node where does connectivity occur?

A: The node sees two interfaces of different speeds that are connected at L3.

Q: Where are your management control signals propagated?

A: Through high priority transit buffer.

Q: Steven Wood proposed homogenous rings yesterday.

A: I am also proposing homogenous rings. But this example shows wrap mode with two separate rings connected at L3.

Q: Why is two a magic number for achieving CoS?

A: You control how much each flow gets by controlling at the access to the ring.

Q: If you upgrade at L3 then you must reconfigure the routers because you must have two subnets on the ring.

A: Yes

Q: I assume you are talking about the interface cards East and West on separate cards so you can upgrade the cards independently. If you use L3 for routing and upgrade individually then you use the backplane of the router as the transit path?

A: None

9:00am: **Presentation - RPR Traffic Management, Lars Ramfelt, Dynarc**

- Node level fairness is fairly easy to interoperate.
- We have large number of requirements with complex trade offs.
- Hardware solution for 10's of ms latency is not good.
- Software solution can be as efficient as a hardware implementation, and is more flexible and leaves more room for future improvements and is external to the MAC.

Q: If many fairness algorithms could solve the problem, how do we answer the question?

A: The bandwidth management is the thing that usually doesn't scale.

Q: If you are managing dual counter rotating rings, you can signal back on the second ring to getting a better control message shorter than latency of the full ring.

A: The longest time is the full round trip time on ring.

Q: If you look at a real world network, traffic in aggregate is very predictable when you aggregate flows.

A: That is another argument for moving fairness away from the MAC to software and make it a longer time scale. There is no value to put it in hardware.

Q: Do you have many definitions of fairness?

A: An objective for the base case is easy but getting a unanimously agreed fairness definition is difficult .

Q: Fairness should not be handled above the MAC?

A: Fairness should be done at L2. You may have resources that are allocated that are configurable depending on the situation.

Q: Should support SLAs?

A: Yes

Q: You mention rate based mechanism. How do you estimate your rates?

A: Efficiency, latency, bandwidth can't be solved all at once.

Comment: Bandwidth management/fairness need be left as an optional feature.

9:35am: **Presentation - Study of QoS Issues in RPR, Sanjay Agrawal, Luminous**

Q: If you take packets off the ring then it is inefficient because it has already used bandwidth.

A: You can elect to implement this way or not. So the system gives you the option.

Q: Are there ways to quantify fairness?

A: Whatever index we design will everyone agree? I think the efforts in this area will be vain but the MAC should accommodate all.

Q: If everything is EF traffic (50%) how do you solve with this MAC model.

A: I'll talk afterward

Q: Why bring the fairness algorithm out of the MAC. Why not bring queues into the MAC layer?

A: You don't want to force vendors to all implement the same fairness.

Q: If scheduling fairness and access are all different how will interoperate?

A: Some may do queueing, some do BCN. All I have to obey is the BCN if I do queueing. We need to see how the vendors would interoperate.

Q: How does RED work on a few nodes with vastly different numbers of flows.

A: Use aggregate metrics. Number of flows can be taken out of the equation.

10:10am: Break

10:25am: **Presentation - RPR MAC Model: Contention Resolution and Fairness Issue, B.J. Lee, Tropic Networks**

Q: None of the access control schemes you present are used today. Still the #1 problem and that is they are too latency sensitive. Should the fairness be in the chip or external?

A: I agree it would be preferable to get it out of the hardware. We should focus on a minimum set that make all vendors boxes work in a ring even in a suboptimal environment.

Q: We can standardize or leave it as an option. We need to understand what we want to standardize later and what we want to do now.

Q: If we have fairness messages at L2 and congestion on L3 both on the ring, how do you avoid the ships in the night problem?

A: I don't believe the control signals interfere with any other signals. I don't know but I didn't mean Layer 3. Maybe the control layer should be divided.

Q: I think this working group needs to define its goal and what it leaves out of the standard. This is an example. We may deal with fairness in different ways. Ring level and system level functions like congestion and bandwidth management for example.

Q: You are saying that the control layer sits between the two MACS and 802.3 forwarding with ST (Spanning Tree) rules. If I take the same Ethernet MAC then our focus should be the focus of 802.17.

A: Protection is pushed to the bridging layer in 802.3, and we need some of that in our MAC model.

Q: It seems to me that fairness and access control in RPR is fundamentally

different than in 802.3 which is competing technology, so why worry about 802.3?

A: There is an issue people are debating, i.e., whether complex fairness should be in or out of the MAC. I propose to come up with a minimum set of fairness algorithms for the MAC.

Comment: It took 20 years to understand Ethernet. The final and best fairness algorithm will not come out of this group today.

11:00am: **Presentation - What is Fairness?, Nader Vije, Lantern Communications**

- Avoid packet loss in the transit ring
- Monitor and signal available bandwidth
- We should support weighted bw allocation based on SLA rates.

Q: You want to reserve bandwidth to minimize jitter, but you also want to allocate unused bandwidth. This seems contradictory.

A: We should have both.

Q: Can you lose traffic on the ring, either 0 or some?

A: I will go into more detail in the afternoon.

11:15am: **Presentation - SLA Compliant Arbitration Protocols, David James, Lara Networks**

- Would like to have 3 arbitration classes
 - . low latency and guaranteed bw
 - . bounded latency and guaranteed bw
 - . fairness on residual bandwidth (unused as well as non-provisioned)
- Fairness weighting is a higher layer thing

Q: Synchronous send seems to imply that you are imbedding a shaper or policer in the MAC. Isn't that too complex in MAC layer?

A: If you want low latency in arbitration you have to have it in MAC. My model is very simple with credits and debits.

Q: What is the purpose of the token? Do we have sequential or parallel access to the ring?

A: The token comes into play when there is residual traffic to send. Some discussion is required on scalability.

Q: Do you propose channelization as 1394 does it?

A: The concept of synchronous and asynchronous classes of service is valuable. Detailed specs of 1394 are irrelevant here.

Q: Have you considered pegging up bandwidth for synchronous flows, instead of relying on idles?

A: In a sense, the idles form the dedicated flow.

11:40am: Lunch Break

1:00pm: **Presentation - Dynamic Bandwidth Control, Nader Vije, Lantern**

Q: The derivative of rate change of the bandwidth should kick off the equation.

A: You can do it in the service module, not in the MAC layer.

Q: How do you define flows. Are they pre-configured?

A: Conversations are on an SLA basis. It is a configured system by the carrier. But you can map Diffserve code points.

Q: Are you using something like CAC?

A: It is a simple rate admission method.

Q: Is your insert rate of the source plus the available bw allocated in a fair manner? What if the source wants to send more than that? Would a leaky bucket work?

A: If there is bandwidth available, it can get as much as the physical layer will allow.

Q: Propagation delay is 5 ms not 3 ms. You have local fairness not global fairness. Your implementation is similar to ours, it doesn't require complex silicon.

Q: How much overhead is required for control messages?

A: Less than 1%.

Q: Weighted fair queueing suggests long packets may create problems with end times?

A: There is no scheduling in the MAC, so the WFQ scheduler on the ingress handles this.

Q: Some of these protocols have a dynamic behavior, i.e., there is a time delay from round trip delay and buffer sizes. Have you simulated to test for oscillation?

A: Adisak will present simulation results in about one hour.

Q: Aren't the calculations based on rates not on packet sizes?

A: The bits in transit is what we are measuring.

1:30pm: Presentation - Spatial Reuse Protocol Fairness (SRP-fa) and Performance Evaluation, Donghui Xie, Cisco

Q: Does SRP-fa support unfairness?

A: No

Q: Http object size is modeled as exponentially distributed? self-similar?

A: I do not expect significant difference.

Comment: With this simulation because it has higher layer issues involved you cannot evaluate the SRP protocol.

Q: What window size did you use?

A: I used the largest window size for this simulation along with slow start.

Q: Have you a tried a 10 Gig ring speed.

A: No

2:10pm: Presentation - Simulation Results, Adisak Mekkittikul, Lantern

Q: The buffer size is 60KB or 2 RTT? Exactly how large is it in terms of bytes?

A: Two cases with two customers with different size, so they are a function of the flow rate. In this case we know the flow rate that the customer will get then to be fair that is the RTT time.

Comment: In one slide you had 3 link utilization sizes for the buffer on the line card. As you increase utilization your efficiency improves. Buffer size does improve link utilization.

Q: When you compare UDP to TCP, were they running at the same priority?

A: Yes, they were. We want to make sure that one customer is not stealing bandwidth from another.

Q: The customer with the higher bandwidth and charges seems to get more bandwidth than a customer who has a lower rate.

A: They do because they have the same weight. However, you can change the weight to meet the carrier requirements.

Q: When you divide pipes with WFQ how do you control low and high priority traffic behaviors?

A: It goes back to flow control. Incoming traffic is controlled by flow control at the ingress port.

2:50pm: **Presentation - High Level Requirements for the RPR MAC Client Interface, Offer Pazy, Native Networks**

- MAC provides basic flow control, and congestion control should be handled by the client.

- MAC Should only provide minimal size transit and add buffers.

Q: If you put the flow control in each client with no knowledge of the whole system, you might have some nodes or clients that can never have access to bandwidth.

A: The mechanisms I propose are at a layers above the MAC. The transit versus the edge and who is really using the ring should be done at a higher layer. You will need traffic engineering that conforms to the organizational need.

Q: When you suggest that the client should control a protection, is that the MAC or the customer client?

A: The MAC client should be able to inject protection events. If we decide to use wrap and steering, then the client should have some say in how that is done.

Q: How would deal with multiple MAC clients from invoking different protection schemes or different clients invoking protection events simultaneously?

A: There must be some management control over the boxes. This is either an IP layer or other higher layer which does this.

3:15pm: Break with an administrative announcements

- The performance ad hoc will be at the Marriott hotel tonight after the social event. Pre registration is imperative so we get the right sized room for our meeting.

3:35pm: **Presentation - IEEE 802.17: Some issues to be considered, Harmen R. Van As, Vienna University of Technology**

Q: You mention QoS and flow on the ring. The difficult example is when VOIP and other services need access. Do you see this as part of the MAC layer or the higher layers?

A: This should be discussed more.

Q: You will pay for no packet loss with end to end delay and jitter. No packet loss on the ring is not a requirement for a ring so why suffer the jitter and delay?

A: Since we have a ring you can have no packet loss on the ring. You can

discard packets with RED at the ingress node.

Q: There is a circuit switched traffic class (send class), do you nail up this bandwidth or is this available if the circuit traffic is not there?

A: Yes, the unused bandwidth is available when the circuit traffic is not used.

Q: Will you share simulation results with 802.17 in May?

A: Certainly we want to present the protocol, simulation and performance at the next meeting.

A: For the circuit switched traffic there is no jitter. It is inserted into the traffic which is pushed back. All traffic is rate shaped and scheduled.

4:00pm: Presentation - Two Key RPR MAC Features, Gunes Aybay, Riverstone Networks

Q: How many customer ID numbers can you have?

A: A small number in the beginning with room to grow in the future.

Q: Ethernet in the 1st mile is using VLAN Ids.

A: Minimum 12 bits would be great.

Q: The application of VLANs in metro areas would involve many rings. How would that work?

A: A mesh to connect these rings at the WAN level. People are working on VLANs in MPLS tags that may help.

Q: You mentioned the possibility of multiple fairness domains. How do you balance fairness among them?

A: It would be a weighted scheme.

Q: You mentioned a need for more than 12 bits. There are already VLANs so you probably need Domain Ids?

A: I agree. This is an ID for the transparent LAN as an aggregate for the service provider ring that relates to the individual customer.

Q: Where do you see the VLAN tag going?

A: We haven't decided. If we use transparent MAC address in the RPR than maybe use the VLAN tag. If we encapsulate we can use it in the header.

Q: If they map to the same Q tag then the customer's traffic will get mixed?

A: Isolating each customer's traffic from sub VLANs from one customer is up to the customer provisioning and is their responsibility.

4:20pm: Interactive Discussion on "Definitions and Terms," Mike Takefman

- Ad Hoc Group volunteered to do "Definitions and Terms" and present to the group on the reflector or in May at the next meeting. Participants of the ad hoc group are:

Bob Sultan , Bob Schiff, Costas Bassias, David James, Raj Sharma

4:30pm: Ad Hoc Group Reports on the preliminary list of "Objectives"

- Ad hoc groups that met last night to begin discussion on the objectives of the 802.17 presented the lists as follows.
(The lists are also posted on the RPRWG web site.)

Group #1:

Fairness
Protection
PHY Agnostic
OC 3 at low end
Class of Service - but how many?
Interoperable on the ring
Support for TDM and Packet services
Define a PHY interface
Use a universal IEEE MAC address 48 or 68 bit address
Support OAM
Need for Control Messages
Support SLA with bandwidth, loss, delay and jitter parameters
Networking and bridging and ring interconnect issues
Frame Format

Group #2:

Ring Behaviors & Characteristics - general agreement on this area
Bandwidth Management - how this will fit into the standards effort will require simulations and more work to reach consensus
Class of Service - There was some consistency on what we have seen on these issues
Congestion Control - There should be a mechanism but the actual control that you exercise is a system function. However, the MAC requires mechanisms that enable congestion mechanisms.
Layer 1 Considerations - How many will we support
Ring Span Speed - No general consensus on this subject
Protection Switching - What are the mechanisms and what errors do we detect? What is the difference between Layer 1 and Layer 2 fault?
Performance Ad Hoc - Take time to approve the ad hoc and assist with what the working group can do to improve their efforts.

Group #3

- MANAGEMENT
Protection - maintain communications services on the ring throughout faults
Interoperability - RPR portion of vendors
Initialization - connections of physical cables will result in
Topology Discovery - automatically
Error Monitoring - relevant monitoring

- FUNCTIONALITY
 - Clock sync methods may be PHY
 - SLA Integrity
 - PHY Agnostic
 - Links can be of differing bandwidth
- PERFORMANCE
 - Cumulative bandwidth should be maximized
 - Maintain packet ordering
 - Lossless in the absence of link loss
 - Per class QoS
 - Per flow QoS
 - Fairness - unused bandwidth
- TIME TO MARKET
 - Avoid unnecessary and marginal objectives

Note - If there are new PHY proposals then those proposing them that should?

Ad Hoc Group Request for Motions

The following are some of the related discussions:

- * It is difficult to do in an ad hoc group.
- * We don't know how to allocate our time, if a group can come up with very specific proposals.
- * If you have a strong opinion you should write your objective. We don't want three groups.
- * We should be better prepared in organizing these objectives. We should focus on what we can vote on. The ad hoc is needed because the objectives are intertwined.
- * We have a complex task. We need to make progress. We need common agreement on some items to include or exclude.
- * We need an organized list of some sort.
- * The process has worked for centuries and we don't need to organize it because the votes tell us what we need to know.
- * We may want to limit discussion in the interest of time. We need a format to present and discuss all motions with time for objective for defense rebuttal and vote. Individuals should have ability to present.
- * We had consensus in the January meeting and we should use those objectives.

5:45pm: Motions

Motion: 2001-03-14-01

Motion to form an Ad hoc group that will meet and create a set of motions on Requirements/Objectives to be voted on by the Working Group.

(M) Paul Amsden

(S) Offer Pazy

(Y) 64 (N) 21 (A) 1

Vote to call the question:

(Y) 57 (N) 22 (A) 1

Motion: 2001-03-14-02

All motions on objectives plus requirements shall be formatted as per the document submitted by David James, reproduced below.

Motion to have a format for the motions to be given tomorrow.

(Undecided)

Example

Your Title: Your title

Objective: To recover from Wrap quickly - What should be accomplished

Requirement: To wrap within 50ms - What shall be accomplished

Strategies: - Wrap or Redirect - Ways it could be done

Ramifications:

- The Ad hoc Committee on Objectives will meet at 9:00pm at the Marriott.

6:15pm: Adjourn for the day.

March 15, Thursday

8:00am: Seating, Everyone

8:00am: Agenda Scrub, Mike Takefman

8:05am: Performance Ad-hoc Report, Khaled Amer (Postponed)

8:15am: Discussion on "Partial Set of Objectives per 3/14/01 Late Night Task Force," Bob Love

Motion 2001-03-15-01

The process for dealing with the objectives will be the following. A consent agenda for all objectives will be created. All objectives will be presented and no discussion will be allowed. A simple straw poll to determine if there is opposition to each objective will be held. If your objective is editorial in nature (wordsmithing) do not raise your hand unless there are no other dissenting votes. After the straw polls are taken we will deal with all objectives in order of least to most opposition.

Procedural (>50%)

(M) Bob Love

(S) Necdet Uzun

(Y) n/a (N) n/a (A) n/a

Voting on this motion is postponed until after the Officer election.

8:40: Granting of Voting Right, Mike Takefman

- 123 individuals from 60 organizations becomes voting members (As of March

21).

9:15am: Performance Ad-hoc Group Report, Khaled Amer

- Perf Ad-hoc objectives
 - . compare the performance characteristics of various proposals
 - . compare against other technologies

10:00am: Break

10:25am: Election of 802.17 Officers

Motion 2001-03-15-02

IEEE 802.17 to affirm Mike Takefman to be the Chair.

(M) Harry Peng

(S) Hani Fafous

Procedural (> 50%)

(Y) 96 (N) 0 (A) 0

• Election of Vice Chair - Bob Love elected.

1. Leon Bruckman, Corrigent Systems (Y) 5
 2. Yong Kim, Broadcom (Y) 29
 3. Bob Love, Lan Interconnect Consultants (Y) 56
- (Total) 90 (A) 2

• Election of Secretary - BJ Lee elected.

1. Byoung-Joon (BJ) Lee, Tropic Networks (Y) 52
 2. Mannix O'Connor, Lantern Communications (Y) 40
- (Total) 92 (A) 0

Motion 2001-03-15-03

IEEE 802.17 to create the position of assistant secretary and to affirm Mannix O'Connor in that role.

(M) Nader Vije

(S) David James

Procedural (> 50%)

Affirmed

Motion 2001-03-15-04

IEEE 802.17 to affirm that John Hawkins to assume the position of Web Master.

(M) Harry Peng

(S) Bob Schiff

Procedural (> 50%)

Affirmed

Motion 2001-03-15-05

IEEE 802.17 to affirm that Edward Messina to assume the position of assistant Web Master.

(M) Bruce Johnson

(S) Harry Peng

Procedural (> 50%)

Affirmed

11:05am: Break

11:20am: Discussion on the earlier motion (2001-03-15-01) regarding the procedure of voting for the WG objectives, Bob Love

- Questions and clarifications on the above motion, and "partial set of objectives."
- Motion 2001-03-15-01 is moved to table by Mannix O'Connor, and affirmed as follows:

Voting on Motion 2001-03-15-01

Procedural (>50%)

(M) Bob Love

(S) Necdet Uzun

(Y) 89 (N) 1 (A) 2

Motion-2001-03-15-06

Debate on each motion shall not exceed five minutes. Vote to extend debate no longer than 15 minutes. Limit each speaker to one minute of discussion.

Procedural (>50%)

(M) Bob Love

(S) Mannix O'Connor

(Y) 78 (N) 12 (A) 2

The followings capture some of the related discussions.

- Let's get a feel for which we feel we support and which we don't.
- Let's consider which require no debate and then move to the contentious points that each require more debate. If there is a controversy and the group wants to vote, fine. Otherwise we should consider another day.
- If you don't understand an objective then vote against the objective.
- You can always make a motion to extend debate.
- Each company is asked to state if you are for or against a motion
- It is also requested that the meeting minutes captures the discussions on each objective, and the company names not be identified during the discussions - Andrew Brown

11:45am: Lunch

1:00pm: Straw poll voting on the objectives.

- Master list of objectives is presented and the initial number of objections to each item has been counted.

Q: Are we going to categorize the items into for further discussion (contentious ones) or completely non-goals?, Offer Pazy

A: No

1:30pm: 1st List vote completed, and additions to list submitted so vote can continue.

- The list has been reordered based on the number of initial objections in the least order, and discussion and voting has started.
- Comment: We can continue to refine the words for another vote at the next meeting.
- Bob Love's comment: We would like to go through this list as fast as possible, deferring more discussion in the reflector and in May.
- The original presenter of the objective has to be the mover, so that the mover knows how to accept/reject friendly/unfriendly amendment.
- The following captures the comments on each of the objectives voted.

(The list of objectives with the voting results is available on the RPRWG web site.)

Objective #2:

C: MAC is a device and spatial reuse is the system issue.

C: What is the meaning of spatial reuse? Does it preclude the need for source stripping feature?

C: The sentence is not different from 802.3?

C: Maybe we are rushing through the ones where wording may not be complete? G

Objective #8:

C: Wording is not good.

Objective #14:

C: What is the meaning of this?

C: What about the fragmentation?

A: L2 will not do fragmentation, and independent of high layer protocol.

Objective #17:

C: OAM&P term may not be familiar within IEEE?

2:55pm: Break

3:15pm: Discussion and voting on the objectives resumed.

Objective #19:

C: "Above 10G" could potentially affect the RPR performance.

C: Are we talking about minimum speed? Then, at higher speed than 10G, there might be a need for bigger packets, etc.

C: We should know that we want to scale up but to name higher speeds would force us to verify our protocols now, but that would be extremely

difficult.

C: We want to support the ability to use higher speeds transmission. This is consistent with 802 verbiage.

C: For higher speeds, certain parameters may need to be modified.

C: At the end of 10G and above, we need to know if that is on a single PHY.

Objective #20:

C: Clarification. Does this mean there is no node that is a master?

A: All nodes shall be equal in terms of accessing within the same ring. A master node shall not be required for access arbitration and restarting the operation after a reset, etc.

Objective #21:

C: How about error prone wireless media which may affect RPR protocol operation?

C: Change the wording to PHY.

Objective #23:

C: Specification of SNMP MIB is not done by IEEE 802, only the implementation is required.

C: what has been done in 802.3 was that 802.3 established a liaison with IETF. Dan Romascanu was the liaison chair. The term "should" is acceptable.

C: Better define ASN.1 format

C: We need to define SNMP MIB for product acceptance

C: RPR experts are in 802.17 and SNMP MIB experts are in IETF, so coordination is required.

C: The management interface to L2 is more important than defining the MIBs.

Objective #24:

C: What is the meaning of 'class'?

A: The meaning of 'class' can be flexible here, e.g., flow-based or node-based.

C: 802.3ad defines the term 'conversation', and we should use that term here.

A: Not acceptable.

C: Within the 802 framework the MAC has no ability to reorder packets or switch packets. There is no precedence for doing reordering packets on the ring.

Objective #25:

C: Clarification needed here.

A: Customers ask to avoid the "black hole."

C: Advantageous feature of the packet technology is tolerant of packet loss.

C: 50ms protection switching has already been the target, why 'minimize' more? Need to know.

A: If there is implementation which can do better than 50ms, so be it.

C: Some traffic may not require tight loss requirement. We need prioritization on this.

C: People would like both protected and unprotected traffic and this impacts

this. Packet loss is dependent on the mechanism you use. The trade-offs are not clear at this point.

C: Friendly amendment - change "shall" to something weaker.

A: Accepted.

C: It is too early to make a decision on this item.

C: The movers should quantify packet loss.

C: What is the relationship between mis-ordering and loss?

A: The purpose is to aim higher

Move to table vote on this objective.

(Y) 33 (N) 26

Failed.

Objective #26:

- This objective is removed by the original mover since considered a duplication.

Objective #27:

C: Is it in addition to 802.1Q tagging?

A: VLAN would satisfy this requirement by either encaps or mapping.

The reason for this was to provide improvement, but at this time the implementation method is open.

A: This was to address the customer need expressed so far.

C: I do not think it is necessary to bring customer stuff down to MAC layer.

C: Use a weaker term than "shall" - accepted.

C: What do you mean by "customer"? The sentence is not quite clear.

C: Does this imply bridging? No.

C: Strong potential for chip implementation complexity, so against it.

C: Customer separation was a strong requirement from the customers.

Move to table discussion on this objective.

(Y) 12 (N) 19

Failed.

Move to table vote on this objective.

(Y) 18 (N) 25

Failed.

- The remaining objectives should now worked for the next meeting.

4:30pm: Planning the Next Meeting/New Business, Mike Takefman

- Interim Meeting is scheduled in the week of May 14-18 in Orlando, Florida
- Update on the IEEE SEC proposed rule change - refer to the document on the IEEE web.
- Harmen Van As to lead an Ad-hoc group to refine the terms and definitions.
- It is acknowledged that there are concerns regarding the process adopted so far in handling the objectives votes. The Movers are encouraged to refine the wording of the objectives.

Comment: Let us use the reflector for more discussions on the remaining objectives, so as to reach consensus in more effectively in the May

meeting.

Comment: More Ad-hoc groups are desired.

Comment: We need to figure out how to work between the meetings, e.g., to use the reflector more efficiently, instead of having more meetings.

Motion 2001-03-15-07

Hold an interim meeting to be held in conjunction with the Wireless groups the week of May 14-18, 2001 at the Raddison Hotel (5780 Major Boulevard, Orlando, Florida).

The meeting is to run from Monday, May 14 at 9am to Friday, May 18, at 12:00 noon.

The meeting is slated to be an IEEE 802.17 plenary meeting if we get a quorum. Otherwise it will be an interim meeting.

(M) Bob Love

(S) Gunes Aybay

Acclaimed

- A bit of debates occurs regarding the need for week long meeting. Bob refers to comments from many analysts, i.e., "Concept looks good, how about believability?" and says "we better have more face-to-face time for speedy standardization, not to lose the market."
- Discussion on the Timeline:
 - Comment: Significant work (or new processes) is needed before the May interim meeting. We should start early with detailed technical stuff. There are large number of new members, and we should not waste time discussing abstract objectives.
 - Comment: 10GE targeted for MAN will soon appear, so 802.17 needs to focus efforts more for fast standardization. The currently proposed timeline and processes are not satisfactory.

Action: (Mike Takefman and Bob Love)

Propose a solid meeting agenda for May interim meeting and a rough plan for the July Plenary.

Comment: There are contradictory objectives.

Comment: Let's begin using the reflector for objectives hashing.

6:00pm: Adjourn, and see you in May 2001 at Orlando, FL.
(End of meeting minutes)