IEEE P802.11
Wireless Access Method and Physical Layer Specifications

Title:Ballot result Recommendations August/September 1994 session

Date: November 3, 1994

Author: Vic Hayes, chair IEEE P802.11
AT&T Global Information Solutions
Zadelstede 1-10
3431 JZ Nieuwegein, the Netherlands

The ballot was sent out to all persons on the mailing list with the mailing of September 17, 1994, with a one month period, explicitly stating the closure on October 19, 1994.

On September 21, 1994, the ballot was announced on the reflector and on September 30, 1994 a friendly reminder was sent on the same reflector.

Result

Todate the result is as follows:

Ballots sent out:	250	
	Total	from voting members
Ballots returned	93	90

All recommendations are approved.

Recommendation 2	2			
w	a	n	y	Grand Total
Aspirant members	0	0	2	2
Observers	1	0	0	1
Voting members	4	3	80	87
Nearly voting members	0	0	2	2
Sleeping voting members	1	0	2	3
Percentage support by voters and sleeping voters	**96.47**			

Recommendation 5	5			
w	a	n	y	Grand Total
Aspirant members	1	0	1	2
Observers	1	0	0	1
Voting members	3	5	79	87
Nearly voting members	0	0	2	2
Sleeping voting members	1	0	2	3
Percentage support by voters and sleeping voters	**94.19**			

Recommendation 7	7			
w	a	n	y	Grand Total
Aspirant members	0	0	2	2
Observers	1	0	0	1
Voting members	4	0	83	87
Nearly voting members	0	0	2	2
Sleeping voting members	1	0	2	3
Percentage support by voters and sleeping voters	**100**			

Recommendation 8	8			
w	a	n	y	Grand Total
Aspirant members	1	0	1	2
Observers	1	0	0	1
Voting members	10	3	74	87
Nearly voting members	1	0	1	2
Sleeping voting members	1	0	2	3
Percentage support by voters and sleeping voters	**96.2**			

Recommendation 9	9			
w	a	n	y	Grand Total
Aspirant members	0	0	2	2
Observers	1	0	0	1
Voting members	1	2	84	87
Nearly voting members	0	0	2	2
Sleeping voting members	1	0	2	3
Percentage support by voters and sleeping voters	**97.73**			

Recommendation 10	10			
w	a	n	y	Grand Total
Aspirant members	0	0	2	2
Observers	1	0	0	1
Voting members	4	0	83	87
Nearly voting members	0	0	2	2
Sleeping voting members	1	0	2	3
Percentage support by voters and sleeping voters	**100**			

Recommendation 11	11			
w	a	n	y	Grand Total
Aspirant members	0	0	2	2
Observers	1	0	0	1
Voting members	2	1	84	87
Nearly voting members	0	0	2	2
Sleeping voting members	1	0	2	3
Percentage support by voters and sleeping voters	**98.85**			

Recommendation 12	12			
w	a	n	y	Grand Total
Aspirant members	0	0	2	2
Observers	1	0	0	1
Voting members	3	6	78	87
Nearly voting members	0	0	2	2
Sleeping voting members	1	1	1	3
Percentage support by voters and sleeping voters	**91.86**			

Recommendation 13	13			
w	a	n	y	Grand Total
Aspirant members	1	0	1	2
Observers	1	0	0	1
Voting members	5	2	80	87
Nearly voting members	1	0	1	2
Sleeping voting members	1	0	2	3
Percentage support by voters and sleeping voters	**97.62**			

Recommendation 15	15			
w	a	n	y	Grand Total
Aspirant members	0	0	2	2
Observers	1	0	0	1
Voting members	2	3	82	87
Nearly voting members	0	0	2	2
Sleeping voting members	2	0	1	3
Percentage support by voters and sleeping voters	**96.51**			

Recommendation 17	17			
w	a	n	y	Grand Total
Aspirant members	1	0	1	2
Observers	1	0	0	1
Voting members	9	2	76	87
Nearly voting members	1	0	1	2
Sleeping voting members	2	0	1	3
Percentage support by voters and sleeping voters	**97.47**			

Note that 34 voting members did not respond. Please be aware that 2 times not responding to a letter ballot in a row would mean loss of voting membership rights! In addition, it causes loss of money and time to the officers of the committee.

Disposition

90 of the 124 voters responded, as this is a procedural matter, I rule this ballot was satisfactorily responded to and the result is "all recommendation are approved".

Comments. The text of the comments is given below.
Disposition of comments. For information to the Working Group

Comments received

L A C E, Incorporated
Research and Development of Wired and Wireless LOCAL AREA COMMUNICATION EQUIPMENT

October 14, 1994

Mr. Victor. Hayes
Chairman, IEEE P802.11
AT&T Global Information Solutions
Zadelstede 1-10
3431 JZ Nieuwegein, the Netherlands
Fax: +31 3402 97555

RE: 802.11 Ballot due before October 19 -- 11 Motions
Comments and explanation of NO votes
Recommended changes

Motion 2 94/124 Physical Definitions for the Interframe Spacings Vote: NO

A system plan based on deferral of transmission when the channel is clear will be of such diminished capacity that it will not be useful. While the mechanisms appear to be PHY and not MAC problems, it is a case of MAC not understanding the limits of the possible PHY properties and adapting. One of key hard core issues is contained in this motion.

Please be patient through some explanation which appears to be about PHYs but will end up with what must be done in the MAC.

If these point raised are ignored, some requirement or performance factor must be grossly compromised. There is a requirement for the possibility 95% area coverage of a covered area with adequate service.. If this requirement is accepted, the average service capacity of a cluster will be only a few % of its standalone capacity. This is about the same as non-performance and therefore appears non-compliant.

Users will find that the aggregate station throughput of their 1 Mbps system is under 40 Kbps, and that they can only achieve this much with insensitivity to an undefinable and often long access delay. This level of performance may cause user dissatisfaction.

ESTIMATING PER CLUSTER CAPACITY

A reference is called 100% or full capacity for the case of one user cluster unaffected by other distant clusters that are also using the same protocol.

Single Channel DS PHY

For 11-chip DS modulation, Diepstraten simulated in 92/51 the aggreagate capacity of two user clusters at various distances between centers. This data in Figure 6 shows approximately that at a spacing of 10 coverage radii between clusters, the capacity of each cluster is reduced about 10% by the interference from the other. This spacing corresponds to a square pattern reuse factor of 25.

A reuse factor of 25 means that 25 independent channels are require to obtain 100% area coverage with the specified level of capacity loss for each pair of interfering clusters at that distance. For a single channel system, the average capacity of each is 1/25th of the capacity after interference losses. The four closest interferers each contribute 5% (discounted), and therefore the remaining capacity is 80%.

Since some of the interference will overlap, possibly once in 5 cases, it is not quite this bad. On the other hand, the effect of the *next four closest* interferers at 1.4 times greater distance, have been neglected which would have a reverse effect.

With a 100% area coverage plan, the capacity of each cluster is about 4% of what it would be standalone. This conclusion assumes that all clusters are equally busy at maximum carryable load, which is somewhat unlikely for other than a minority. Considering that a fraction of the clusters are loaded at any one time, it is possible to rationalize an upward adjustment of the estimated capacity to about 10% in a probable model.

There are many arguable approximations in the simulation, but there is some balance between those that influence the outcome in either direction, none of which change the general conclusion.

Multi-channel Fequency Hopping PHY

The next two important variables are the choice of modulation and means of channelization.

The choice of modulation influences greatly the required like-type signal-to-interference ratio for low error rate transfer. Modulations with better than

0.7 bits/Hz are increasingly affected by like signal interference--the more spectrum efficient, the less resistance.

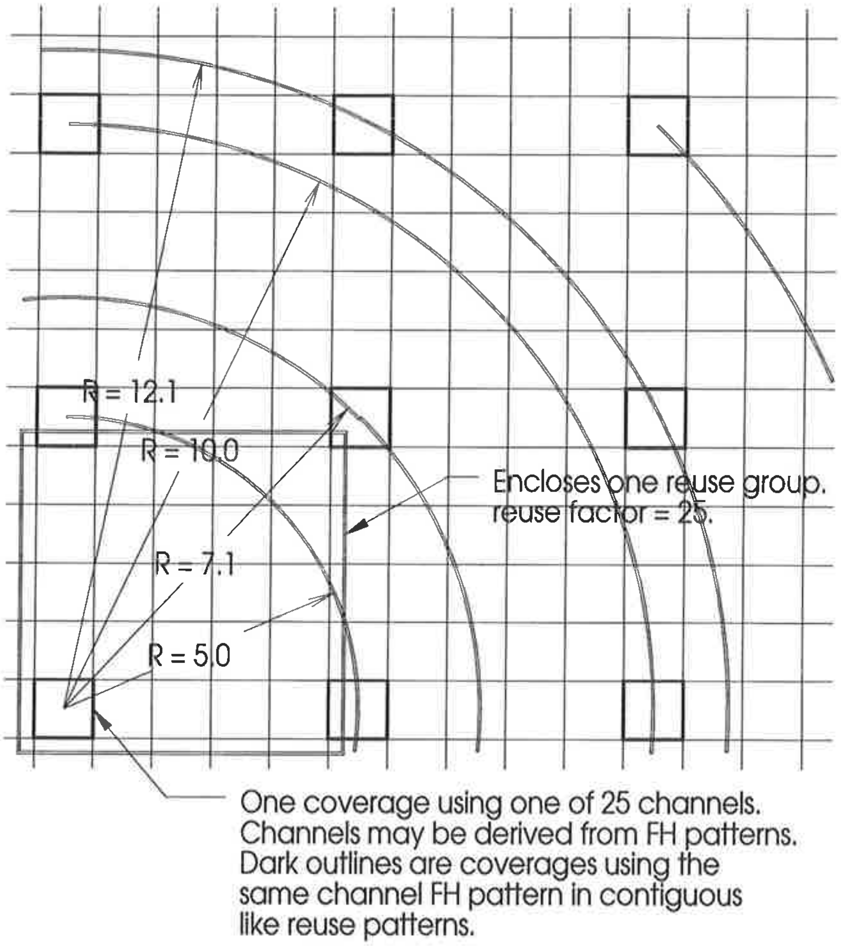
Frequency hopping is essentially a narrow band operation which works no differently whether it is hopping or standing still. The only possible benefit from a second frequency is less interference or reduced impairment from a fade. This characteristic shows as more interference for a given cochannel separation or a greater required separation for the same level of interference compared with DS.

Applied to the current case, it would be found that an FH PHY in which the available channels were used to obtain 100% area coverage requires a reuse factor of at least 36 and probably 49 or 64--the is only a distance increase of 1.2, 1.4 and 1.6 times between independent co-users of the same pattern. The 22 available channels would have to be used more than once within the interference range defined by less than 10% decrease in capacity from each cluster at the edge of the range. This requirment will spend the available channels for frequency reuse before they can be used for overlaid systems.

To illustrate, clusters are spaced in a square pattern of 25 to stay requiring reuse of some of the 22 available channels at closer spacing.. Extrapolating and adjusting the Diepstraten simulation for DS for less interference resistance, the carried traffic would drop to 20% of standalone for one interfering cluster (double the DS value). This neglects the loss from three channels outside of the plan.

The four closest interferers (for DS modulation) togehter will cause a worst case loss of 80% of the capacity of each coverage in a continuous pattern. Since some of the time two or more interfering transmitters may be on at the same time, and the capacity may only be lost once; the capacity loss might be more like 40%.

In this instance, the clusters at greater distances cannot be neglected. At the distance where each cluster-pair causes a 4-6% loss of capacity in each, there are 16 coverages. Beyond the 4 interior coverages, there are 12 more coverages which are 11-13 dB down from the interior ring of interferers (at path loss average for cluttered environment--less unobstructed). A drawing of the model for this case is shown below.



The dimension R, shown is the approximate radius of the service area. As a ratio to the radius of the service area, the interference range increases with narrowband modulations relative to spread spectrum. This is why the spectrum efficiency of DS is greater than that estimated with simple spectrum occupancy ratios.

The following estimates ignore the deficiency of 3 channels necessary to complete the 25 channel pattern.

A cluster in the R=10 ring is estimated to reduce capacity by about 5%, Together the outer 12 may cost the central cluster 20-30% of its capacity. The R = 7.1 ring with 4 coverages may take another 20%.

While it is possible to argue about how to estimate the combined loss from the 16 interferers, it remains certain that it is substantial. Systems using excessive power in stations will have greater interference loss from a deferral system with a fixed threshhold, than would interference-limited systems depending only on sufficient margin for the desired to undesired.

The energy based CCA function will be responding to traffic in 36 or more surrounding cochannel clusters that are within interfence range. If the location of the FH clusters is random and uncoordinated, the peak congestion will be even higher in the important places and quite reasonable where the capacity is not needed. The capacity of the FH PHY that is unneeded on one channel may not be dynamically reallocated to coverages that need it.

Because of the high sensitivity to interference loss with narrowband modulation, the available distance between cochannel uses is much less than what is required for independent use. There is much more intercluster traffic loss and channel sharing than would otherwise be the case. **The capacity of one coverage in this context will be less than 10% of the channel time** before taking into account the CSMA losses within one cluster.

EVALUATION OF PROPOSAL 94/124

What is to be preserved is the definition of necessary functions. What should be changed is the use of absence as a logic state substituting positive criteria.

The MAC offered by IBM Research staff members used broadcast messages to announce time allocations in the following frame and it subparts. This is far superior than measuring the amount of a presumed silent interval for the same result.

The SIFS

The predominant use of this interval is between parts of one transaction. These parts should not be separated by pending use of the channel by others. One of the motivations for segmentation is limiting the amount of channel time for one transaction so that the channel may be better shared.

Example shown: RTS:CTS:DATA (XFR):ACK The RTS should be enabled by specific enabling message from an integration of Access-point, PCF and Beacon. All following steps are enabled by receipt of the end of the expected preceding message without further delay.

After a POLL (CF or background status) is received there is no reason for the addressed station to wait beyond the end of themessage.

Mostly, the SIFS is unnecessary, and the opportunity for other stations to become interleaved within one transaction is undesirable.

The PIFS

There is need to prioritize the PCF use of the channel over random use. There is a short list of important functions which can take place under this enablement. PCF/Access-point is in a much better position to listen to the channel and determine availability that any station that it serves. By definition the access-point has priviledged intallation (ceiling height antenna).

The PCF can know the traffic backlog status from external networks which is not knowable at a station. The PCF can maintain a queue. These functions require a means for the PCF to exercise control over use of channel time by stations. **Control is by sending enabling messages for station originated transactions and setup messages for station terminating messages.** In the background there may be POLL messages. In this mode, when the PCF originates transfers, there is inherently no contention within the cluster (BSS).

What is less obvious is that **the PCF enable message may be conditioned on the status of other surrounding BSS** that may or may not be interfering. The PCFs which together comprise a reuse group may work cooperatively to dynamically allocate exclusive capacity between themselves.

The PIFS should not be a timing window for CCA of doubtful accuracy. The interval should be the indication of a time sharing algorithm in the PCF which is expressed to the station by enabling or setup messages.

The DIFS

This timer delinates the start of the interval in which contention type communication is allowed including service request messages and peer-to-peer direct transfers. The same instant could also be defined by a message from the PCF based on much better activity information and coordinated with a broader view of existing and pending channel activity.

This one change would be a large improvement, but will not by itself fix what is wrong. There must be a change to make the PCF controlled function primary, and the direct peer-to-peer autonomous only in the DIFS interval or when no infrastructure is present.

The ENDu and CCAp

These functions are evidence of the contortions necessary to live with a fundamentally unsound method.

Diversity Antenna Selection

No time interval should be allowed for this function. The antenna selection function should be done before there is data to be transferred--preferrably during a backgound POLL. This function is one of several reasons for having such a POLL.

A diversity antenna was considered of opposed cardioid pattern on the two sides of the computer display so that the shadow would be in the antenna null. One difficulty is that each antenna migh be receiving a strong signal, but not from the same station. There is risk in making an antenna selection decision without knowing the identity of the station on which it is based. The time required for such a decision must allow for the decoding of the source address and recognition that the signal is from an associated station before the decision is made. That interval should be excluded from the normal chain of steps associated with a data transaction.

GENERAL COMMENT

While the detail of this contribution shows a high level of skill and knowledge, its fault is in accepting the CCA in a station as a dependable method of enabling channel access. **Systems using CCA controlled access will have a maximum load capacity before considering protocol and failed transfer overhead that is only a few percent of the channel standalone transfer rate.**

This assumes that the system is intended to be able to provide access over a building-wide area for which a peak capacity will be defined and approached. It would be a serious compromise of the functional requirements for 802.11 if the standard does not have a useful level of transfer capacity at the same time it is providing an approximation of 100% area coverage.

Motion 5 94/050r4 PHY Layer Spec for 2.4 GHz DS Vote: NO

While the radio portion of this document is well done, there is a considerable problem with the PLCP header. The preamble and clock recovery functions are properly part of the PHY. The remaining functions should be in the MAC. The preamble is much too long considering function and realizability. Retaining such **a long preamble is prejudicial against handshake type protocols** and short message data traffic. The support of a dual rate is unfortunate, and is unlikely to create benefits as great as the cost of the complication in the processing of the bit stream. The scrambler might require a little time to get synchronized with the source (the text says NO), but that is measured in bits not octets.

PMD Specifications 10.4.6

Well done. Congratulations on the fast transfer from send to receive and power ramp up/down. The spectrum mask is good too.

PMD Specification 8.4.1.20 95/50R March 94

25 µsec is just too long though that could well be what some designs need. 12 µseconds would be a bearable compromise. These numbers have a big effect on throughput for short transfers.

Preamble Length

With respect to the clock acquisition function, 4 bits is sufficient and 16 bits is the beginning of overkill. The preamble may be long for other reasons like enabling a signal level measurment and antenna selection. There may be slow automatic gain control circuits or wake-up circuits from sleep mode depending on energy measurement. None of these are a sufficient reason for lengthening the preamble. In fact, the long preamble becomes a handicap because of implied slow response.

The allocation of 32 octets of preamble time when 1-4 are sufficient is a major structural inefficiency affecting short messages most seriously. All of the functions above can be avoided insofar as a connection with preamble length, and they will work better where ever logic content of the message can be substituted for an analog measurement.

The radio can be made with some or no AGC as are FM receivers generally, When the penalties for AGC are fully understood, this type of circuit is well worth avoiding in short reach radio. The time and memory penalties do not appear until the implications of short burst transmissions are considered. If signal level measurement is necessary, there are better methods than the classic feedback loop which do not have memory or instability. Many RSSI and log amp circuits work with cascaded limiting or compressing stages.

Sleep mode should be independent of signal level measurements. Presence of energy is a bad indication of "time to wake up." Most of the above threshhold received energy is irrelevant to any particular station. The PCF should manage and program station sleep mode considering received traffic for that station. The control can be a part of a backgound POLL function (not CF

POLL). The station should simply obey a message to wake up at a stated time interval after receipt.

The energy measurement associated with antenna or access point selection should be remembered from the last poll or station activity using the entire duration of the transmission for energy averaging concurrent with knowledge of the identity of the station measured. The time cost of the POLL is much less than that of the overlong preamble on every transfer.

Dual Rate

The DS modulation should support the higher rate only. If it is believed that the lower rate has value as a fallback, the same factor can be interpreted as a range reduction. The DS PHY should be considering higher rates.

The FH PHY has different problems some of which will not be resolved. Therefore, nothing should be done in the DS PHY simply to harmonize with the FH PHY. Rather the reverse is the only way to get clean designs.

Scrambler

Limiting this to 7 bits is a good move. Doing it in the PHY is alright because it might not be necessary with some other mediums.

Signal and Service Octets

When PHYs talk to each other, the MACs may not be doing what they should. These functions should be in the MAC frame, and to the extent that the PHY has a need to know the decoded information should be handed back.

The defined radio control parameters passed in the radio octet, particularly power and squelch threshhold may be retained as contingency space, but systems would be well advised to avoid these functions. There use must not be mandatory. They will be difficult to implement in part because of non-evident accuracy and stability requirements, and they will almost impossible to manage because of inaccuracy and short duration of usefulness of collected inputs.

CRC

This is only necessary because there is material decoded information in the PLCP header. It should not be needed.

RECOMMENDED CHANGES

1. Reduce the length of the preamble to no more than 8 octets--4 is better
2. Rename the unique 16 bits pattern as a Start Delimiter and put the function in MAC
3. Keep the scrambler in the PHY
4. Move the Radio and Services octets to the MAC
5. The radio octet should be a PHY management space reservation without required function.
6. The CRC is now redundant but could reappear on the MPDU header
7. Delete the PLCP header as a concept, however the PHY should retain definition of the preamble up to the start delimiter.

MOTION 7 94/180 NoRTS Parameter Vote: YES

The function is necessary. Access point originated traffic does not need a handshake if there is also a background poll. Stations should not use the RTS if the message is not appropriate for mult-segment transfer.

Motion 8 Issue 20.3 closed to incorporate above frame format changes Vote: NO

Reasons are shown in Motions 2 and 5 above.

Motion 9 94/230 and 213 common CRC Vote: YES

This YES vote applies to the CRC only and not to the documents as a whole.

Motion 10 Table 4-1 Vote: YES

Motion 11 Change name of VIA to BSS ID Vote: YES
Motion 12 94/171 FH PHY frame fixes Vote: NO

The FH PHY will prove unserviceable when used at a high enough level of loading to require that all channels be used. The management of channelization is not addressed in this MAC, and must be for a benefit to result. The reasons dealing with capacity are covered in the comments accompanying the NO vote on Motions 2 and 5.

Being more specific to the subject matter in 94/171--

ITEM 4 Frag field only when needed

A minimum size segment (fragment) of 256 bytes is an understandable choice in this context of long preambles and headers. This value is near the edge of being too large as a factor in access delay. It is alright to permit or prefer its use, but not to forbid shorter values.. The number is closer to the maximum which should be allowed unsegmented which is certainly 512 octets or less. This limit is based on fairness and access delay considerations.

If it is too long, it will preclude timely relay of digitized voice maintaining near public network standards. If any possibility is to remain for transmitting voice at 64 or 32 Kbps, the maximum length transfer is probably 48 octets with reasonable limits on delay added. Failure to allow transfers of this size will preclude extension of public network digital voice through this LAN.

ITEM 5 LOAD ELEMENT

The concept is that the broadcast parameters enable the Station to select the channel/access-point with which it will associate. There is a case for this, but it is not a good way to do it. LOAD information loses it accuracy very soon after broadcast. It will work well when load is light. When the time comes to queue requests priority weighted, this will be much reduced in value.

The station should be able to associate with any PCF. Subsequently, the infrastructure should decide where the station is better served and send a channel change command.
The penalty is small for the octet. The information it represents really has a resolution of less than 4 bits. As the need for timely forecast information appears, this will no longer be simple if it must be defined within the standard.

It is probably allright to leave the field with a default of capacity available/not available 1 bit value.

MOTION 13 Add CF capable indication to association & reassociation VOTE: NO

If the deferral mechanisms really worked, all transfers would be contention free. The question posed is on the fringe of the real question of whether there should be or can be a contention free service. So stated, the question is misleading. What is at issue is whether the some or all of the packet service provided shall reserve future capacity taking precedence over random use. The elevation of priority by allowing a shorter wait before the channel is judged idle is no elevation at all.

There cannot be a reservation mechanism without infrastructure control functions and the means of control. The notion of distributing that function is really hopeless. I have no objection to adding the indication. The whole concept of CF or anything like it without a common manager is faulty.

MOTION 15 One mechanism to support DTBS within each PHY
VOTE: YES

As worded, the motion is not arguable. The question of whether and how to provide DTBS is very arguable, and I hope the question comes up. To work, it is a MAC and not a PHY problem.

MOTION 17 94/182 text incorporated in 20b2 sect 7 & 11
VOTE: YES

Good work.

Cordially,

Chandos A. Rypinski

title_firstname	lastname	w	date	2	5	7	8	9	10	11	12	13	15	17
Dr.Eng. TOMOAKI	ISHIFUJI	am	10/19/94	y	a	y	a	y	y	y	y	a	y	a
Mr. MIKE	MICELI	am	10/4/94	y	y	y	y	y	y	y	y	y	y	y
Mr. BRADLEY	HERRIN	dm	9/23/94	a	a	a	a	a	a	a	a	a	a	a
Mr. ROBERT	ACHATZ	m												
Mr. DAVID	BAGBY	m	9/26/94	y	y	y	y	y	y	y	y	y	y	y
Dr. FRÉDÉRIC	BAUCHOT	m	9/22/94	y	y	y	y	y	y	y	y	y	y	y
Mr. C. THOMAS	BAUMGARTNER	m	9/30/94	a	y	y	y	y	a	a	a	y	y	a
Mr. PHIL	BELANGER	m	10/12/94	y	y	y	a	n	y	y	y	y	y	a
Mr. ALEXANDER	BELFER	m												
Mr. MANUEL J.	BETANCOR	m	10/4/94	y	y	y	y	y	y	y	y	y	y	y
Mr. KEN	BIBA	m												
Mr. RON	BJORKLUND	m												
Mr. SIMON	BLACK	m	10/4/94	y	y	y	y	y	y	y	y	y	y	y
Mr. TIM	BLANEY	m	10/13/94	y	y	y	a	n	y	y	y	y	y	a
Mr. PETER	BLOMEYER	m	10/13/94	y	y	y	y	y	y	y	y	y	y	y
Mr. JAN	BOER	m	9/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. JACK L.	BRADBERY	m	9/20/94	y	y	y	y	y	y	y	y	y	y	y
Mr. PABLO	BRENNER	m	9/19/94	y	y	y	y	y	y	y	y	a	y	a
Mr. CHARLES	BRILL	m												
Mr. ROBERT A.	BUAAS	m	10/11/94	y	y	y	y	y	y	y	y	y	y	y
Mr. PETER E.	CHADWICK	m	9/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. ALAN	CHAU	m												
Mr. NAFTALI	CHAYAT	m	9/19/94	y	y	y	y	y	y	y	y	a	y	a
Dr. KWANG-CHENG	CHEN	m	10/13/94	y	y	y	y	y	y	y	y	y	y	y
Mr. STEVE	CHEN	m												
Mr. ARTHUR	COLEMAN	m	9/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. PETER K.	CRIPPS	m												
Mr. ROBERT S.	CROWDER	m	10/6/94	y	y	y	y	y	y	y	y	y	y	n
Ms. SANCHAITA	DATTA	m												
Mr. MARK	DEMANGE	m	9/23/94	y	y	y	y	y	y	y	y	y	y	y
Mr. JIM	DERBYSHIRE	m	10/10/94	y	y	y	y	y	y	y	y	y	y	y
Mr. WIM	DIEPSTRATEN	m	10/11/94	y	y	y	n	y	y	y	y	y	y	y
Mr. BARRY A.	DOBYNS	m	9/26/94	y	y	y	y	y	y	y	y	y	y	y
Mr. WAYCHI	DOO	m												
Dr. PAUL	EASTMAN	m	10/14/94	y	y	y	y	y	y	y	y	y	y	y
Mr. ROBERT J.	EGAN	m	10/18/94	y	y	y	y	y	y	y	y	y	y	y
Mr. GREG	ENNIS	m	10/18/94	y	y	y	y	y	y	y	y	y	y	y
Mr. MEL	FARRER	m												
Dr. KAMILO	FEHER	m												
Mr. MICHAEL	FISCHER	m	9/20/94	y	y	y	y	y	y	y	y	y	y	y
Mr. MAURICE	FRANCE	m												
Mr. PAUL R.	FULTON	m												
Mr. KEITH S.	FURUYA	m	9/30/94	y	y	y	y	y	y	y	y	y	y	y
Mr. ED	GEIGER	m	10/7/94	n	n	y	y	y	y	y	n	y	n	n
Mr. EUGEN	GERSHON	m												
Mr. JUAN	GRAU	m	9/30/94	y	n	y	y	y	y	y	n	y	n	y
Dr. LEE	HAMILTON	m	9/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. VICTOR	HAYES	m	10/10/94	y	y	y	y	y	y	y	y	y	y	y

title_firstname	lastname	w	date	2	5	7	8	9	10	11	12	13	15	17
Ms. CAROLYN L.	HEIDE	m	9/21/94	a	a	a	a	y	y	y	y	y	y	a
Mr. ALEX	HERMAN	m	11/11/94	y	y	y	y	y	y	y	y	y	y	y
Ms. LAURA	HINDY	m												
Mr. BILL	HUHN	m	9/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. LARRY van der	JAGT	m	10/11/94	y	y	a	n	y	y	y	n	y	y	y
Mr. ROGER	JELLICOE	m	9/26/94	y	y	y	y	y	y	y	y	y	y	y
Mr. CHARLIE	JENKINS	m	10/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. FRED	KAMP	m	10/3/94	y	y	y	y	y	y	y	y	y	y	y
Mr. DEAN M.	KAWAGUCHI	m	9/29/94	y	y	y	y	y	y	y	y	y	y	y
Mr. STUART	KERRY	m	9/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. MIKIO	KIYONO	m	10/18/94	y	y	y	y	y	y	y	y	y	y	y
Mr. BUD	KOCH	m	9/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. NING	KONG	m												
Mr. JOSEPH J.	KUBLER	m	9/21/94	y	y	y	y	y	y	y	y	y	y	y
Mr. RICK	KUNZ	m	9/26/94	y	y	y	y	y	y	y	y	y	y	y
Mr. FRANÇOIS	LEMAUT	m												
Mr. DANIEL E.	LEWIS	m	10/14/94	y	y	y	a	y	a	y	y	y	a	y
Ms. ISABEL	LIN	m	10/7/94	y	y	y	y	y	y	y	y	y	y	y
Mr. FRANCISCO J.	LOPEZ-HERNANDEZ	m	10/11/94	y	y	y	y	y	y	y	y	y	y	y
Mr. JERRY	LORAINE	m	10/3/94	y	y	y	y	y	y	y	y	y	y	y
Mr. KERRY	LYNN	m	10/18/94	y	y	y	y	y	y	y	y	y	y	y
Mr. COLIN L.M.	MACNAB	m												
Mr. RONALD	MAHANY	m	9/27/94	y	y	y	y	y	y	y	y	y	y	y
Mr. DAVID	MANSOUR	m												
Mr. JIM	McDONALD	m	9/20/94	a	y	y	y	y	y	y	y	y	y	y
Mr. JOHN	McKOWN	m	9/15/94	y	y	y	y	y	y	y	y	y	y	y
Mr. BRIAN	MESSENGER	m	9/27/94	y	n	y	y	y	y	y	n	y	n	y
Mr. T.	MITSUTOMI	m	10/18/94	a	a	a	a	a	a	a	a	a	a	a
Dr. AKIRA	MIURA	m	9/27/94	y	y	y	y	y	y	y	y	y	y	y
Mr. ROY	MIYANO	m	9/22/94	y	y	y	y	y	y	y	y	y	y	y
Mr. WAYNE D.	MOYERS	m	10/18/94	n	y	y	y	y	y	y	n	n	y	y
Mr. HENRY P.	NGAI	m												
Mr. BOB	O'HARA	m	9/16/94	y	y	y	y	y	y	y	y	y	y	y
Mr. FRANK	O'NEILL	m	10/18/94	y	n	y	y	y	y	y	y	y	y	y
Mr. MITSUJI	OKADA	m	10/7/94	y	a	y	a	y	y	y	y	y	y	y
Mr. ROGER	PANDANDA	m	9/21/94	y	y	y	y	y	y	y	y	y	y	y
Mr. JIM	PANIAN	m	9/21/94	y	y	y	y	y	y	y	y	y	y	y
Mr. AL	PETRICK	m												
Mr. TOM	PHINNEY	m	10/7/94	y	y	y	y	y	y	y	y	y	y	y
Mr. TIM	PHIPPS	m	9/20/94	y	y	y	y	y	y	y	y	y	y	y
Mr. PAUL	PIRILLO	m	10/13/94	y	y	y	a	y	y	y	y	y	y	y
Mr. JEFF	RACKOWITZ	m	10/11/94	y	y	y	y	y	y	y	y	y	y	y
Mr. JAMES A.	RENFRO	m	9/21/94	y	y	y	y	y	y	y	y	y	y	y
Mr. DAVE	ROBERTS	m	9/21/94	y	y	y	y	y	y	y	y	y	y	y
Mr. JAMES F.	ROESCH JR	m	9/30/94	y	y	y	y	y	y	y	y	y	y	y
Mr. JON WALTER	ROSDAHL	m	9/20/94	y	y	y	y	y	y	y	y	y	y	y
Mr. MICHAEL	ROTHENBERG	m	9/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. CHANDOS	RYPINSKI	m	10/16/94	n	n	y	n	y	y	y	n	n	y	y

title_firstname	lastname	w	date	2	5	7	8	9	10	11	12	13	15	17
Mr. ROGER N.	SAMDAHL	m	9/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. KULBIR	SANDHU	m												
Mr. LEON S.	SCALDEFERRI	m	9/16/94	y	y	y	y	y	y	y	y	y	y	y
Mr. JAMES E.	SCHUESSLER	m												
Mr. GLEN	SHERWOOD	m	9/27/94	y	y	y	y	y	y	y	y	y	y	y
Mr. GREG	SMITH	m												
Mr. JERRY	SOCCI	m	10/10/94	y	y	a	a	y	y	y	y	a	y	y
Mr. MARVIN	SOJKA	m	9/20/94	y	y	y	y	y	y	y	y	y	y	y
Dr. WALTER C.	SOTELO	m	10/11/94	y	y	y	y	y	y	y	y	y	y	y
Mr. PAUL F.	STRUHSAKER	m	9/22/94	y	y	y	y	y	y	y	y	y	y	y
Mr. MACK	SULLIVAN	m												
Mr. MIKE	TROMPOWER	m	9/21/94	y	y	y	y	y	a	y	a	a	y	a
Mr. TOM	TSOULOGIANNIS	m	10/1/94	y	y	y	a	y	y	y	y	y	y	a
Dr. EDWIN	TURNER	m												
Mr. RYAN H.	TZE	m	10/6/94	y	y	y	y	y	y	y	y	y	y	y
Mr. RUI T.	VALADAS	m	9/26/94	y	y	y	y	y	y	y	y	y	y	y
Ms. JEANINE	VALADEZ	m	10/18/94	y	y	y	y	y	y	y	y	y	y	y
Mr. SAROSH	VESUNA	m	10/1/94	y	y	y	a	y	y	n	y	y	y	y
Mr. HIROHISA	WAKAI	m												
Mr. RICHARD E.	WHITE	m	9/20/94	y	y	y	y	y	y	y	y	y	y	y
Ms. QING	YANG	m												
Mr. IWEN	YAO	m												
Mr. CHRIS	ZEGELIN	m												
Mr. LAWRENCE H.	ZUCKERMAN	m	10/11/94	y	y	y	y	y	y	y	y	y	y	y
Mr. FRANK	DELLA CORTE	nm	10/19/94	y	y	y	y	y	y	y	y	y	y	y
Mr. JOHN	SONNENBERG	nm	10/10/94	y	y	y	a	y	y	y	y	a	y	a
Mr. BURCHALL	COOPER	sm												
Mr. RICHARD	ELY	sm	10/14/94	a	a	a	a	a	a	a	a	a	a	a
Mr. DAVID A.	FISHER	sm												
Mr. DONALD C.	JOHNSON	sm	9/27/94	y	y	y	y	y	y	y	y	y	y	y
Mr. ROBERT	LUTZ	sm												
Mr. NATHAN	SILBERMAN	sm	10/7/94	y	y	y	y	y	y	y	n	y	a	a
Ms. PAULINE	YEUNG	sm												