A DETERMINISTIC STUDY OF THE FODA FRAME UTILIZATION AT VARIABLE BIT AND CODING RATES

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I. INTRODUCTION

FODA stands for Fifo Ordered Demand Assignment. It is a TDMA satellite access scheme, suitable for simultaneous transmissions of real time data and bulk data. It is able to compensate satellite movements and to efficaciously counter deep fades of the signal due to rain attenuation at high frequencies, while maintaining a good channel optimization even at reduced performances in terms of global capacity of the system.
The system is dimensioned to work simultaneously with a large number of stations, each of which is able to enter or to leave the network without disrupting its operations. As far as the assignments of the transmission time slots are concerned, the control is centralized; it means that at least one round trip delay time between requests of transmissions windows and their time assignments must be considered.
A version of FODA was designed and realized to work at fixed bit and coding rates at the frequency 12/14 GHz, using a prototype of TDMA controller manufactured by the MARCONI R.C. (U.K.) ([1], [2], [3]). This version of the system has been patented (patent N. 9373A/89) and it was first presented at the EUTECO Conference held in Vienna in April 1988 ([5]) and later at the Olympus Utilization Conference held again in Vienna in April 1989 ([6]).
Results rising from the simulation study and from real transmissions can be found in [4] and in [7].

The major drawback associated with frequencies over 10 GHz is the signal attenuation associated with rain fall. In general, attenuation at these frequencies is an increasing function of the rain rate and standard techniques might be employed to combat the rain effect (site diversity, frequency diversity, etc.), but unfortunately all these techniques are costly because permanently dedicated system resources are seldom used, i.e. when it rains, being the system over-designed for the clear air conditions that may exist more than 99 % of the time.
The FODA system will be used in the Olympus programme, working at 20/30 GHz frequencies, where the signal attenuation due to bad atmospheric conditions has a big impact on the quality (and sometimes also on the possibility) of the transmissions. Therefore, the architecture of the original FODA system needed to be reviewed by modifying the numeric value of some parameters and adding more functions in order to counter fades. The different features of the new prototype of TDMA controller, also including the variable coding rate codec and the variable bit rate modem, were considered. The hardware prototype will be manufactured again by the MARCONI R.C and should be, hopefully, ready in the third quarter 1990.
Among the many possibilities to cope with fade conditions on a satellite link, the variation of the data coding and, eventually, of the transmission bit rate too is the procedure the FODA system is based on to counteract fades.

2. A SHORT ACCOUNT OF FODA

For any description of the FODA system see references.
In the following, the most important points are briefly resumed.

1) The control is centralized (master station).

2) The FODA time frame is 31.25 ms long.

3) *m* frames constitute a *superframe*. (m>=1).

4) In the FODA frame, 4 sub-frames are distinguishable: the reference, the control, the stream and the datagram sub-frames.

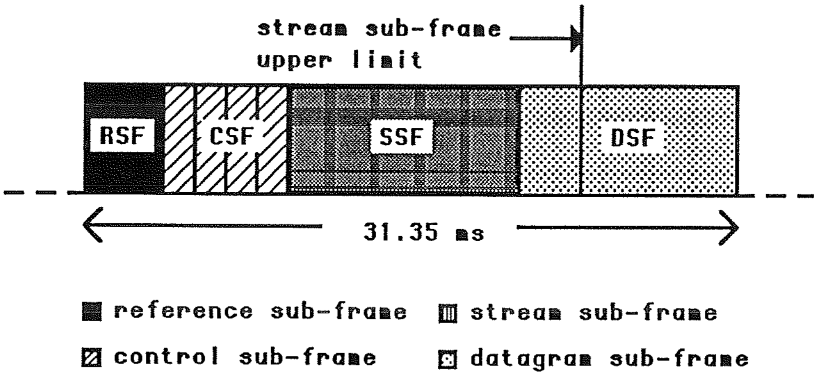


Fig. 1 - Frame structure

The first one is used by the master to send the reference burst; the second one is sharable among the slave stations according to an algorithm which allows up to 4 stations to use it in the same frame; the third one is reserved to the stream traffic and the last one to the datagram traffic. The stream sub-frame may or may not be present according to the presence or not of stream traffic. If present, it starts immediately after the control sub-frame and has two different moveable upper limits in the frame, used for different conditions as explained later on. Datagram traffic may be sent by a station in its stream transmit window during absence of stream traffic (like during the periods of silence in the voice transmissions). The datagram sub-frame starts immediately after the last stream allocation and, in any case, not farther than the current upper limit of the stream sub-frame. In absence of stream allocations, the datagram sub-frame starts immediately after the control sub-frame, till the end of the frame.

5) The structure of each FODA traffic burst is shown in Fig. 2, being the traffic burst defined as the number of bits the user sends to the satellite when the relative transmission window opens. Each traffic burst consists of one or more sub-bursts.

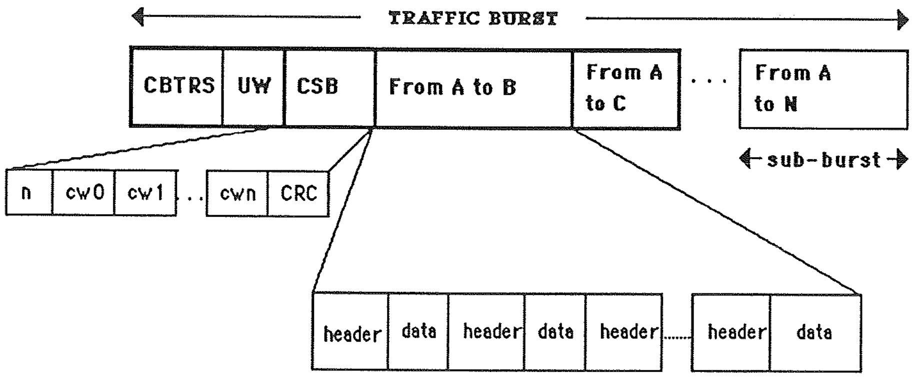


Fig. 2 - Traffic burst format

The first two fields are the CBTRS (Clock and Bit Timing Recovery Sequence) and the Unique Word which constitute the *preamble* of the traffic burst, *always sent uncoded.* It may have a variable length (number of symbols), according to the used bit rate. The preamble bit rate, at each incoming burst, must be known by the modem which is driven by the TDMA controller. Therefore,

the preamble bit rate must be the same for all the bursts sent by all the stations. A technique is foreseen to change the preamble bit rate on a superframe basis and to synchronize all the stations on the changing time.The preamble is, unfortunately, the most significant part of the frame overhead: the smaller the overhead, the more efficient a TDMA system is, but there is a lower threshold below where the modem is no more able to acquire data. This is due to the difficulty by the modem to rebuild the carrier and the data clock signals in a short number of symbols, when the signal-to-noise ratio is below a certain threshold.
The *control sub-burst* (CSB) describes the following traffic sub-bursts, therefore its length depends on the number of sub-bursts constituting the traffic burst. In the control sub-burst, the length, the bit rate and the coding rate of each sub-burst is specified. The CSB bit rate is the same as the preamble one, while the encoding rate is the maximum one, to increase the protection. It must be outlined that a corrupted CSB obliges us to discard the entire data burst.
The *header sub-burst* contains the 18 8-bit bytes header of the satellite network. It describes the source, the destination, the length of the following data together with other information necessary to correctly reassemble eventually fragmented data, whose original length can assume any value. The header also contains a field usable to enter new requests or updates of previously sent requests for transmission time slots either in the stream and/or in the datagram sub-frames (request piggybacked with data). The header bit and coding rates are specified in the control sub-burst, together with the bit and the coding rates of the data sub-burst(s) the header refers to.

5) The stream request is made only once, on the basis of multiples of a basic unit called *elementary slot* (time allowing the sending of 16 8-bit bytes, after eventual coding), corresponding to a throughput of 4 Kbit/s (stream channel). The assignment is intended to be granted for each frame of the superframe and valid until updates of the request are received by the master. Updates take place starting from the first frame of the next superframe. Stream channels allocated to a station are released when a station sends a relinquish request or when a station is declared dead by the master. In both cases, starting from the next superframe, if no new stream requests are received, the datagram sub-frame is enlarged as a result.
The overhead of the stream transmit window, translated into a number of elementary slots, is added by the slave station to the global stream request sent to the master, being this request the sum of all the requests for stream channels coming from the *n* stream applications in some way connected to the station. New stream requests are accepted up to the upper limit of the stream sub-frame, which is normally fixed to half the space in the frame after the RB and the CSF. When fades have to be countered, this upper limit can be moved ahead, occupying up to 3/4 of the frame and squeezing the datagram sub-frame just to contain the already assigned enlarged stream channels. New stream requests are not accepted when the stream sub-frame is enlarged.
The normal limit is reached again when the fade situation overcomes.

6) The datagram request, made on a prevision basis and frame by frame, must be expressed on the basis of multiples of the elementary slot. The assignment, not guaranteed in each frame, is a percentage of the request (from 10% as lower threshold up to 50% as upper threshold, according to the number of active stations). At each assignment, the assigned quantum is decreased from the requested one. The overhead of the datagram transmit window, translated into a number of elementary slots, is added by the master to each assignment.
N datagram allocations as maximum in a frame do not mean that only N stations may send datagram traffic, but that only N , as maximum , can be accommodated in each frame. Therefore, 4N stations transmitting datagram traffic are scheduled in 4 frames, being allocated spaces for N stations in each frame.

3. THE "CLASS OF SERVICE" PARAMETER

It is assumed that any application running on a host in some way connected to the satellite TDMA controller (usually via a fast LAN), on which the FODA system runs, specifies the *class of service* (COS) of the data to be transmitted on satellite.
The class of service parameter (COS) in the FODA system is only the requested range of bit error rate (BER). Other parameters, which normally play an important role in characterizing the quality of the service requested between two end-to-end applications (like the typical data delay and the maximum jitter of the packet inter-arrival time) are really not negotiable. In fact, as far as the stream is concerned, the delay depends on the round trip time (in turn depending on the geographic position of the station) plus a fraction of the time frame. The maximum jitter can be assumed one frame long. In case of datagram, both the delay and the jitter depend on the overall traffic conditions and on the saturation control mechanism.
The BER, on the contrary, is not related to any external factor but must be specified by the application, using a table associating a BER range to a class of service, like, for example, the one shown in Table 1, which our study is based on.

	BER		
COS	not >	not <	Examples of TYPE of DATA
1	10^{-8}	----	reference burst; broadcasted control information; control sub-bursts; satellite headers
2	$3 * 10^{-7}$	10^{-8}	reliable data: bulk; special voice/video interactive data
3	$3 * 10^{-5}$	$3*10^{-7}$	standard voice/video
4	10^{-3}	$3*10^{-6}$	degraded voice

Tab. 1 - The COS indication

4. THE REDUNDANCY FACTORS.

When the necessity arises to compensate an increased attenuation of the signal in order to maintain the class of service required by the application, it is preferable to increase the coding rate of the data first, taking advantage of the coding gain with respect to reducing the bit rate.
Let's indicate with ***Ri*** (redundancy information) the ratio between the time necessary to send a certain amount of information at a certain bit and coding rates and the time necessary to send the same information at the maximum speed (8 Mbit/s) and uncoded (best conditions). *Ri can be expressed as the product of two other redundancy values: the coding redundancy **Rc** and the speed redundancy **Rs**.* The coding redundancy is the inverse of the used coding rate; the speed redundancy is the ratio between the maximum bit rate and the current one. The goal is to maintain Ri as low as possible, while countering the declared fade level. This one is measured in dB and is defined as the offset between a reference value of Eb/N_0, fixed to 12 dB (allowing the reception of uncoded data at 8Mbit/s with a BER of 10^{-8}), and the current value of Eb/N_0. This dB offset represents also the

correction for the data in terms of coding rate and, eventually, of bit rate in order to maintain the requested class of service.
From Eb/N_0-Table in Appendix, which shows the relationship between the Eb/N_0 values and the BERs, Ri-Table is derived, showing the relationship between the fade level and the Ri factor for all the four classes of service previously indicated.

A station in fade, once detected the dB fade level (the fade detection system is not a matter of this paper), broadcasts this information to the network. The compensation of a fade condition is translated into a request for a wider equivalent bandwidth both by the station in fade and by all the other stations wishing to send data to the station in fade. This enlarged request is due to the necessity to increase the coding rate (and, therefore, the Rc value) and, eventually, to decrease the bit rate (therefore increasing the Rs value) to improve transmissions in order to counter the fade.
As far as the master station is concerned, the deepest declared fade must be kept in consideration for chosing the coding and the bit rates to send the reference burst. The chosen bit rate is called driving bit rate and it fixes the bit rate needed to send the preambles and the control sub-bursts of all the traffic bursts in the satellite network.

As far as data are concerned, the FODA system reacts to the increased request of bandwidth in a different way, according to whether the type of traffic is stream or datagram.

A stream application needs a preliminary phase in which a certain bandwidth is negotiated between the master and the station ([8)]. Once a stream request has been granted, the system tries to keep the links characteristics unchanged even in the presence of fade conditions. To counter fades, a station is obliged to increase the previously done stream request in order to maintain the already set-up sessions which now, due to the changing of the coding and/or of the bit rate, have a larger occupancy in the stream sub-frame. The master tries to grant the enlarged request at first within the normal stream sub-frame upper limit U_1 and then, if there is not sufficient space, by moving ahead the stream sub-frame upper limit up to an U_2 value, squeezing therefore the datagram sub-frame. The moving of the upper stream sub-frame limit from U_1 to U_2 is not allowed for granting new stream requests. This extended stream upper limit is put back to the normal position when the fade conditions overcome.
If the enlarging of the stream sub-frame is not sufficient to satisfy the increased stream request, the system notifies to the application(s) the necessity of reducing the used bandwidth. If the application can reduce the requested bandwidth (compressible application) , the station begins sending data with reduced bit rate, while maintaining the requested class of service.
Incompressible applications are not guaranteed to maintain the requested BER under heavy fade conditions, especially if experienced when the system is strongly loaded.

As far as the datagram is concerned, fading conditions cause an increment of the real amount of data waiting in the system to be sent to satellite (backlog) and of the amount of the instantaneous traffic. This automatically increases the station request, making the attempt to get more bandwidth. Due to the increase of the request itself and/or to the eventual compression of the datagram sub-frame, the overall capacity of the datagram may result sensibly reduced, particularly under heavy load conditions of the system. An efficient action of the saturation control system, like, for example, exercising a back-pressure on the remote applications, is requested to avoid congestion ([4]).

5. THE FADE LEVEL CLASSES

On the basis of the class of service, the Ri factor may vary more or less quickly. Higher the class of service is, quicker the Ri increase is. In any case, whatever the class of service is, several fade levels can be supported without any coding or speed changing, as shown in Figs. 3, 4, 5 and 6 in which the fade levels, which do not provoke any change of the Ri factor, have been grouped into classes from 0 to 10. These classes, in which no change of the Ri factor is requested, are called *fade level classes* (FLC) and the grouping of the fade levels depends on the class of service.

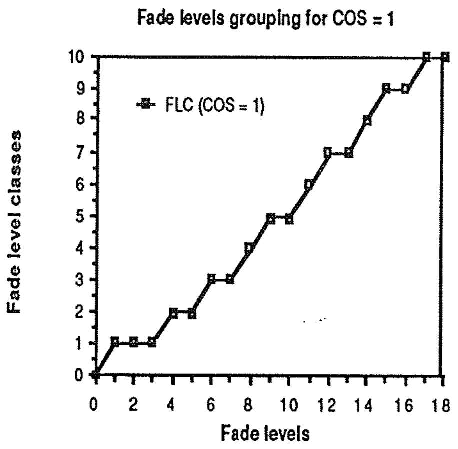


Fig. 3

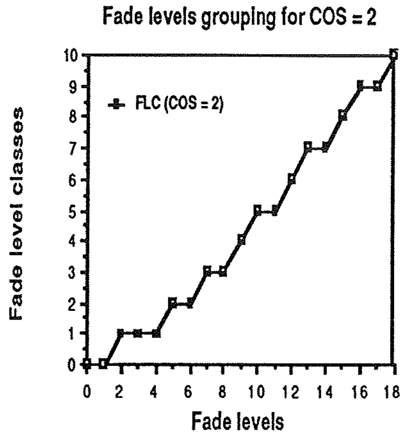


Fig. 4

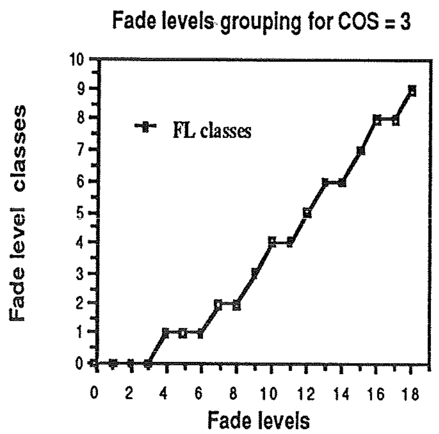


Fig. 5

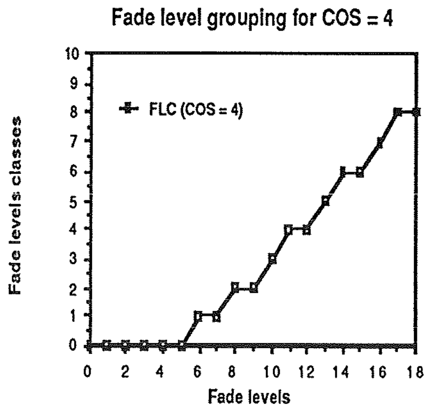


Fig. 6

Fig. 7 is the sum of the previous four figures and it is the scenario of the fade level groupings for the four classes of service.

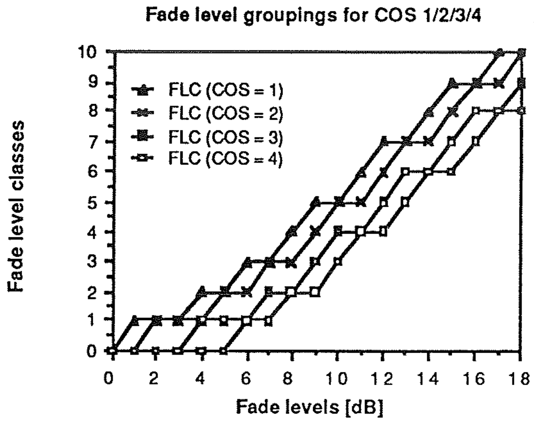


Fig. 7

6. THE HYPOTHESES OF THE STUDY

This study is aimed to give an idea of the FODA frame utilization when deep fade levels must be countered. The study is focused mainly on the stream sub-frame utilization.
In the following, the assumptions taken are listed.

1) The considered bit rates are 8, 4, 2, 1 Mbit/s.
2) The considered coding rates are: 1, 7/8, 3/4, 2/3, 1/2.
3) The preamble is considered 320 (CBTRS)+32 (UW)=352 bits long.
Its length does not depend on the bit rate. On the other hand, its time occupancy doubles at each 1/2 reducing of the bit rate.
4) The control sub-burst (CSB) is assumed 1/2 coded. Its length depends on the number of sub-bursts in the traffic burst. Its bit rate is the same as the preamble one.
5) It is assumed that satellite headers and data be sent in the same class of service.
6) The bit and the coding rates used for the control slots in the control sub-frame are the same as those used for the reference burst.
7) The control sub-frame consists of 4 control slots, each large enough to send a satellite header (18 bytes) plus a small amount of data (16 8-bit bytes).
8) As far as the stream traffic is concerned, the computations are made assuming applications requiring a throughput of 64 Kbit/s.
9) Compressed applications are those which can pass from a throughput of 64Kbit/s to one of 16 Kbit/s.
10) One stream application for each active station is considered. Therefore, **number of supported stream applications = number of supported active stations.** This is the worst case from the SRB occupancy and the frame overhead point of view, where, **from here on, "worst case" means "most expensive in term of bits of overhead".**
11) The master station fixes the bit rate of the preambles and the control sub-bursts of all the data bursts to that one used to send the reference burst ***(driving bit rate)***.
12) Up to a maximum of 64 stations simultaneously active are considered.
13) "Clear sky conditions" means that uncoded data can be sent at 8Mbit/s maintaining the requested class of service. It corresponds to a fade level of 0 dB. The deepest considered fade is 18dB. **The considered increment step is 1 dB.**
14) The stream sub-frame upper limit is moved ahead <u>at least</u> when the driving bit rate drops from 8 Mbit/s to 4 Mbit/s.
15) Guard times of 40 bits each are considered (unaffected by any Ri value).

16) Computations are all referred to the 8Mbit/s, uncoded case, i.e. the Ri factor is used to indicate the cost in time of a bit with respect to the 8 Mbit/s, uncoded case cost.

17) The frame efficiency is defined as the *ratio* of the number of bits available for carrying *traffic* and the *total* number of bits available in the TDMA frame.
It is expressed in percentage by the formula:

$$E = \frac{\text{total number of bits - total overhead}}{\text{total number of bits}} \; 100\,\% \qquad (1)$$

where:

$$\textit{total overhead} = (RB + CSF)\,Ri + n\,G_t + n\,(P_b + CSB\,R'c)\,Rs + \sum_{k=1}^{n} S_{hdr}\,R'_{ik} \qquad (2)$$

being:

RB	=	reference burst bit occupancy (overhead included);
CSF	=	control sub-frame bit occupancy (overhead and 4 guard times included but the space available for small data transmission excluded);
CSB	=	control sub-burst bit length;
S_{hdr}	=	satellite header bit length;
G_t	=	guard time, expressed in bits;
P_b	=	preamble bit length (always uncoded);
n	=	number of data bursts in a frame;
Ri	=	Rs Rc = redundancy speed and redundancy code for the RB;
Rs	=	redundancy speed relative to the driving bit rate;
R'c	=	redundancy coding for the control sub-burst (normally 1/2 coded);
R'_{ik}	=	redundancy information factor for the k-th traffic burst.

7. THE REFERENCE BURST OCCUPANCY

Information regarding events changing on a superframe basis are contained in the *superframe reference burst (SRB)* only, while information specific of each frame are contained in the *reference burst (RB). Both must be sent using an Ri factor suitable to counter the deepest declared fade.*
RB and SRB are always sent in class of service 1.
If superframe and frame coincide, SRB and RB coincide too.

The RB is sent at the beginning of each frame of a superframe, aside from the frame zero. It contains the datagram allocations for the frame plus information about the preamble speed.
The SRB is the reference burst sent at the beginning of the frame zero of each superframe. It is composed of the RB plus a part regarding superframe information (SRBfix) plus the stream allocations of the superframe (SRBstrass). The part of the SRB exceeding the RB is supposed to cover the space devoted to the control sub-frame; it happens once every superframe.

In Fig. 8 the RB and the SRB formats are presented. In Figs. 8a and 8b the single parts are more detailed.

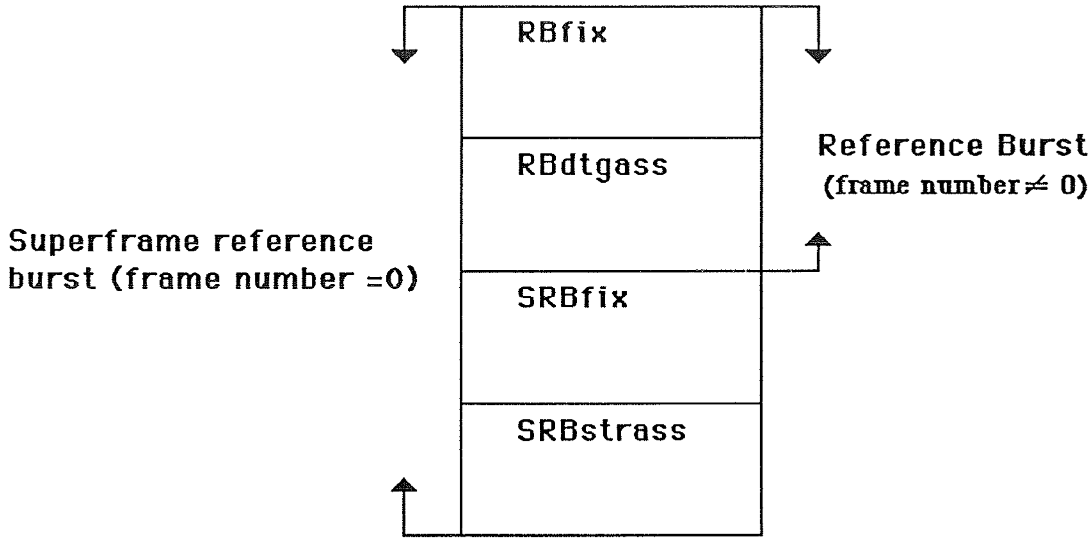
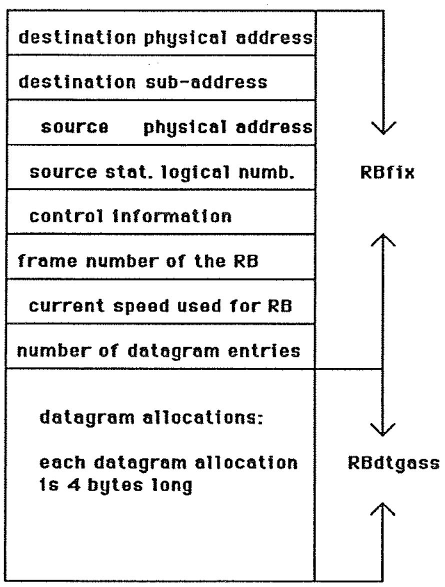
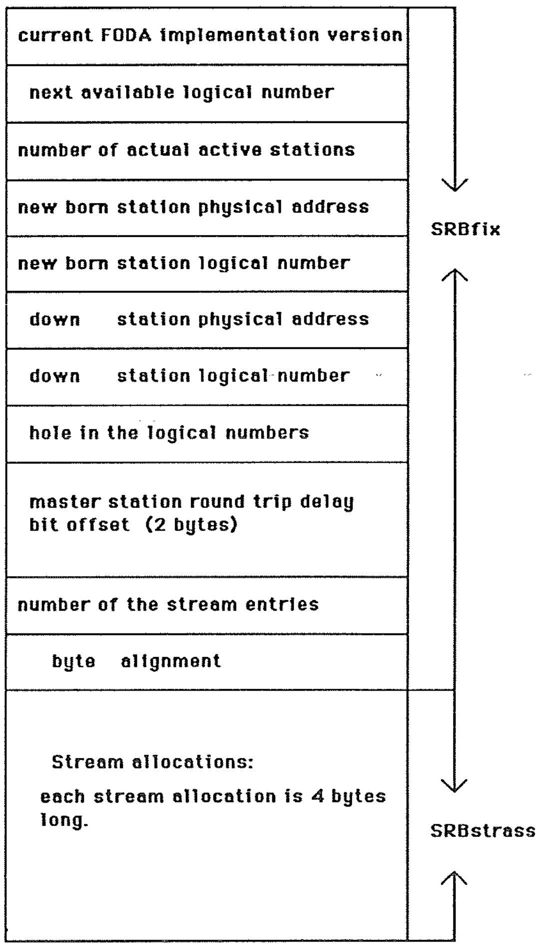


Fig. 8



RB = RBfix + RBdtgass
Fig. 8a



SRBfix + SRBstrass
Fig. 8b

Being:

SRB = RBfix + RBdtgass + SRBfix + SRBstrass,

the SRB bit length depends on the number of both the stream and the datagram assignments allowable in each frame of the the superframe.

8. FIRST HYPOTHESIS:

10 datagram allocations per frame.
Incompressible stream applications
Stream sub-frame 1/4 enlarged from 9 dB of fade on .

In the RB-TABLES 1-4 in Appendix, the SRB occupancy is computed in terms of number of bits, percentage of the frame and milliseconds respectively when 32/45/48/64 stream allocations are considered and the RB is dimensioned to contain 10 datagram allocations.
The used formulas are:

[bit] occupancy	=	(preamble + CSB) Rs + (S)RB Ri	(3)
% of the frame	=	bit occupancy / 2560	(4)
[ms] time length	=	bit occupancy / 8192	(5)

where:

CSB	=	control sub-burst bit length, 1/2 coded;
(S)RB	=	SRB or RB bit length;
Ri	=	redundancy information factor of the RB (=Rs Rc);
Rs	=	redundancy speed of the RB.

In Fig. 9 the *bit occupancy* of the SRB is shown. From the values available in the RB-TABLES those which would have provoked discontinuity on the line graphs (double points) have been discarded. In fact , for example, the value Ri = 2 can be obtained in two ways:

1) Rs = 1 (i.e. used bit rate = 8Mbit/s) * Rc = 2 (i.e. used coding rate = 1/2)
2) Rs = 2 (i.e. used bit rate = 4Mbit/s) * Rc = 1 (i.e. uncoded data).

Between the two solutions, the second one is surely to be avoided. It is much better to reduce the coding rate, maintaining the same bit rate, rather than to reduce the bit rate and to send uncoded data.

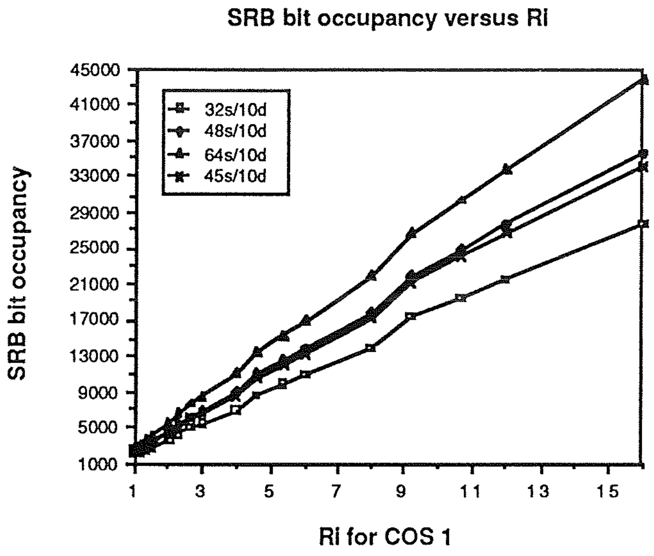


Fig. 9

The CSF-TABLE in Appendix shows the occupancy (in [bits], [%] and [ms]) of the control sub-frame when each of the 4 control slots is dimensioned for a small amount of data equal to 1 Elementary Slot. On the basis of this table, Fig. 10 is derived.

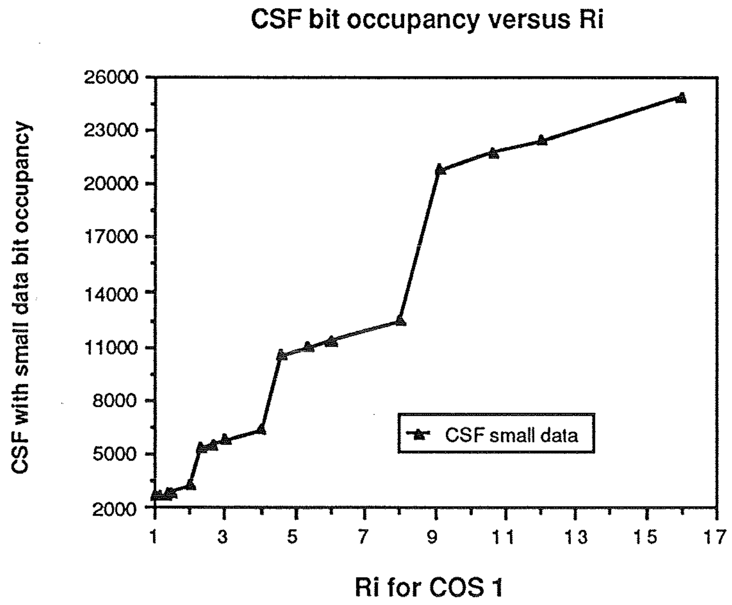


Fig. 10

Let us now make some considerations. At the frame zero of each superframe, the SRB is sent by the master station, at the most as large as the space occupied by the RB plus the control sub-frame. The RB, the SRB and the data in the control slots must be always sent in class of service 1. The possible bit and coding rates usable by the *class of service 1*, to counter up to 18 dB of fade, are shown in Tab. 1.

SPEED Mbit/s	CODING RATE	Ri FOR COS = 1	FADE LEVELS
8	1	1	0
8	7/8	1.14	1, 2, 3
8	3/4	1.33	4, 5
8	2/3	1.5	6, 7
8	1/2	2	8
4	2/3	3	9, 10
4	1/2	4	11
2	2/3	6	12, 13
2	1/2	8	14
1	2/3	12	15, 16
1	1/2	16	17, 18

Tab. 2

In Fig. 11, the space available for the SRB in the frame is shown. It is obtained as the sum between the RB for 10 datagram allocations and the control sub-frame. It is then compared with the bit occupancy of SRBs computed respectively for 32, 45, 48 and 64 stream + 10 datagram allocations.

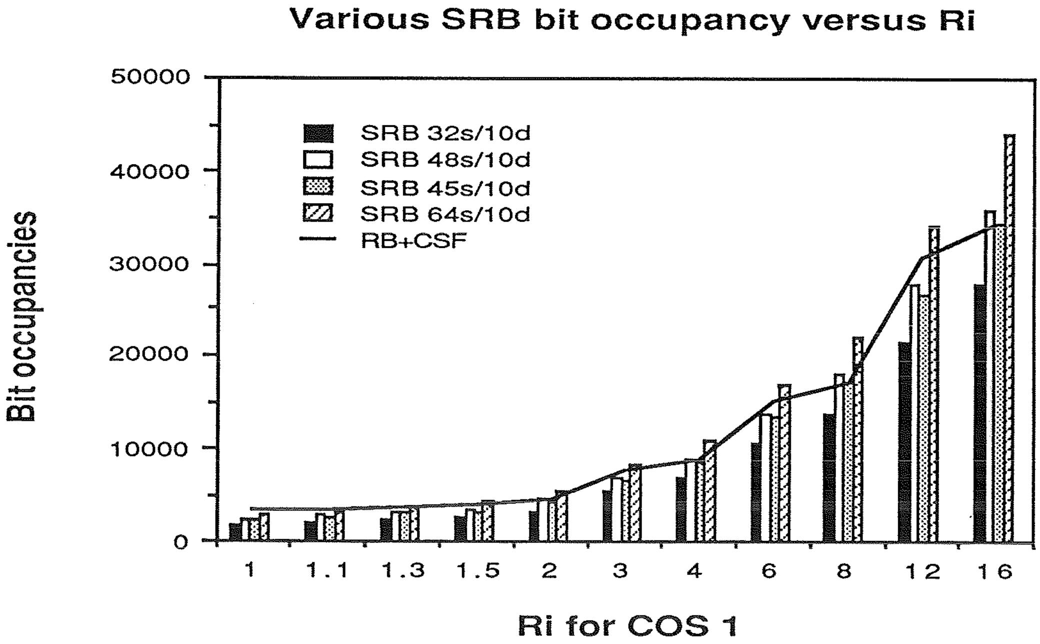


Fig. 11

From Fig. 11, it is clear that **the SRB must be dimensioned for 45 stream allocations in order to occupy the space of the RB + CSF at each Ri value of the COS 1.**
The problem is whether or not these allocations can be supported whatever the bit rate is.

Let 's compute the number of bits available in a 31.25 ms frame after the bit occupancy of RB + CSF (= SRB) in all the Ri cases foreseen by the class of service 1.

Ri for COS = 1	RB+CSF [bit]	AVAILABLE bits	FLC for COS 1
1	3492	252508	0
1.14	3629	252370	1/2/3
1.33	3813	252186	4/5
1.5	3974	252026	6/7
2	4456	251544	8
3	7788	248212	9/10
4	8752	247248	11
6	15416	240584	12/13
8	17344	238656	14
12	30672	225328	15/16
16	34528	221472	17/18

being 256.000 - (RB+CSF), for each Ri value, the total number of bits available for the two stream and datagram sub-frames. Each of them occupies half of the available space in the frame in normal conditions. When it is required by some fade condition, half of the datagram sub-frame is used to maintain stream allocations. It happens when the reference burst must reduce its bit rate from 8Mbit/s to 4 Mbit/s (i.e. from the fade level of 9 dB) and there is enough stream load to require the stream sub-frame expansion.

The formula used to compute the bit occupancy of *n* stream allocations (stream sub-frame bit occupancy SSF), each requesting a throughput of 64Kbit/s (=2048 bits every 31.25 ms), is the following, using the same notation as in (2).

$$SSF = n\ (P_b + CSB\ R'c)\ Rs + n\ G_t + \sum_{k=1}^{n} (S_{hdr} + 2048)\ R'i_k. \qquad (6)$$

The datagram sub-frame bit occupancy (DSF) with *m datagram allocations* is given by (7), while (8) gives the maximum number of bits of real data (mrd), overhead excluded, of each of the m datagram allocations.

$$DSF = m\ \ G_t + m\ \ (P_b + CSB\ R'c)\ Rs + m\ \ (S_{hdr} + x)\ \ R'i \qquad (7)$$

$$mrd = [\ DSF - (m\ \ G_t) - m\ \ (P_b + CSB\ R'c)\ Rs\ - m\ \ S_{hdr}\ \ R'i] / m\ \ R'i. \qquad (8)$$

In (6), (7) and (8), the same notation as in (2) has been followed.

The Rs value used to send the preambles and the CSBs is determined by the bit rate used by the reference burst which, being the most important broadcasted message, is always sent in COS=1. Moreover, the RB must reduce its bit rate with respect to the reference 8 Mbit/s as soon as a station declares a fade level deeper than 8dB, according to the parameters of the class of service 1. It means that if the RB must be sent at 1Mbit/s, all the preambles and CSBs will be sent at 1Mbit/s (Rs = 8).

In Tab. 3, *the maximum bit size of each real data* of the assumed 10 datagram allocations is shown. The four values 1, 2, 4, and 8 the Rs parameter can assume (as far as the overhead increase is concerned) and the worst Ri values, at each reducing of the bit rate, for datagram data sent in COS2 have been considered. Moreover, the datagram sub-frame is supposed to be 1/2 squeezed by the stream sub-frame starting from a fade of 9 dB on.

	Bits for the DSF	Max number of bits of real "data" for each datagram allocation
Rs = 8 dB range for COS1 = [15, 18] Worst Ri for COS2 = 16	55368	306 (only 5 datagram alloc. supported)
Rs = 4 dB range for COS1 = [12, 14] Worst Ri for COS2 = 6	59664	523
Rs = 2 dB range for COS1 = [9, 11] Worst Ri for COS2 = 3	61812	1583
Rs = 1 dB range for COS1 = [0, 8] Worst Ri for COS2 = 1.5	125772	7894
Clear sky conditions 8 Mbit/s, uncoded	126254	11962

Tab. 3 - Real data of each out of 10 datagram allocations

The ST-TAB1 and ST-TAB 2 in Appendix (for COS2 and COS3 respectively) show the number of bits devoted to the stream sub-frame according to the bit occupancy of the RB+CSF for each Ri value which can be assumed by the COS 1. All the computations are done on the basis of these two tables.
The stream sub-frame normally occupies half of the remaining space in the frame and it is increased by 50% when the RB bit rate is reduced from the standard 8 Mbit/s.
For the various Ri values of the two classes of services COS 2 and COS 3, envisaged for standard voice and video applications (stream traffic), the bit occupancy of a 64Kbit/s throughput is shown at the various bit rates of the preambles+CSBs.
The most expensive case is when the RB must be sent at 1 Mbit/s and 1/2 coded because it means that there is at least one station experiencing a *fade level of 18 dB* in the network. In this situation, the SRB (RB+CSF) has the maximum expansion due to the imposed Ri factor (reducing, therefore, the available space for the stream and the datagram sub-frames). The preambles and the control sub-bursts of all the bursts must be sent at 1Mbit/s bit rate.
Tabs. 4 and 5 show a possible utilization of the stream sub-frame in this situation, respectively for COS2 and for COS 3. They are derived utilizing TAB1.COS2 and TAB1.COS3 (in Appendix), respectively for data sent in class of service 2 and 3. **It must be reminded, for a correct utilization of the tables in Appendix, that the space available for the stream sub-frame is that one corresponding to the deepest considered fade.**

In the tables presented in this report, each column gives one of the possible distributions of stations in fade out of a constant number of active stations. For example, in Tab. 4 the leftmost column indicates that 3 out of 11 active stations can experience a fade level of 18 dB on 8 in no fade conditions. In each column, any number of stations can be moved downward, giving one more possible combination. The fade levels are always expressed in dB and the fade classes group those fade levels which do not provoke any change of the Ri value.
The table does not give an exhaustive scenario of all the possible combinations, but it gives a precise idea of the system performances.

Stations-in-fade distribution supported by COS=2 when RB sent at 1Mbit/s, 1/2 coded

FADE CLASSES FOR COS = 2										
18	3	2	1	1	1	1	1	1	1	1
16,17	-	1	2	1	1	1	1	1	1	1
15	-	-	1	2	1	1	1	1	1	1
13,14	-	-	-	1	1	1	1	1	1	1
12	-	-	-	-	2	1	1	1	1	1
10,11	-	-	-	-	-	2	1	1	1	1
9	-	-	-	-	-	-	2	1	1	1
7,8	-	-	-	-	-	-	-	2	1	1
5,6	-	-	-	-	-	-	-	-	1	1
2,3,4	-	-	-	-	-	-	-	-	-	1
0,1	8	8	7	6	5	4	3	2	2	1

Tab. 4 - 11 active stations

Stations-in-fade distribution supported by COS=3 when RB sent at 1Mbit/s, 1/2 coded

FADE CLASSES FOR COS = 3									
18	4	2	1	1	1	1	1	1	1
16,17	-	2	2	1	1	1	1	1	1
15	-	-	3	2	1	1	2	1	1
13,14	-	-	-	3	3	2	2	1	1
12	-	-	-	-	3	2	1	1	1
10,11	-	-	-	-	-	2	1	1	1
9	-	-	-	-	-	-	2	2	1
7,8	-	-	-	-	-	-	-	2	1
4,5,6	-	-	-	-	-	-	-	-	2
0,1,2,3	7	7	5	4	2	2	1	1	1

Tab. 5 - 11 active stations

It must be considered that, very likely, not all the stations will experience the same fade level at the same time, but as many as possible stations will continue to send uncoded data at 8Mbit/s. The preambles, in any case, must be sent at the same bit rate used by the master for the reference burst. From the worst case of Tab. 4 (at least one station in each fade class for COS2) it results that when a fade level of 18 dB must be compensated, only 11 stream applications are supportable. This is still valid for COS=3, even if in this case the stream sub-frame is not entirely exhausted.

Let us now make the same computations in a better case: i.e. when all the preambles and CSBs are sent at 2Mbit/s and the reference burst is sent at 2Mbit/s, 1/2 coded. It means that there is at least one station experiencing a *fade level of 14 dB.* In this case, a number of 32 active stations can be considered.

Stations in fade distribution supported by COS = 2 when RB sent at 2 Mbit/s, 1/2 coded

FADE CLASSES FOR COS = 2							
13,14	4	3	2	2	2	2	2
12	-	2	2	2	2	2	2
10,11	-	-	2	1	1	1	1
9	-	-	-	3	2	1	1
7,8	-	-	-	-	2	2	2
5,6	-	-	-	-	-	2	2
2,3,4	-	-	-	-	-	-	2
0,1	28	27	26	24	23	22	20

Tab. 6 - 32 active stations

Stations-in-fade distribution supported by COS=3 when RB sent at 2Mbit/s, 1/2 coded

FADE CLASSES FOR COS = 3						
13,14	4	3	3	2	2	2
12	-	4	2	3	3	3
10,11	-	-	2	2	2	2
9	-	-	-	2	3	3
7,8	-	-	-	-	4	3
4,5,6	-	-	-	-	-	3
0,1,2,3	28	25	25	23	18	16

Tab. 7 - 32 active stations

Let us now analyze the stream sub-frame situation when the RB is sent at 4 Mbit/s, 1/2 coded: i.e. there is at least one station experiencing a _fade level of 11 dB._ 45 active stations are considered.

Station-in-fade distribution for COS=2 when RB sent at 4Mbit/s, 1/2 coded

FADE CLASSES FOR COS = 2					
10,11	9	6	5	5	5
9		7	6	4	4
7,8			6	4	4
5,6				8	7
2,3,4					5
0,1	36	32	28	24	20

Tab. 8 - 45 active stations

Stations-in-fade distribution supported by COS=3 when RB sent at 4Mbit/s, 1/2 coded

FADE CLASSES FOR COS = 3				
10,11	11	9	8	8
9		7	6	5
7,8			7	6
4,5,6				7
0,1,2,3	34	29	24	19

Tab. 9 - 45 active stations

In the end, Tabs. 10 and 11 show the stream sub-frame utilization when the RB is sent at 8Mbit/s, 1/2 coded: i.e. there is at least one station experiencing a <u>*fade level of 8 dB.*</u> In this case the stream sub-frame is not enlarged but exactly equal to half of the remaining space in the frame after the RB plus the control sub-frame. Still, 45 active stations can be supported.

Station-in-fade distribution for COS=2 when RB sent at 8Mbit/s, 1/2 coded

FADE CLASSES FOR COS = 2			
7,8	3	2	1
5,6		2	2
2,3,4			3
0,1	42	41	39

Tab. 10 - 45 active stations

Stations-in-fade distribution supported by COS=3 when RB sent at 8Mbit/s, 1/2 coded

Fade classes for COS=3		
7,8	5	37
4,5,6	-	5
0,1,2,3	40	3

Tab. 11 - 45 active stations

8.1 Conclusions about the first hypothesis

The behaviour of a system configured with 45 incompressible stream applications and 10 datagram applications, when the datagram sub-frame is assumed to be 1/2 squeezed from a fade of 9 dB on, is summarized in Tab. 12.

	Supportable stream applications (64Kbit/s)	Supportable datagram applications
dB range [15, 18]	11	5
dB range [12, 14]	32	10
dB range [9, 11]	45	10
dB range [0, 8]	45	10

Tab. 12 - Summary

In the second hypothesis we will consider the case in which stream applications may be compressed to 16 Kbit/s and the system is tailored in two ways:

1) to support up to 11 dB of fade level. In this case the bit rate (for COS1) may drop down to only 4 Mbit/s and the system can foresee 64 simultaneously active stations;

2) to support up to 18 dB of fade level. In this case the bit rate may drop down to 1 Mbit/s and the system must be configured for a reduced number of stations which are guaranteed to be supported even at the lowest value of the Eb/N_0 ratio.

9. SECOND HYPOTHESIS: A different tailored system. Compressible stream applications. Stream sub-frame 1/4 enlarged from 6 dB of fade on.

9.1 Up to 11dB of fade. In play bit rates: 8 and 4Mbit/s.

Assumptions: 64 simultaneously active stations are assumed, each having one stream allocation and one datagram allocation. Moreover, the number of stream applications supported by the system must remain unchanged from 0 dB fade level to 11 dB fade level.

Room for 64 stream and for 64 datagram allocations is allocated in the RB and SRB.
RB-TABLE 5 in Appendix gives the RB and SRB occupancy (in bits, frame percentage and milliseconds) up to when a fade level of 11 dB must be compensated. Fig. 12 shows the relationship between the SRB bit occupancy and the available space (in bits) for the SRB obtained as sum of the RB plus the control sub-frame.

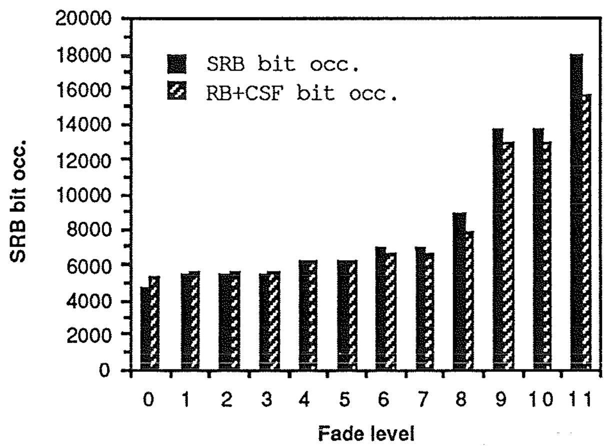


Fig. 12

From Fig. 12 it results that the space for the SRB is contained in the CSF plus the RB space up to a fade level of 5 dB. For deeper fades, part of the stream sub-frame must also be used to contain the SRB.
A fade condition of 5 dB seems therefore a good threshold to decide to eventually 1/4 enlarge the stream sub-frame by squeezing the datagram sub-frame, to maintain the already set-up sessions.

Tabs. 13 and 14, based on the computations presented in the tables TABLE1.COS2 and TABLE1.COS3, respectively for data in COS2 and in COS3, show the distribution of the stations in fade supported by the system when the RB is sent at 8Mbit/s, 1/2 coded.
The deepest fade level to be countered in this case is 8 dB.

Station-in-fade distribution for COS=2 when RB sent at 8Mbit/s. 1/2 coded

Fade classes for COS=2			
7,8	10	6	4
5,6	---	7	7
2,3,4	---	---	7
0,1	54	51	46

Tab. 13 - 64 active stations

Stations-in-fade distribution supported by COS=3 when RB sent at 8Mbit/s, 1/2 coded

FADE CLASSES FOR COS = 3		
7,8	16	12
4,5,6	---	9
0,1,2,3	48	43

Tab. 14 - 64 active stations

64 stream allocations, each declaring a 64Kbit/s throughput, are not supported when the bit rate drops to 4 Mbit/s. Some applications must be compressible to 16Kbit/s; the problem is to find the correct number of compressible stream applications in order to run the system with the same number of global allocations. Tabs. 15 and 16 are derived using both TABLE1.COS2 (data throughput at 64Kbit/s) and TABLE1.C.COS2 (data throughput at 16Kbit/s) for data in class of service 2 and from TABLE1.COS3 and TABLE1.C.COS3 for data in class of service 3. They must be read as Tab. 4 and, apart from that, each column is subdivided into two columns: one for non compressed applications (64 Kbps) and one for the compressed ones (16 Kbps). The number of supported stream applications, for each fade class, is obtained as sum of the values in each row of each column (which, at its turn, consists of two sub-columns).

Station-in-fade distribution for COS=2
when RB sent at 4Mbit/s. 1/2 coded

Fade classes for COS=2	64Kbps	16Kbps	64Kbps	16Kbps	64Kbps	16Kbps	64Kbps	16Kbps	64Kbps	16Kbps
10,11	-	20	-	10	-	8	-	8	-	8
9	-	-	3	5	3	5	3	5	3	8
7,8	-	-	-	-	3	7	2	7	2	8
5,6	-	-	-	-	-	-	4	8	4	8
2,3,4	-	-	-	-	-	-	-	-	4	7
0,1	30	14	29	27	24	14	19	8	11	1

Tab. 15 - 64 active stations

Station-in-fade distribution for COS= 3
when RB sent at 4Mbit/s. 1/2 coded

Fade classes for COS= 3	64Kbps	16Kbps	64Kbps	16Kbps	64Kbps	16Kbps	64Kbps	16Kbps
10,11	-	58	-	29	-	29	-	24
9	-	-	9	19	4	13	2	8
7,8	-	-	-	-	5	4	5	4
4,5,6	-	-	-	-	-	-	4	5
0,1,2,3	6	-	7	-	9	-	12	-

Tab. 16 - 64 active stations

Both in case of COS 2 and in case of COS 3, 11 dB of fade level can be supported by the system running with 64 active stations if some of the foreseen 64 stream applications are compressible to 16Kbit/s. Tabs. 15 and 16 give supportable stream distributions.

9.2 About the datagram allocations

Tab. 17 gives a scenario of the maximum number of net bits of real data which can be sent in each allocation in the datagram sub-frame. The stream sub-frame upper limit is considered moved ahead (1/2 squeezing the datagram sub-frame) from a fade of 6 dB on.
In the RB, room for 64 datagram allocations is considered but, as it results from the scenario, this number of applications will not be supported with a fade of 11 dB.

	Bits for the DSF	64 alloc.	32 alloc.	16 alloc.	10 alloc.
Rs = 2 dB range for COS1 = [9, 11] Worst Ri for COS2 = 3	59520	--	142	762	1506
Rs = 1 dB range for COS1 = [6, 8] Worst Ri for COS2 = 1.5	61760	152	796	2082	3626
Rs = 1 dB range for COS1 = [0, 5] Worst Ri for COS2 = 1.33	124941	923	2404	5336	9063
Clear sky conditions 8 Mbit/s, uncoded	125390	1295	3254	7172	11875

Tab. 17

9.3 Conclusions about the system tailored up to 11 dB of fade

64 stream allocations, each declaring a 64Kbit/s throughput, are supported in the first 8 dB of fade. From 9 to 11 dB of fade (when the driving bit rate drops from 8 to 4 Mbit/s) this number remains unchanged if about half of the foreseen 64 applications are compressible to 16Kbit/s. As far as the datagram allocations are concerned, it is useless to consider 64 allocations per frame, because, even when supported, the transmit windows are too small compared to the paid overhead.

9.4 Up to 18 dB of fade. In play bit rates: 8, 4, 2 and 1Mbits/s.

Assumptions: 32 simultaneously running stations , each having one stream allocation and only 10 stations having datagram traffic. Moreover, the number of stream applications supported by the system must remain unchanged from 0 up to 18 dB of fade level.
The stream sub-frame is 1/4 enlarged starting from 9 dB of fade on.

The choice of 10 datagram allocations is derived by the consideration that, as it results from Tab. 17, 10 datagram allocations still allow the transmission of a considerable number of bits at 11 dB of fade, and the fade we are going to consider is still deeper.

The RB and SRB occupancies are shown in RB-TABLE4 in the Appendix and it is easy to detect that the SRB bit occupancy never exceeds the control sub-frame bit length.
Computations are based on the tables TABL2.COS2 and TABLE2.C.COS2 for the COS=2 traffic requesting respectively a throughput equal to 64 and 16Kbit/s, and on the analogous tables TABLE2.COS3 and TABLE2.C.COS3 for the COS=3 traffic.
Of course, it is obvious that 32 stream and 10 datagram allocations can be easily accommodated when the bit rate is 8 or 4 Mbit/s (see the first hypothesis, in which 45 stream allocations are supported up to a fade of 11 dB together with 10 datagram allocations). In the worst case, i.e. when at least one station is experiencing a fade of 18dB, the station-in-fade stream distribution is given by Tab. 18 for traffic of COS=2.
In this table, the value in each cell represents the *number of compressed stream applications* (16kbps) supported in that fade class on the basis of the story in the preceding cells of the same column. The last row, corresponding to the lightest fade class, is split into two sub-rows: the highest indicating the number of supported non compressed stream applications, the lowest the number of the compressed ones. The total number of supported applications is obtained, as usually, by adding the values of the same column.

Station-in-fade distribution for COS = 2
when RB sent at 1Mbit/s, 1/2 coded

Fade classes for COS=2										
18	1	1	1	1	1	1	1	1	1	1
16,17	-	1	1	1	-	-	-	-	-	-
15	-	-	1	1	-	-	-	-	-	-
13,14	-	-	-	1	-	-	-		-	-
12	-	-	-	-	1	1	1	1	1	1
10,11	-	-	-	-	-	3	3	3	3	3
9	-	-	-	-	-	-	3	3	3	3
7,8	-	-	-	-	-	-	-	3	3	3
5,6	-	-	-	-	-	-	-	-	3	3
2,3,4	-	-	-	-	-	-	-	-	-	3
0,1 (64Kbit/s)	10	5	2	-	9	6	5	4	4	4
0,1 (16Kbit/s)	21	25	27	28	21	21	19	17	14	11

Tab. 18 - 32 active stations

From Tab. 18 it results that a fade of 12 dB cannot be supported by the system together with deeper fades as from 18 to 13 dB, also together with lighter fades as from 0 to 4 dB.
In fact, the fourth column from the left-hand size has zero values from the row corresponding to 12 dB of fade up to the row corresponding to 2 dB of fade. From the next column on, it results that no station in the range of fade from 17 up to 13 dB can be supported together with fades from 12 dB on, when a fade of 18 dB is experienced.

Let us see now the distribution for the stream traffic of COS =3.

Station-in-fade distribution for COS =3 when RB sent at 1Mbit/s, 1/2 coded

Fade classes for COS=3									
18	1	1	1	1	1	1	1	1	1
16,17	-	1	1	1	1	1	1	1	1
15	-	-	1	1	1	1	1	1	1
13,14	-	-	-	1	1	1	1	1	1
12	-	-	-	-	1	1	1	1	1
10,11	-	-	-	-	-	1	1	1	1
9	-	-	-	-	-	-	1	1	1
7,8	-	-	-	-	-	-	-	1	1
4,5,6	-	-	-	-	-	-	-	-	1
0,1,2,3 (64Kbit/s)	12	8	6	4	3	2	2	2	2
0,1 (16Kbit/s)	19	22	23	24	24	24	23	22	21

Tab. 19 - 32 active stations

When the requested class of service is 3, at least one station at each fade level can be supported, maintaining the total number of 32 supported stations.

As far as the datagram is concerned, Tab. 20 gives the maximum number of "real data" which can be transmitted (in class of service 2) in each of the 10 datagram allocations. The worst cases of the COS2 at each change of the bit rate have been considered.

	Bits for the DSF	Max number of bits of real "data" for each datagram allocation
Rs = 8 dB range for COS1 = [15, 18] Worst Ri for COS2 = 16	57088	327 (only 5 datagram alloc. supported)
Rs = 4 dB range for COS1 = [12, 14] Worst Ri for COS2 = 6	60544	545
Rs = 2 dB range for COS1 = [9, 11] Worst Ri for COS2 = 3	62272	1598
Rs = 1 dB range for COS1 = [0, 8] Worst Ri for COS2 = 1.5	126272	7927
Clear sky conditions 8 Mbit/s, uncoded	126254	11962

Tab. 20

10. CONCLUSIONS ABOUT THE SSF UTILIZATION

Enlarging the stream sub-frame of 1/4 of the frame allows the additional allocation of about 20 64-Kbit/s stream allocations at fade level 0 or 1.
Considering 1 dB the granularity of the increment of the fade level (for example, 8.4 dB are assumed as 9 dB), the driving bit rate is obliged to a 1/2 decrease when the fade level passes from 8 to 9 dB (from 8 Mbit/s to 4 Mbit/s), from 11 to 12 dB (from 4 Mbit to 2 Mbit/s) and from 14 to 15 dB (from 2 Mbit/s to 1 Mbit/s). Therefore, as far as the driving bit rate is concerned, the considered **fade level ranges** are:

0 - 8 dB	driving bit rate = 8 Mbit/s
9 - 11 dB	driving bit rate = 4 Mbit/s
12 - 14 dB	driving bit rate = 2 Mbit/s
15 - 18 dB	driving bit rate = 1 Mbit/s.

For each fade level range, the worst case has always been considered in the study: i.e., when there is at least one station declaring a fade level of 8 or 11 or 14 or 18 dB. The reference burst has been always assumed transmitted with the worst Ri of each fade level range. Also in realty, it it suggestible to always send the reference burst with the worst Ri of the related fade level range. For example, if station A declares a fade level of 4 dB and station B a fade level of 10 dB, it is suggested to send the reference burst at 4Mbit/s, 1/2 coded, which corresponds to a fade level of 11 dB. This will avoid the reference burst to change its Ri value at each fade declaration.
As far as generic traffic bursts are concerned, general distributions of the stations in the dB ranges, have been studied.

If the enlarging of the stream sub-frame (of 1/4 of the frame) happens from the fade level of 6 dB (section 9.1) instead of from the fade level of 9 dB (section 8 and section 9.4), when at least one station declares a fade level of 8 dB (range from 0 up to 8 dB of fade), up to 64 64-Kbit/s stream allocations are supported (Tabs 13 and 14) in the first case and only 45 64-Kbit/s stream allocations are supported (Tabs 8 and 9) in the second case.
From 9 dB of fade level on, the stream sub-frame is in any case 1/4 enlarged.

In the range from 9 up to 11 dB of fade, Tabs 8 and 9 demonstrate that only 45 64-Kbit/s stream applications are supportable. Therefore, if 64 stream applications must be supported, about 64% of them must be compressed to 16Kbit/s, as shown in Tabs. 15 and 16. The space devoted to the SSF is more or less the same whatever the SRB length is. Therefore, it is obvious that if 45 64-Kbit/s stream allocations fit more or less exactly the stream sub-frame, space for additional 19 allocations must be found only by compressing part of the 64-Kbit/s allocations.
This percentage and all the following ones are computed considering the most right-hand column of the tables, in which the heaviest case is considered, with one or more stations in each class of fade.

In the range from 12 up to 14 dB of fade, 32 64-Kbit/s stream allocations can be accommodated, as shown in Tabs. 6 and 7. A consideration comes from this: if 45 incompressed applications can be supported up to 11 dB of fade, can this number still be supported up to 14 dB of fade if the compressible applications are also considered? The reply is yes, as it results from Tab. 21 (it must be read as Tab. 15) derived, for data sent in class of service 2, from the RB-TABLE3, ST-TABLE1 and ST-C-TABLE1 in the Appendix. Therefore, in the range from 12 up to 14 dB of fade, 32 incompressed stream applications can be supported or 45 stream applications if about 76% of them are compressible to 16 Kbit/s.

Station-in-fade distribution for COS=2 when RB sent at 2Mbit/s, 1/2 coded

	64Kbps	16Kbps	64Kbps	16Kbps	64Kbps	16Kbps	64Kbps	16Kbps	64Kbps	16Kbps	64Kbps	16Kbps	64Kbps	16Kbps
13,14	2	2	1	2	1	2	1	2	1	2	1	2	1	2
12	-	-	2	3	1	2	1	2	1	2	1	2	1	2
10,11	-	-	-	-	2	2	1	2	1	2	1	2	1	2
9	-	-	-	-	-	-	2	2	2	2	1	2	1	2
7,8	-	-	-	-	-	-	-	-	2	2	2	2	2	2
5,6	-	-	-	-	-	-	-	-	-	-	2	2	2	2
2,3,4	-	-	-	-	-	-	-	-	-	-	-	-	2	2
0,1	19	22	13	24	10	25	8	24	4	24	3	22	1	20

Tab. 21 - 45 stations

In the range from 15 up to 18 dB of fade, only 11 64-Kbit/s stream allocations can be accommodated, as shown in Tabs. 4 and 5. But, 32 stream allocations are supported, as shown in Tabs. 18 and 19 if about 88% of them are compressible.

Fig. 13 is a general scenario of the supported number of stream allocations in all the fade ranges.

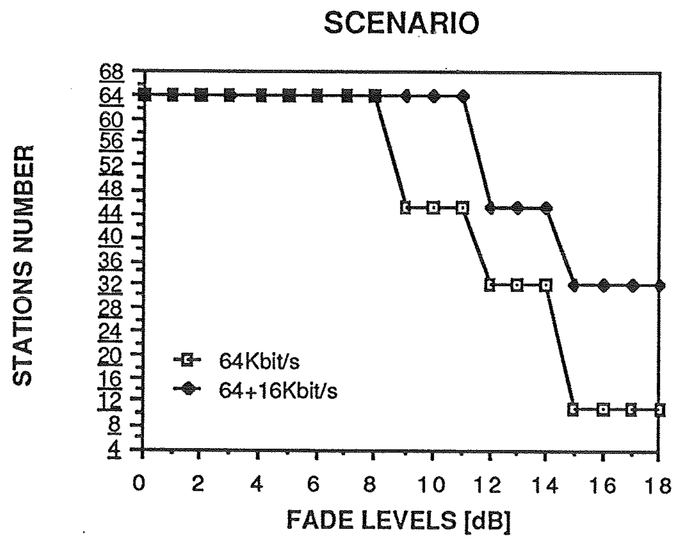


Fig. 13

11. CONSIDERATIONS ABOUT THE DSF

The results of the simulation study of the FODA system at 2Mbit/s fixed rate, have shown that 2048 bits, after eventual coding, are the minimum threshold for transmitting data with a good channel efficiency. To this number, the transmission overhead must be added.

When 18 dB of fade must be countered, it results that the condition :

Ri x = 2048

must be satisfied, where Ri is the redundancy factor of the data and x the net number of bits. For data sent in class of service 2, Ri varies from 1 (data sent to a station not in fade) up to 16 (data sent to a station experiencing a fade of 18dB). Therefore, the net number of bits ranges from 2048 up to 128. As the overhead is always sent with Rs=8, and considering the satellite header sent at Ri=16 (COS=1 or 2) and to Ri=1, it results that, at 18 dB of fade, the minimum datagram allocations ranges <u>from 8192 bits</u>, considering:

preamble + (csb 1/2 coded) *Rs => 480*8=3840
satellite header at Ri = 16 => 144*16=2304
2048 bits of data (after eventual coding)

<u>to 6032 bits</u>, considering:

preamble + (csb 1/2 coded) *Rs => 480*8=3840
satellite header at Ri = 1 => 144
2048 bits of data (after eventual coding).

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APPENDIX

	A	B	C	D	E	F	G
1	**Fade level**	**Ri(COS = 1)**	**RB**	**CSF**	**RB+CSF**	**SRB**	**Free space**
2	0	1	832	2660	3492	1952	252508
3	1	1.14	887	2743	3630	2167	252370
4	2	1.14	887	2743	3630	2167	252370
5	3	1.14	887	2743	3630	2167	252370
6	4	1.33	960	2854	3814	2454	252186
7	5	1.33	960	2854	3814	2454	252186
8	6	1.5	1024	2950	3974	2704	253296
9	7	1.5	1024	2950	3974	2704	253296
10	8	2	1216	3240	4456	3456	252544
11	9	3	2048	5740	7788	5408	250592
12	10	3	2048	5740	7788	5408	250592
13	11	4	2432	6320	8752	6912	249088
14	12	6	4096	11320	15416	10816	245184
15	13	6	4096	11320	15416	10816	245184
16	14	8	4864	12480	17344	13824	242176
17	15	12	8192	22480	30672	21632	234368
18	16	12	8192	22480	30672	21632	234368
19	17	16	9728	24800	34528	27648	228352
20	18	16	9728	24800	34528	27648	228352
21							
22							
23	**The bit rate used for all the preambles is driven by the bit rate of the RB.**						
24	**Therefore, the driving bit rate is that one of the COS = 1.**						
25	**The considered throughput for the stream requests is 16Kbit/s.**						
26	**RB computed for 32 stream+10 datagram allocations**						
27	guard time	40					
28	shdr	144					
29	csb	128					
30	tr.put	2048					
31	preamble	352					
32							
33	**Fade level**	**Ri (COS=3)**	**pr. at 2Mbps**	**pr. at 1Mbps**	**Stream SBF**	**Datag. SBF**	
34	0	1	4152	6072	126254	126254	
35	1	1	4152	6072	126185	126185	
36	2	1	4152	6072	126185	126185	
37	3	1	4152	6072	126185	126185	
38	4	1.14	4459	6379	126093	126093	
39	5	1.14	4459	6379	126093	126093	
40	6	1.14	4459	6379	126648	126648	
41	7	1.33	4875	6795	126648	126648	
42	8	1.33	4875	6795	126272	126272	
43	9	1.5	5248	7168	187944	62648	
44	10	2.66	7791	9711	187944	62648	
45	11	2.66	7791	9711	186816	62272	
46	12	3	8536	10456	183888	61296	
47	13	5.33	13643	15563	183888	61296	
48	14	5.33	13643	15563	181632	60544	
49	15	6		17032	175776	58592	
50	16	10.66		27247	175776	58592	
51	17	10.66		27247	171264	57088	
52	18	12		30184	171264	57088	
53							
54	(*) These colums show the bit occupancy of a 16Kbit/s stream allocation for the various						
55	Ri of the COS=3 when all the preambles must be sent at bit rate 2 and 1 respectively.						
56			TABLE 2.COS3				
57							

EB/N0			CODINGS		
	1	7/8	3/4	2/3	1/2
12	10**-8	<	<	<	<
11	2.5*10**-7	<	<	<	<
10	4*10**-6	<	<	<	<
9	3.5*10**-5	<	<	<	<
8	2*10**-4	3*10**-8	..	<	<
7	7.5*10**-4	10**-6	<	<	<
6	2.5*10**-3	3.5*10**-5	4*10**-8	<	<
5	6*10**-3	6.5*10**-4	1.5*10**-6	<	<
4	1.5*10**-2	8*10**-3	3*10**-5	2*10**-7	<
3	2.5*10**-2	---	7*10**-4	6*10**-6	1.5*10**-8
2	4*10**-2	---	10**-2	10**-4	8*10**-7
1	6*10**-2	---	---	2*10**-3	10**-4
0	8*10**-2	---	---	---	4*10**-4

Eb/N0-TABLE

Relationship between the Eb/No values and the bit rates.

	A	B	C	D	E	F	G	H	I	J	K
1											
2		CLASS OF SERVICE #1					CLASS OS SERVICE #2				
3	**Fade level**	**Bit rate**	**Coding rate**	**Rs**	**Rc**	**Ri**	**Bit rate**	**Coding rate**	**Rs**	**Rc**	**Ri**
4	0	8	1	1	1	1	8	1	1	1	1
5	1	8	7/8	1	8/7	8/7	8	1	1	1	1
6	2	8	7/8	1	8/7	8/7	8	7/8	1	8/7	8/7
7	3	8	7/8	1	8/7	8/7	8	7/8	1	8/7	8/7
8	4	8	3/4	1	4/3	4/3	8	7/8	1	8/7	8/7
9	5	8	3/4	1	4/3	4/3	8	3/4	1	4/3	4/3
10	6	8	2/3	1	3/2	3/2	8	3/4	1	4/3	4/3
11	7	8	2/3	1	3/2	3/2	8	2/3	1	3/2	3/2
12	8	8	1/2	1	2	2	8	2/3	1	3/2	3/2
13	9	4	2/3	2	3/2	3	8	1/2	1	2	2
14	10	4	2/3	2	3/2	3	4	2/3	2	3/2	3
15	11	4	1/2	2	2	4	4	2/3	2	3/2	3
16	12	2	2/3	4	3/2	6	4	1/2	2	2	4
17	13	2	2/3	4	3/2	6	2	2/3	4	3/2	6
18	14	2	1/2	4	2	8	2	2/3	4	3/2	6
19	15	1	2/3	8	3/2	12	2	1/2	4	2	8
20	16	1	2/3	8	3/2	12	1	2/3	8	3/2	12
21	17	1	1/2	8	2	16	1	2/3	8	3/2	12
22	18	1	1/2	8	2	16	1	1/2	8	2	16
23											
24											
25		CLASS OF SERVICE #3					CLASS OS SERVICE #4				
26	**Fade level**	**Bit rate**	**Coding rate**	**Rs**	**Rc**	**Ri**	**Bit rate**	**Coding rate**	**Rs**	**Rc**	**Ri**
27	0	8	1	1	1	1	8	1	1	1	1
28	1	8	1	1	1	1	8	1	1	1	1
29	2	8	1	1	1	1	8	1	1	1	1
30	3	8	1	1	1	1	8	1	1	1	1
31	4	8	7/8	1	8/7	8/7	8	1	1	1	1
32	5	8	7/8	1	8/7	8/7	8	1	1	1	1
33	6	8	7/8	1	8/7	8/7	8	7/8	1	8/7	8/7
34	7	8	3/4	1	4/3	4/3	8	7/8	1	8/7	8/7
35	8	8	3/4	1	4/3	4/3	8	3/4	1	4/3	4/3
36	9	8	2/3	1	3/2	3/2	8	3/4	1	4/3	4/3
37	10	4	3/4	2	4/3	8/3	4	7/8	2	8/7	16/7
38	11	4	3/4	2	4/3	8/3	4	3/4	2	4/3	8/3
39	12	4	2/3	2	3/2	3	4	3/4	2	4/3	8/3
40	13	2	3/4	4	4/3	16/3	2	7/8	4	8/7	32/7
41	14	2	3/4	4	4/3	16/3	2	3/4	4	4/3	16/3
42	15	2	2/3	4	3/2	6	2	3/4	4	4/3	16/3
43	16	1	3/4	8	4/3	32/3	1	7/8	8	8/7	64/7
44	17	1	3/4	8	4/3	32/3	1	3/4	8	4/3	32/3
45	18	1	2/3	8	3/2	12	1	3/4	8	4/3	32/3
46											
47											
48											
49					Ri-TABLE						
50			The Ri factors for COS #1, 2, 3, 4								
51											
52											
53											
54											
55											
56											
57											

	64 STREAM ALLOCATIONS			
	10 DATAGRAM ALLOCATIONS			
	RB occ. Rc*1	RB occ. Rc*2	RB occ. Rc *4	RB occ. Rc*8
RB occ. 1*Rs	832	1664	3328	6656
RB occ. 8/7*Rs	887	1774	3547	7095
RB occ. 4/3*Rs	960	1920	3840	7680
RB occ. 3/2*Rs	1024	2048	4096	8192
RB occ. 2*Rs	1216	2432	4864	9728
	SRB occ. Rc*1	SRB occ. Rc*2	SRB occ. Rc *4	SRB occ. Rc*8
SRB occ. 1*Rs	2976	5952	11904	23808
SRB occ. 8/7*Rs	3337	6674	13349	26697
SRB occ. 4/3*Rs	3819	7637	15275	30549
SRB occ. 3/2*Rs	4240	8480	16960	33920
SRB occ. 2*Rs	5504	11008	22016	44032
	RB % Rc*1	RB % Rc*2	RB % Rc *4	RB % Rc*8
RB % 1*Rs	0.33	0.65	1.30	2.60
RB % 8/7*Rs	0.35	0.69	1.39	2.77
RB % 4/3*Rs	0.38	0.75	1.50	3.00
RB % 3/2*Rs	0.40	0.80	1.60	3.20
RB % 2*Rs	0.48	0.95	1.90	3.80
	SRB % Rc*1	SRB % Rc*2	SRB % Rc *4	SRB % Rc*8
SRB % 1*Rs	1.16	2.33	4.65	9.30
SRB % 8/7*Rs	1.30	2.61	5.21	10.43
SRB % 4/3*Rs	1.49	2.98	5.97	11.93
SRB % 3/2*Rs	1.66	3.31	6.63	13.25
SRB % 2*Rs	2.15	4.30	8.60	17.20
	RB [ms] Rc*1	RB [ms] Rc*2	RB [ms] Rc *4	RB [ms] Rc*8
RB [ms] 1*Rs	0.10	0.20	0.41	0.81
RB [ms] 8/7*Rs	0.11	0.22	0.43	0.87
RB [ms] 4/3*Rs	0.12	0.23	0.47	0.94
RB [ms] 3/2*Rs	0.13	0.25	0.50	1.00
RB [ms] 2*Rs	0.15	0.30	0.59	1.19
	SRB [ms] Rc*1	SRB [ms] Rc*2	SRB [ms] Rc *4	SRB [ms] Rc*8
SRB [ms] 1*Rs	0.36	0.73	1.45	2.91
SRB [ms] 8/7*Rs	0.41	0.81	1.63	3.26
SRB [ms] 4/3*Rs	0.47	0.93	1.86	3.73
SRB [ms] 3/2*Rs	0.52	1.04	2.07	4.14
SRB [ms] 2*Rs	0.67	1.34	2.69	5.38
		RB-TABLE 1.		
RB basic bit length =		384		
SRB basic bit length =		2528		

A	B	C	D	E
		48 STREAM ALLOCATIONS		
		10 DATAGRAM ALLOCATIONS		
	RB occ.Rc*1	RB occ.Rc*2	RB occ. Rc *4	RB occ. Rc*8
RB occ. 1*Rs	832.00	1664.00	3328.00	6656.00
RB occ. 8/7*Rs	886.86	1773.71	3547.43	7094.86
RB occ. 4/3*Rs	960.00	1920.00	3840.00	7680.00
RB occ. 3/2*Rs	1024.00	2048.00	4096.00	8192.00
RB occ. 2*Rs	1216.00	2432.00	4864.00	9728.00
	SRB occ.Rc*1	SRB occ. Rc*2	SRB occ. Rc *4	SRB occ. Rc*8
SRB occ. 1*Rs	2464.00	4928.00	9856.00	19712.00
SRB occ. 8/7*Rs	2752.00	5504.00	11008.00	22016.00
SRB occ. 4/3*Rs	3136.00	6272.00	12544.00	25088.00
SRB occ. 3/2*Rs	3472.00	6944.00	13888.00	27776.00
SRB occ. 2*Rs	4480.00	8960.00	17920.00	35840.00
	RB % Rc*1	RB % Rc*2	RB % Rc *4	RB % Rc*8
RB % 1*Rs	0.33	0.65	1.30	2.60
RB % 8/7*Rs	0.35	0.69	1.39	2.77
RB % 4/3*Rs	0.38	0.75	1.50	3.00
RB % 3/2*Rs	0.40	0.80	1.60	3.20
RB % 2*Rs	0.48	0.95	1.90	3.80
	SRB % Rc*1	SRB % Rc*2	SRB % Rc *4	SRB % Rc*8
SRB % 1*Rs	0.96	1.93	3.85	7.70
SRB % 8/7*Rs	1.08	2.15	4.30	8.60
SRB % 4/3*Rs	1.23	2.45	4.90	9.80
SRB % 3/2*Rs	1.36	2.71	5.43	10.85
SRB % 2*Rs	1.75	3.50	7.00	14.00
	RB [ms] Rc*1	RB [ms] Rc*2	RB [ms] Rc *4	RB [ms] Rc*8
RB [ms] 1*Rs	0.10	0.20	0.41	0.81
RB [ms] 8/7*Rs	0.11	0.22	0.43	0.87
RB [ms] 4/3*Rs	0.12	0.23	0.47	0.94
RB [ms] 3/2*Rs	0.13	0.25	0.50	1.00
RB [ms] 2*Rs	0.15	0.30	0.59	1.19
	SRB [ms] Rc*1	SRB [ms] Rc*2	SRB [ms] Rc *4	SRB [ms] Rc*8
SRB [ms] 1*Rs	0.30	0.60	1.20	2.41
SRB [ms] 8/7*Rs	0.34	0.67	1.34	2.69
SRB [ms] 4/3*Rs	0.38	0.77	1.53	3.06
SRB [ms] 3/2*Rs	0.42	0.85	1.70	3.39
SRB [ms] 2*Rs	0.55	1.09	2.19	4.38
		RB-TABLE 2		
RB basic length =		384		
SRB basic length =		2016		

A	B	C	D	E	F
		45 STREAM ALLOCATIONS			
		10 DATAGRAM ALLOCATIONS			
	RB occ.Rc*1	RB occ.Rc*2	RB occ. Rc *4	RB occ. Rc*8	
RB occ. 1*Rs	832	1664	3328	6656	
RB occ. 8/7*Rs	886.86	1773.71	3547.43	7094.86	
RB occ. 4/3*Rs	960	1920	3840	7680	
RB occ. 3/2*Rs	1024	2048	4096	8192	
RB occ. 2*Rs	1216	2432	4864	9728	
	SRB occ.Rc*1	SRB occ. Rc*2	SRB occ. Rc *4	SRB occ. Rc*8	
SRB occ. 1*Rs	2368	4736	9472	18944	
SRB occ. 8/7*Rs	2642.29	5284.57	10569.14	21138.29	
SRB occ. 4/3*Rs	3008	6016	12032	24064	
SRB occ. 3/2*Rs	3328	6656	13312	26624	
SRB occ. 2*Rs	4288	8576	17152	34304	
	RB % Rc*1	RB % Rc*2	RB % Rc *4	RB % Rc*8	
RB % 1*Rs	0.33	0.65	1.30	2.60	
RB % 8/7*Rs	0.35	0.69	1.39	2.77	
RB % 4/3*Rs	0.38	0.75	1.50	3.00	
RB % 3/2*Rs	0.40	0.80	1.60	3.20	
RB % 2*Rs	0.48	0.95	1.90	3.80	
	SRB % Rc*1	SRB % Rc*2	SRB % Rc *4	SRB % Rc*8	
SRB % 1*Rs	0.93	1.85	3.70	7.40	
SRB % 8/7*Rs	1.03	2.06	4.13	8.26	
SRB % 4/3*Rs	1.18	2.35	4.70	9.40	
SRB % 3/2*Rs	1.30	2.60	5.20	10.40	
SRB % 2*Rs	1.68	3.35	6.70	13.40	
	RB [ms] Rc*1	RB [ms] Rc*2	RB [ms] Rc *4	RB [ms] Rc*8	
RB occ. [ms] 1*R	0.10	0.20	0.41	0.81	
RB [ms] 8/7*Rs	0.11	0.22	0.43	0.87	
RB [ms] 4/3*Rs	0.12	0.23	0.47	0.94	
RB [ms] 3/2*Rs	0.13	0.25	0.50	1.00	
RB [ms] 2*Rs	0.15	0.30	0.59	1.19	
	SRB [ms] Rc*1	SRB [ms] Rc*2	SRB [ms] Rc *4	SRB [ms] Rc*8	
SRB [ms] 1*Rs	0.29	0.58	1.16	2.31	
SRB [ms] 8/7*Rs	0.32	0.65	1.29	2.58	
SRB [ms] 4/3*Rs	0.37	0.73	1.47	2.94	
SRB [ms] 3/2*Rs	0.41	0.81	1.63	3.25	
SRB [ms] 2*Rs	0.52	1.05	2.09	4.19	
		RB-TABLE 3			
RB basic length =		384 bits			
SRB basic length =		1920 bits			

		32 STREAM ALLOCATIONS		
		10 DATAGRAM ALLOCATIONS		
	RB occ.Rc*1	RB occ.Rc*2	RB occ. Rc *4	RB occ. Rc*8
RB occ. 1*Rs	832.00	1664.00	3328.00	6656.00
RB occ. 8/7*Rs	886.86	1773.71	3547.43	7094.86
RB occ. 4/3*Rs	960.00	1920.00	3840.00	7680.00
RB occ. 3/2*Rs	1024.00	2048.00	4096.00	8192.00
RB occ. 2*Rs	1216.00	2432.00	4864.00	9728.00
	SRB occ.Rc*1	SRB occ. Rc*2	SRB occ. Rc *4	SRB occ. Rc*8
SRB occ. 1*Rs	1952.00	3904.00	7808.00	15616.00
SRB occ. 8/7*Rs	2166.86	4333.71	8667.43	17334.86
SRB occ. 4/3*Rs	2453.33	4906.67	9813.33	19626.67
SRB occ. 3/2*Rs	2704.00	5408.00	10816.00	21632.00
SRB occ. 2*Rs	3456.00	6912.00	13824.00	27648.00
	RB % Rc*1	RB % Rc*2	RB % Rc *4	RB % Rc*8
RB % 1*Rs	0.33	0.65	1.30	2.60
RB % 8/7*Rs	0.35	0.69	1.39	2.77
RB % 4/3*Rs	0.38	0.75	1.50	3.00
RB % 3/2*Rs	0.40	0.80	1.60	3.20
RB % 2*Rs	0.48	0.95	1.90	3.80
	SRB % Rc*1	SRB % Rc*2	SRB % Rc *4	SRB % Rc*8
SRB % 1*Rs	0.76	1.53	3.05	6.10
SRB % 8/7*Rs	0.85	1.69	3.39	6.77
SRB % 4/3*Rs	0.96	1.92	3.83	7.67
SRB % 3/2*Rs	1.06	2.11	4.23	8.45
SRB % 2*Rs	1.35	2.70	5.40	10.80
	RB [ms] Rc*1	RB [ms] Rc*2	RB [ms] Rc *4	RB [ms] Rc*8
RB [ms] 1*Rs	0.10	0.20	0.41	0.81
RB [ms] 8/7*Rs	0.11	0.22	0.43	0.87
RB [ms] 4/3*Rs	0.12	0.23	0.47	0.94
RB [ms] 3/2*Rs	0.13	0.25	0.50	1.00
RB [ms] 2*Rs	0.15	0.30	0.59	1.19
	SRB [ms] Rc*1	SRB [ms] Rc*2	SRB [ms] Rc *4	SRB [ms] Rc*8
SRB [ms] 1*Rs	0.24	0.48	0.95	1.91
SRB [ms] 8/7*Rs	0.26	0.53	1.06	2.12
SRB [ms] 4/3*Rs	0.30	0.60	1.20	2.40
SRB [ms] 3/2*Rs	0.33	0.66	1.32	2.64
SRB [ms] 2*Rs	0.42	0.84	1.69	3.38
		RB-TABLE 4		
RB basic bit length =		384		
SRB basic bit length =		1504		

64 STREAM ALLOCATIONS

64 DATAGRAM ALLOCATIONS

	RB occ.Rc*1	RB occ.Rc*2	RB occ. Rc *4	RB occ. Rc*8
RB occ. 1*Rs	2560	5120	10240	20480
RB occ. 8/7*Rs	2862	5723	11447	22894
RB occ. 4/3*Rs	3264	6528	13056	26112
RB occ. 3/2*Rs	3616	7232	14464	28928
RB occ. 2*Rs	4672	9344	18688	37376

	SRB occ.Rc*1	SRB occ. Rc*2	SRB occ. Rc *4	SRB occ. Rc*8
SRB occ. 1*Rs	4704	9408	18816	37632
SRB occ. 8/7*Rs	5312	10624	21248	42496
SRB occ. 4/3*Rs	6123	12245	24491	48981
SRB occ. 3/2*Rs	6832	13664	27328	54656
SRB occ. 2*Rs	8960	17920	35840	71680

	RB % Rc*1	RB % Rc*2	RB % Rc *4	RB % Rc*8
RB % 1*Rs	1.00	2.00	4.00	8.00
RB % 8/7*Rs	1.12	2.24	4.47	8.94
RB % 4/3*Rs	1.28	2.55	5.10	10.20
RB % 3/2*Rs	1.41	2.83	5.65	11.30
RB % 2*Rs	1.83	3.65	7.30	14.60

	SRB % Rc*1	SRB % Rc*2	SRB % Rc *4	SRB % Rc*8
SRB % 1*Rs	1.84	3.68	7.35	14.70
SRB % 8/7*Rs	2.08	4.15	8.30	16.60
SRB % 4/3*Rs	2.39	4.78	9.57	19.13
SRB % 3/2*Rs	2.67	5.34	10.68	21.35
SRB % 2*Rs	3.50	7.00	14.00	28.00

	RB [ms] Rc*1	RB [ms] Rc*2	RB [ms] Rc *4	RB [ms] Rc*8
RB [ms] 1*Rs	0.31	0.63	1.25	2.50
RB [ms] 8/7*Rs	0.35	0.70	1.40	2.79
RB [ms] 4/3*Rs	0.40	0.80	1.59	3.19
RB [ms] 3/2*Rs	0.44	0.88	1.77	3.53
RB [ms] 2*Rs	0.57	1.14	2.28	4.56

	SRB [ms] Rc*1	SRB [ms] Rc*2	SRB [ms] Rc *4	SRB [ms] Rc*8
SRB [ms] 1*Rs	0.57	1.15	2.30	4.59
SRB [ms] 8/7*Rs	0.65	1.30	2.59	5.19
SRB [ms] 4/3*Rs	0.75	1.49	2.99	5.98
SRB [ms] 3/2*Rs	0.83	1.67	3.34	6.67
SRB [ms] 2*Rs	1.09	2.19	4.38	8.75

RB - TABLE 5

64 STREAM ALLOCATIONS

32 DATAGRAM ALLOCATIONS

	RB occ.Rc*1	RB occ.Rc*2	RB occ. Rc *4	RB occ. Rc*8
RB occ. 1*Rs	1536	3072	6144	12288
RB occ. 8/7*Rs	1691	3383	6766	13531
RB occ. 4/3*Rs	1899	3797	7595	15189
RB occ. 3/2*Rs	2080	4160	8320	16640
RB occ. 2*Rs	2624	5248	10496	20992

	SRB occ.Rc*1	SRB occ. Rc*2	SRB occ. Rc *4	SRB occ. Rc*8
SRB occ. 1*Rs	3680	7360	14720	29440
SRB occ. 8/7*Rs	4142	8283	16567	33134
SRB occ. 4/3*Rs	4757	9515	19029	38059
SRB occ. 3/2*Rs	5296	10592	21184	42368
SRB occ. 2*Rs	6912	13824	27648	55296

	RB % Rc*1	RB % Rc*2	RB % Rc *4	RB % Rc*8
RB % 1*Rs	0.60	1.20	2.40	4.80
RB % 8/7*Rs	0.66	1.32	2.64	5.29
RB % 4/3*Rs	0.74	1.48	2.97	5.93
RB % 3/2*Rs	0.81	1.63	3.25	6.50
RB % 2*Rs	1.03	2.05	4.10	8.20

	SRB % Rc*1	SRB % Rc*2	SRB % Rc *4	SRB % Rc*8
SRB % 1*Rs	1.44	2.88	5.75	11.50
SRB % 8/7*Rs	1.62	3.24	6.47	12.94
SRB % 4/3*Rs	1.86	3.72	7.43	14.87
SRB % 3/2*Rs	2.07	4.14	8.28	16.55
SRB % 2*Rs	2.70	5.40	10.80	21.60

	RB [ms] Rc*1	RB [ms] Rc*2	RB [ms] Rc *4	RB [ms] Rc*8
RB [ms] 1*Rs	0.19	0.38	0.75	1.50
RB [ms] 8/7*Rs	0.21	0.41	0.83	1.65
RB [ms] 4/3*Rs	0.23	0.46	0.93	1.85
RB [ms] 3/2*Rs	0.25	0.51	1.02	2.03
RB [ms] 2*Rs	0.32	0.64	1.28	2.56

	SRB [ms] Rc*1	SRB [ms] Rc*	SRB [ms] Rc *4	SRB [ms] Rc*8
SRB [ms] 1*Rs	0.45	0.90	1.80	3.59
SRB [ms] 8/7*Rs	0.51	1.01	2.02	4.04
SRB [ms] 4/3*Rs	0.58	1.16	2.32	4.65
SRB [ms] 3/2*Rs	0.65	1.29	2.59	5.17
SRB [ms] 2*Rs	0.84	1.69	3.38	6.75

RB - TABLE 6

64 STREAM ALLOCATIONS,
16 DATAGRAM ALLOCATIONS

	RB occ.Rc*1	RB occ.Rc*2	RB occ. Rc *4	RB occ. Rc*8
RB occ. 1*Rs	1024	2048	4096	8192
RB occ. 8/7*Rs	1106	2213	4425	8850
RB occ. 4/3*Rs	1216	2432	4864	9728
RB occ. 3/2*Rs	1312	2624	5248	10496
RB occ. 2*Rs	1600	3200	6400	12800
	SRB occ.Rc*1	SRB occ. Rc*2	SRB occ. Rc *4	SRB occ. Rc*8
SRB occ. 1*Rs	3168	6336	12672	25344
SRB occ. 8/7*Rs	3557	7113	14226	28453
SRB occ. 4/3*Rs	4075	8149	16299	32597
SRB occ. 3/2*Rs	4528	9056	18112	36224
SRB occ. 2*Rs	5888	11776	23552	47104
	RB % Rc*1	RB % Rc*2	RB % Rc *4	RB % Rc*8
RB % 1*Rs	0.40	0.80	1.60	3.20
RB % 8/7*Rs	0.43	0.86	1.73	3.46
RB % 4/3*Rs	0.48	0.95	1.90	3.80
RB % 3/2*Rs	0.51	1.03	2.05	4.10
RB % 2*Rs	0.63	1.25	2.50	5.00
	SRB % Rc*1	SRB % Rc*2	SRB % Rc *4	SRB % Rc*8
SRB % 1*Rs	1.24	2.48	4.95	9.90
SRB % 8/7*Rs	1.39	2.78	5.56	11.11
SRB % 4/3*Rs	1.59	3.18	6.37	12.73
SRB % 3/2*Rs	1.77	3.54	7.08	14.15
SRB % 2*Rs	2.30	4.60	9.20	18.40
	RB [ms] Rc*1	RB [ms] Rc*2	RB [ms] Rc *4	RB [ms] Rc*8
RB [ms] 1*Rs	0.13	0.25	0.50	1.00
RB [ms] 8/7*Rs	0.14	0.27	0.54	1.08
RB [ms] 4/3*Rs	0.15	0.30	0.59	1.19
RB [ms] 3/2*Rs	0.16	0.32	0.64	1.28
RB [ms] 2*Rs	0.20	0.39	0.78	1.56
	SRB [ms] Rc*1	SRB [ms] Rc*2	SRB [ms] Rc *4	SRB [ms] Rc*8
SRB [ms] 1*Rs	0.39	0.77	1.55	3.09
SRB [ms] 8/7*Rs	0.43	0.87	1.74	3.47
SRB [ms] 4/3*Rs	0.50	0.99	1.99	3.98
SRB [ms] 3/2*Rs	0.55	1.11	2.21	4.42
SRB [ms] 2*Rs	0.72	1.44	2.88	5.75

RB - TABLE 7

A	B	C	D	E
		32 STREAM ALLOCATIONS		
		32 DATAGRAM ALLOCATIONS		
	RB occ.Rc*1	RB occ.Rc*2	RB occ. Rc *4	RB occ. Rc*8
RB occ. 1*Rs	1536	3072	6144	12288
RB occ. 8/7*Rs	1691	3383	6766	13531
RB occ. 4/3*Rs	1899	3797	7595	15189
RB occ. 3/2*Rs	2080	4160	8320	16640
RB occ. 2*Rs	2624	5248	10496	20992
	SRB occ.Rc*1	SRB occ. Rc*2	SRB occ. Rc *4	SRB occ. Rc*8
SRB occ. 1*Rs	2656	5312	10624	21248
SRB occ. 8/7*Rs	2971	5943	11886	23771
SRB occ. 4/3*Rs	3392	6784	13568	27136
SRB occ. 3/2*Rs	3760	7520	15040	30080
SRB occ. 2*Rs	4864	9728	19456	38912
	RB % Rc*1	RB % Rc*2	RB % Rc *4	RB % Rc*8
RB % 1*Rs	0.60	1.20	2.40	4.80
RB % 8/7*Rs	0.66	1.32	2.64	5.29
RB % 4/3*Rs	0.74	1.48	2.97	5.93
RB % 3/2*Rs	0.81	1.63	3.25	6.50
RB % 2*Rs	1.03	2.05	4.10	8.20
	SRB % Rc*1	SRB % Rc*2	SRB % Rc *4	SRB % Rc*8
SRB % 1*Rs	1.04	2.08	4.15	8.30
SRB % 8/7*Rs	1.16	2.32	4.64	9.29
SRB % 4/3*Rs	1.33	2.65	5.30	10.60
SRB % 3/2*Rs	1.47	2.94	5.88	11.75
SRB % 2*Rs	1.90	3.80	7.60	15.20
	RB [ms] Rc*1	RB [ms] Rc*2	RB [ms] Rc *4	RB [ms] Rc*8
RB [ms] 1*Rs	0.19	0.38	0.75	1.50
RB [ms] 8/7*Rs	0.21	0.41	0.83	1.65
RB [ms] 4/3*Rs	0.23	0.46	0.93	1.85
RB [ms] 3/2*Rs	0.25	0.51	1.02	2.03
RB [ms] 2*Rs	0.32	0.64	1.28	2.56
	SRB [ms] Rc*1	SRB [ms] Rc*2	SRB [ms] Rc *4	SRB [ms] Rc*8
SRB [ms] 1*Rs	0.32	0.65	1.30	2.59
SRB [ms] 8/7*Rs	0.36	0.73	1.45	2.90
SRB [ms] 4/3*Rs	0.41	0.83	1.66	3.31
SRB [ms] 3/2*Rs	0.46	0.92	1.84	3.67
SRB [ms] 2*Rs	0.59	1.19	2.38	4.75
		RB-TABLE 8		

A	B	C	D	E
		CONTROL SUB-FRAME OCCUPANCY		
	1 CS occ. Rc * 1	1 CS occ. Rc * 2	1 CS occ. Rc * 4	1 CS occ. Rc * 8
1 CS occ. 1 * Rs	625.00	1250.00	2500.00	5000.00
1 CS occ. 8/7 * Rs	645.71	1291.43	2582.86	5165.71
1 CS occ. 4/3 * Rs	673.33	1346.67	2693.33	5386.67
1 CS occ. 3/2 * Rs	697.50	1395.00	2790.00	5580.00
1 CS occ. 2 * Rs	770.00	1540.00	3080.00	6160.00
	1 CS %. Rc * 1	1 CS % Rc * 2	1 CS %. Rc * 4	1 CS % Rc * 8
1 CS %. 1 * Rs	0.24	0.49	0.98	1.95
1 CS %. 8/7 * Rs	0.25	0.50	1.01	2.02
1 CS %. 4/3 * Rs	0.26	0.53	1.05	2.10
1 CS %. 3/2 * Rs	0.27	0.54	1.09	2.18
1 CS %. 2 * Rs	0.30	0.60	1.20	2.41
	1 CS [ms] Rc * 1	1 CS [ms] Rc * 2	1 CS [ms] Rc * 4	1 CS [ms] Rc * 8
1 CS [ms] 1 * Rs	0.08	0.15	0.31	0.61
1 CS [ms] 8/7 * Rs	0.08	0.16	0.32	0.63
1 CS [ms] 4/3 * Rs	0.08	0.16	0.33	0.66
1 CS [ms] 3/2 * Rs	0.09	0.17	0.34	0.68
1 CS [ms] 2 * Rs	0.09	0.19	0.38	0.75
	CSF occ. Rc * 1	CSF occ. Rc * 2	CSF occ. Rc * 4	CSF occ. Rc * 8
CSF occ. 1 * Rs	2660.00	5160.00	10160.00	20160.00
CSF occ. 8/7 * Rs	2742.86	5325.71	10491.43	20822.86
CSF occ. 4/3 * Rs	2853.33	5546.67	10933.33	21706.67
CSF occ. 3/2 * Rs	2950.00	5740.00	11320.00	22480.00
CSF occ. 2 * Rs	3240.00	6320.00	12480.00	24800.00
	CSF %. Rc * 1	CSF % Rc * 2	CSF %. Rc * 4	CSF % Rc * 8
CSF %. 1 * Rs	1.04	2.02	3.97	7.88
CSF %. 8/7 * Rs	1.07	2.08	4.10	8.13
CSF %. 4/3 * Rs	1.11	2.17	4.27	8.48
CSF %. 3/2 * Rs	1.15	2.24	4.42	8.78
CSF %. 2 * Rs	1.27	2.47	4.88	9.69
	CSF [ms] Rc * 1	CSF [ms] Rc * 2	CSF [ms] Rc * 4	CSF [ms] Rc * 8
CSF [ms] 1 * Rs	0.32	0.63	1.24	2.46
CSF [ms] 8/7 * Rs	0.33	0.65	1.28	2.54
CSF[ms] 4/3 * Rs	0.35	0.68	1.33	2.65
CSF[ms] 3/2 * Rs	0.36	0.70	1.38	2.74
CSF[ms] 2 * Rs	0.40	0.77	1.52	3.03
		CSF-TABLE 1		
4 control slots				
small data in each control slot = 1 Elementary slot = 16 bytes				
1 control slot = preamble + CSB + 1 satellite header + small data				
1 satellite header = 18 bytes				
1 guard time = 40 bits				

Fade level	Ri(COS = 1)	RB+CSF (COS=1)	Ri (COS=2)	Rs (COS=1)	Stream SBF	DTG SBF
0	1	3492	1	1	126254	126254
1	1.14	3629	1	1	126186	126186
2	1.14	3629	1.14	1	126186	126186
3	1.14	3629	1.14	1	126186	126186
4	1.33	3813	1.14	1	126094	126094
5	1.33	3813	1.33	1	126094	126094
6	1.5	3974	1.33	1	126013	126013
7	1.5	3974	1.5	1	126013	126013
8	2	4456	1.5	1	125772	125772
9	3	7788	2	2	186159	62053
10	3	7788	3	2	186159	62053
11	4	8752	3	2	185436	61812
12	6	15416	4	4	180438	60146
13	6	15416	6	4	180438	60146
14	8	17344	6	4	178992	59664
15	12	30672	8	8	168996	56332
16	12	30672	12	8	168996	56332
17	16	34528	12	8	166104	55368
18	16	34528	16	8	166104	55368

RB computed for 10 datagram allocations.
The bit rate used for all the preambles is driven by the bit rate of the RB.
Therefore, the driving bit rate is that one of the COS = 1.
The considered throughput for the stream requests is 64Kbit/s.

guard time	40
shdr	144
csb	128
tr.put	2048
preamble	352

pr. at 8Mbps	pr. at 4Mbps	pr. at 2Mbps	pr. at 1Mbps	Fade level	Ri (COS=2)
2712	3192	4152	6072	0	1
2712	3192	4152	6072	1	1
3019	3499	4459	6379	2	1.14
3019	3499	4459	6379	3	1.14
3019	3499	4459	6379	4	1.14
3435	3915	4875	6795	5	1.33
3435	3915	4875	6795	6	1.33
3808	4288	5248	7168	7	1.5
3808	4288	5248	7168	8	1.5
	5384	6344	8264	9	2
	7576	8536	10456	10	3
	7576	8536	10456	11	3
		10728	12648	12	4
		15112	17032	13	6
		15112	17032	14	6
			21416	15	8
			30184	16	12
			30184	17	12
			38952	18	16

(*) These colums show the bit occupancy of a 64Kbit/s stream allocation for the various Ri of the COS=2 when all the preambles must be sent at bit rate 8,4,2,1 respectively.

ST-TAB 1

Fade level	Ri(COS = 1)	RB+CSF (COS=1)	Ri (COS=2)	Rs (COS=1)	Stream SBF	DTG SBF
0	1	3492	1	1	126254	126254
1	1.14	3629	1	1	126186	126186
2	1.14	3629	1.14	1	126186	126186
3	1.14	3629	1.14	1	126186	126186
4	1.33	3813	1.14	1	126094	126094
5	1.33	3813	1.33	1	126094	126094
6	1.5	3974	1.33	1	126013	126013
7	1.5	3974	1.5	1	126013	126013
8	2	4456	1.5	1	125772	125772
9	3	7788	2	2	186159	62053
10	3	7788	3	2	186159	62053
11	4	8752	3	2	185436	61812
12	6	15416	4	4	180438	60146
13	6	15416	6	4	180438	60146
14	8	17344	6	4	178992	59664
15	12	30672	8	8	168996	56332
16	12	30672	12	8	168996	56332
17	16	34528	12	8	166104	55368
18	16	34528	16	8	166104	55368

SRB computed for 45 stream and 10 datagram allocations.
The bit rate used for all the preambles is driven by the bit rate of the RB.
Therefore, the driving bit rate is that one of the COS = 1.
The considered throughput for the stream requests is 16Kbit/s.

guard time	40
shdr	144
csb	128
tr.put	512
preamble	352

pr. at 8Mbps	pr. at 4Mbps	pr. at 2Mbps	pr. at 1Mbps	Fade level	Ri (COS=2)
1176	1656	2616	4536	0	1
1176	1656	2616	4536	1	1
1268	1748	2708	4628	2	1.14
1268	1748	2708	4628	3	1.14
1268	1748	2708	4628	4	1.14
1392	1872	2832	4752	5	1.33
1392	1872	2832	4752	6	1.33
1504	1984	2944	4864	7	1.5
1504	1984	2944	4864	8	1.5
	2312	3272	5192	9	2
	2968	3928	5848	10	3
	2968	3928	5848	11	3
		4584	6504	12	4
		5896	7816	13	6
		5896	7816	14	6
			9128	15	8
			11752	16	12
			11752	17	12
			14376	18	16

(*) These colums show the bit occupancy of a 16 Kbit/s stream allocation for the various Ri of the COS=2 when all the preambles must be sent at bit rate 8,4,2,1 respectively.

ST-C-TAB 1

Fade level	Ri(COS = 1)	RB+CSF (COS=1)	Ri (COS=3)	Rs (COS=1)	Stream SBF	DTG SBF
0	1	3492	1	1	126254	126254
1	1.14	3629	1	1	126186	126186
2	1.14	3629	1	1	126186	126186
3	1.14	3629	1	1	126186	126186
4	1.33	3813	1.14	1	126094	126094
5	1.33	3813	1.14	1	126094	126094
6	1.5	3974	1.14	1	126013	126013
7	1.5	3974	1.33	1	126013	126013
8	2	4456	1.33	1	125772	125772
9	3	7788	1.5	2	186159	62053
10	3	7788	2.66	2	186159	62053
11	4	8752	2.66	2	185436	61812
12	6	15416	3	4	180438	60146
13	6	15416	5.33	4	180438	60146
14	8	17344	5.33	4	178992	59664
15	12	30672	6	8	168996	56332
16	12	30672	10.66	8	168996	56332
17	16	34528	10.66	8	166104	55368
18	16	34528	12	8	166104	55368

The bit rate used for all the preambles is driven by the bit rate of the RB.
Therefore, the driving bit rate is that one of the COS = 1.
The considered throughput for the stream requests is 64Kbit/s.

guard time	40
shdr	144
csb	128
tr.put	2048
preamble	352

pr. at 8Mbps	pr. at 4Mbps	pr. at 2Mbps	pr. at 1Mbps	Fade level	Ri (COS=3)
2712	3192	4152	6072	0	1
2712	3192	4152	6072	1	1
2712	3192	4152	6072	2	1
2712	3192	4152	6072	3	1
3019	3499	4459	6379	4	1.14
3019	3499	4459	6379	5	1.14
3019	3499	4459	6379	6	1.14
3435	3915	4875	6795	7	1.33
3435	3915	4875	6795	8	1.33
	4288	5248	7168	9	1.5
	6831	7791	9711	10	2.66
	6831	7791	9711	11	2.66
		8536	10456	12	3
		13643	15563	13	5.33
		13643	15563	14	5.33
			17032	15	6
			27247	16	10.66
			27247	17	10.66
			30184	18	12

(*) These colums show the bit occupancy of a 64Kbit/s stream allocation for the various Ri of the COS=3 when all the preambles must be sent at bit rate 8,4,2,1 respectively.

ST-TAB.2.

Fade level	Ri(COS = 1)	RB	CSF	RB+CSF	SRB	Free space
0	1	2560	2660	5220	4704	250780
1	1.14	2862	2743	5605	5312	250395
2	1.14	2862	2743	5605	5312	250395
3	1.14	2862	2743	5605	5312	250395
4	1.33	3264	2854	6118	6123	249882
5	1.33	3264	2854	6118	6123	249882
6	1.5	3616	2950	6566	6832	249168
7	1.5	3616	2950	6566	6832	249168
8	2	4672	3240	7912	8960	247040
9	3	7232	5740	12972	13664	242336
10	3	7232	5740	12972	13664	242336
11	4	9344	6320	15664	17920	238080

The bit rate used for all the preambles is driven by the bit rate of the RB.
Therefore, the driving bit rate is that one of the COS = 1.
The considered throughput for the stream requests is 64Kbit/s.

guard time	40
shdr	144
csb	128
tr.put	2048
preamble	352

Fade level	Ri (COS=2)	pr. at 8Mbps	pr. at 4Mbps	Stream SBF	Datag. SBF
0	1	2712	3192	125390	125390
1	1	2712	3192	125198	125198
2	1.14	3019	3499	125198	125198
3	1.14	3019	3499	125198	125198
4	1.14	3019	3499	124941	124941
5	1.33	3435	3915	124941	124941
6	1.33	3435	3915	186876	62292
7	1.5	3808	4288	186876	62292
8	1.5	3808	4288	185280	61760
9	2		5384	181752	60584
10	3		7576	181752	60584
11	3		7576	178560	59520

TABLE 1. COS2

(*) These colums show the bit occupancy of a 64Kbit/s stream allocation for the various Ri of the COS=2 when all the preambles must be sent at bit rate 8 and 4 respectively.

Fade level	Ri(COS = 1)	RB	CSF	RB+CSF	SRB	Free space
0	1	2560	2660	5220	4704	250780
1	1.14	2862	2743	5605	5312	250395
2	1.14	2862	2743	5605	5312	250395
3	1.14	2862	2743	5605	5312	250395
4	1.33	3264	2854	6118	6123	249882
5	1.33	3264	2854	6118	6123	249882
6	1.5	3616	2950	6566	6832	249168
7	1.5	3616	2950	6566	6832	249168
8	2	4672	3240	7912	8960	247040
9	3	7232	5740	12972	13664	242336
10	3	7232	5740	12972	13664	242336
11	4	9344	6320	15664	17920	238080

The bit rate used for all the preambles is driven by the bit rate of the RB.
Therefore, the driving bit rate is that one of the COS = 1.
The considered throughput for the stream requests is 16Kbit/s.

guard time	40
shdr	144
csb	128
tr.put	512
preamble	352

Fade level	Ri (COS=2)	pr. at 8Mbps	pr. at 4Mbps	Stream SBF	Datag. SBF
0	1	1176	1656	125390	125390
1	1	1176	1656	125198	125198
2	1.14	1268	1748	125198	125198
3	1.14	1268	1748	125198	125198
4	1.14	1268	1748	124941	124941
5	1.33	1392	1872	124941	124941
6	1.33	1392	1872	186876	62292
7	1.5	1504	1984	186876	62292
8	1.5	1504	1984	185280	61760
9	2		2312	181752	60584
10	3		2968	181752	60584
11	3		2968	178560	59520

TABLE 1.C. COS2

(*) These colums show the bit occupancy of a 64Kbit/s stream allocation for the various Ri of the COS=2 when all the preambles must be sent at bit rate 8 and 4 respectively.

Fade level	Ri(COS = 1)	RB	CSF	RB+CSF	SRB	Free space
0	1	2560	2660	5220	4704	250780
1	1.14	2862	2743	5605	5312	250395
2	1.14	2862	2743	5605	5312	250395
3	1.14	2862	2743	5605	5312	250395
4	1.33	3264	2854	6118	6123	249882
5	1.33	3264	2854	6118	6123	249882
6	1.5	3616	2950	6566	6832	249168
7	1.5	3616	2950	6566	6832	249168
8	2	4672	3240	7912	8960	247040
9	3	7232	5740	12972	13664	242336
10	3	7232	5740	12972	13664	242336
11	4	9344	6320	15664	17920	238080

The bit rate used for all the preambles is driven by the bit rate of the RB.
Therefore, the driving bit rate is that one of the COS = 1.
The considered throughput for the stream requests is 64Kbit/s.

guard time	40
shdr	144
csb	128
tr.put	2048
preamble	352

Fade level	Ri (COS=3)	pr. at 8Mbps	pr. at 4Mbps	Stream SBF	Datag. SBF
0	1	2712	3192	125390	125390
1	1	2712	3192	125198	125198
2	1	2712	3192	125198	125198
3	1	2712	3192	125198	125198
4	1.14	3019	3499	124941	124941
5	1.14	3019	3499	124941	124941
6	1.14	3019	3499	186876	62292
7	1.33	3435	3915	186876	62292
8	1.33	3435	3915	185280	61760
9	1.5		4288	181752	60584
10	2.66		6831	181752	60584
11	2.66		6831	178560	59520

TABLE 1. COS3

(*) These colums show the bit occupancy of a 64Kbit/s stream allocation for the various Ri of the COS=3 when all the preambles must be sent at bit rate 8 and 4 respectively.

Fade level	Ri(COS = 1)	RB	CSF	RB+CSF	SRB	Free space
0	1	2560	2660	5220	4704	250780
1	1.14	2862	2743	5605	5312	250395
2	1.14	2862	2743	5605	5312	250395
3	1.14	2862	2743	5605	5312	250395
4	1.33	3264	2854	6118	6123	249882
5	1.33	3264	2854	6118	6123	249882
6	1.5	3616	2950	6566	6832	249168
7	1.5	3616	2950	6566	6832	249168
8	2	4672	3240	7912	8960	247040
9	3	7232	5740	12972	13664	242336
10	3	7232	5740	12972	13664	242336
11	4	9344	6320	15664	17920	238080

The bit rate used for all the preambles is driven by the bit rate of the RB.
Therefore, the driving bit rate is that one of the COS = 1.
The considered throughput for the stream requests is 16Kbit/s.

guard time	40
shdr	144
csb	128
tr.put	512
preamble	352

Fade level	Ri (COS=3)	pr. at 8Mbps	pr. at 4Mbps	Stream SBF	Datag. SBF
0	1	1176	1656	125390	125390
1	1	1176	1656	125198	125198
2	1	1176	1656	125198	125198
3	1	1176	1656	125198	125198
4	1.14	1268	1748	124941	124941
5	1.14	1268	1748	124941	124941
6	1.14	1268	1748	186876	62292
7	1.33	1392	1872	186876	62292
8	1.33	1392	1872	185280	61760
9	1.5		1984	181752	60584
10	2.66		2745	181752	60584
11	2.66		2745	178560	59520

TABLE 1.C. COS3

(*) These colums show the bit occupancy of a 16Kbit/s stream allocation for the various Ri of the COS=3 when all the preambles must be sent at bit rate 8 and 4 respectively.

A	B	C	D	E	F	G
Fade level	Ri(COS = 1)	RB	CSF	RB+CSF	SRB	Free space
0	1	832	2660	3492	1952	252508
1	1.14	887	2743	3630	2167	252370
2	1.14	887	2743	3630	2167	252370
3	1.14	887	2743	3630	2167	252370
4	1.33	960	2854	3814	2454	252186
5	1.33	960	2854	3814	2454	252186
6	1.5	1024	2950	3974	2704	253296
7	1.5	1024	2950	3974	2704	253296
8	2	1216	3240	4456	3456	252544
9	3	2048	5740	7788	5408	250592
10	3	2048	5740	7788	5408	250592
11	4	2432	6320	8752	6912	249088
12	6	4096	11320	15416	10816	245184
13	6	4096	11320	15416	10816	245184
14	8	4864	12480	17344	13824	242176
15	12	8192	22480	30672	21632	234368
16	12	8192	22480	30672	21632	234368
17	16	9728	24800	34528	27648	228352
18	16	9728	24800	34528	27648	228352

The bit rate used for all the preambles is driven by the bit rate of the RB.
Therefore, the driving bit rate is that one of the COS = 1.
The considered throughput for the stream requests is 64Kbit/s.
RB computed for 32 stream+10 datagram allocations

guard time	40
shdr	144
csb	128
tr.put	2048
preamble	352

Fade level	Ri (COS=2)	pr. at 2Mbps	pr. at 1Mbps	Stream SBF	Datag. SBF
0	1	4152	6072	126254	126254
1	1	4152	6072	126185	126185
2	1.14	4459	6379	126185	126185
3	1.14	4459	6379	126185	126185
4	1.14	4459	6379	126093	126093
5	1.33	4875	6795	126093	126093
6	1.33	4875	6795	126648	126648
7	1.5	5248	7168	126648	126648
8	1.5	5248	7168	126272	126272
9	2	6344	8264	187944	62648
10	3	8536	10456	187944	62648
11	3	8536	10456	186816	62272
12	4	10728	12648	183888	61296
13	6	15112	17032	183888	61296
14	6	15112	17032	181632	60544
15	8		21416	175776	58592
16	12		30184	175776	58592
17	12		30184	171264	57088
18	16		38952	171264	57088

(*) These colums show the bit occupancy of a 64Kbit/s stream allocation for the various Ri of the COS=2 when all the preambles must be sent at bit rate 2 and 1 respectively.

TABLE 2.COS2

Fade level	Ri(COS = 1)	RB	CSF	RB+CSF	SRB	Free space
0	1	832	2660	3492	1952	252508
1	1.14	887	2743	3630	2167	252370
2	1.14	887	2743	3630	2167	252370
3	1.14	887	2743	3630	2167	252370
4	1.33	960	2854	3814	2454	252186
5	1.33	960	2854	3814	2454	252186
6	1.5	1024	2950	3974	2704	253296
7	1.5	1024	2950	3974	2704	253296
8	2	1216	3240	4456	3456	252544
9	3	2048	5740	7788	5408	250592
10	3	2048	5740	7788	5408	250592
11	4	2432	6320	8752	6912	249088
12	6	4096	11320	15416	10816	245184
13	6	4096	11320	15416	10816	245184
14	8	4864	12480	17344	13824	242176
15	12	8192	22480	30672	21632	234368
16	12	8192	22480	30672	21632	234368
17	16	9728	24800	34528	27648	228352
18	16	9728	24800	34528	27648	228352

The bit rate used for all the preambles is driven by the bit rate of the RB.
Therefore, the driving bit rate is that one of the COS = 1.
The considered throughput for the stream requests is 16Kbit/s.
RB computed for 32 stream+10 datagram allocations

guard time	40
shdr	144
csb	128
tr.put	512
preamble	352

Fade level	Ri (COS=2)	pr. at 2Mbps	pr. at 1Mbps	Stream SBF	Datag. SBF
0	1	2616	4536	126254	126254
1	1	2616	4536	126185	126185
2	1.14	2708	4628	126185	126185
3	1.14	2708	4628	126185	126185
4	1.14	2708	4628	126093	126093
5	1.33	2832	4752	126093	126093
6	1.33	2832	4752	126648	126648
7	1.5	2944	4864	126648	126648
8	1.5	2944	4864	126272	126272
9	2	3272	5192	187944	62648
10	3	3928	5848	187944	62648
11	3	3928	5848	186816	62272
12	4	4584	6504	183888	61296
13	6	5896	7816	183888	61296
14	6	5896	7816	181632	60544
15	8		9128	175776	58592
16	12		11752	175776	58592
17	12		11752	171264	57088
18	16		14376	171264	57088

(*) These colums show the bit occupancy of a 16Kbit/s stream allocation for the various Ri of the COS=2 when all the preambles must be sent at bit rate 2 and 1 respectively.

TABLE 2.C.COS2

	A	B	C	D	E	F	G
1	**Fade level**	**Ri(COS = 1)**	**RB**	**CSF**	**RB+CSF**	**SRB**	**Free space**
2	0	1	832	2660	3492	1952	252508
3	1	1.14	887	2743	3630	2167	252370
4	2	1.14	887	2743	3630	2167	252370
5	3	1.14	887	2743	3630	2167	252370
6	4	1.33	960	2854	3814	2454	252186
7	5	1.33	960	2854	3814	2454	252186
8	6	1.5	1024	2950	3974	2704	253296
9	7	1.5	1024	2950	3974	2704	253296
10	8	2	1216	3240	4456	3456	252544
11	9	3	2048	5740	7788	5408	250592
12	10	3	2048	5740	7788	5408	250592
13	11	4	2432	6320	8752	6912	249088
14	12	6	4096	11320	15416	10816	245184
15	13	6	4096	11320	15416	10816	245184
16	14	8	4864	12480	17344	13824	242176
17	15	12	8192	22480	30672	21632	234368
18	16	12	8192	22480	30672	21632	234368
19	17	16	9728	24800	34528	27648	228352
20	18	16	9728	24800	34528	27648	228352
21							
22							
23	**The bit rate used for all the preambles is driven by the bit rate of the RB.**						
24	**Therefore, the driving bit rate is that one of the COS = 1.**						
25	**The considered throughput for the stream requests is 16Kbit/s.**						
26	**RB computed for 32 stream+10 datagram allocations**						
27	guard time	40					
28	shdr	144					
29	csb	128					
30	tr.put	512					
31	preamble	352					
32							
33	**Fade level**	**Ri (COS=3)**	**pr. at 2Mbps**	**pr. at 1Mbps**	**Stream SBF**	**Datag.SBF**	
34	0	1	2616	4536	126254	126254	
35	1	1	2616	4536	126185	126185	
36	2	1	2616	4536	126185	126185	
37	3	1	2616	4536	126185	126185	
38	4	1.14	2708	4628	126093	126093	
39	5	1.14	2708	4628	126093	126093	
40	6	1.14	2708	4628	126648	126648	
41	7	1.33	2832	4752	126648	126648	
42	8	1.33	2832	4752	126272	126272	
43	9	1.5	2944	4864	187944	62648	
44	10	2.66	3705	5625	187944	62648	
45	11	2.66	3705	5625	186816	62272	
46	12	3	3928	5848	183888	61296	
47	13	5.33	5456	7376	183888	61296	
48	14	5.33	5456	7376	181632	60544	
49	15	6		7816	175776	58592	
50	16	10.66		10873	175776	58592	
51	17	10.66		10873	171264	57088	
52	18	12		11752	171264	57088	
53							
54	(*) These colums show the bit occupancy of a 16Kbit/s stream allocation for the various						
55	Ri of the COS=3 when all the preambles must be sent at bit rate 2 and 1 respectively.						
56			TABLE 2.C.COS3				
57							

Fade level	Ri(COS = 1)	RB	CSF	RB+CSF	SRB	Free space
0	1	832	2660	3492	1952	252508
1	1.14	887	2743	3630	2167	252370
2	1.14	887	2743	3630	2167	252370
3	1.14	887	2743	3630	2167	252370
4	1.33	960	2854	3814	2454	252186
5	1.33	960	2854	3814	2454	252186
6	1.5	1024	2950	3974	2704	253296
7	1.5	1024	2950	3974	2704	253296
8	2	1216	3240	4456	3456	252544
9	3	2048	5740	7788	5408	250592
10	3	2048	5740	7788	5408	250592
11	4	2432	6320	8752	6912	249088
12	6	4096	11320	15416	10816	245184
13	6	4096	11320	15416	10816	245184
14	8	4864	12480	17344	13824	242176
15	12	8192	22480	30672	21632	234368
16	12	8192	22480	30672	21632	234368
17	16	9728	24800	34528	27648	228352
18	16	9728	24800	34528	27648	228352

The bit rate used for all the preambles is driven by the bit rate of the RB.
Therefore, the driving bit rate is that one of the COS = 1.
The considered throughput for the stream requests is 16Kbit/s.
RB computed for 32 stream+10 datagram allocations

guard time	40
shdr	144
csb	128
tr.put	2048
preamble	352

Fade level	Ri (COS=3)	pr. at 2Mbps	pr. at 1Mbps	Stream SBF	Datag. SBF
0	1	4152	6072	126254	126254
1	1	4152	6072	126185	126185
2	1	4152	6072	126185	126185
3	1	4152	6072	126185	126185
4	1.14	4459	6379	126093	126093
5	1.14	4459	6379	126093	126093
6	1.14	4459	6379	126648	126648
7	1.33	4875	6795	126648	126648
8	1.33	4875	6795	126272	126272
9	1.5	5248	7168	187944	62648
10	2.66	7791	9711	187944	62648
11	2.66	7791	9711	186816	62272
12	3	8536	10456	183888	61296
13	5.33	13643	15563	183888	61296
14	5.33	13643	15563	181632	60544
15	6		17032	175776	58592
16	10.66		27247	175776	58592
17	10.66		27247	171264	57088
18	12		30184	171264	57088

(*) These colums show the bit occupancy of a 16Kbit/s stream allocation for the various Ri of the COS=3 when all the preambles must be sent at bit rate 2 and 1 respectively.

TABLE 2.COS3