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UTILIZATION OF SATELLITE FOR DETERMINING THE ROUTE OF THE TRAFFIC

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SUMMARY

In the satellite communication area a a primary concern is to obtain excellent interconnection among the earth stations. This paper utilizes the SS/FDMA technique to provide such interconnectivity. The whole frequency band is divided into n different subbands by means of filters and the required interconnectivity is obtained by arranging the connection of these filters of the output beams in each of the n sub-bands.If each beam is required to be connected to all other beams, a number of sub-bands equal to the number of beams is required and a number of filters equals to the square of the number of sub-bands is needed. These numbers are mathematically derived starting to consider the transmission of traffic between two spot-beams, three spot-beams, and n - spot-beams. The work has been extended for discussing the situation when more than one source of traffic are intended for different spot beams simultenously. In this case a distination code is transmitted with the modulated signal in order to assigne the required zone. At the satellite board, a decoder must be added before each channelizeing filter. In this paper a practical connection for a system operating on this technique is introduced. This system indicates a relative degree of simplification and is considered more acceptable for military purposes.

RESUME

Dans le domaine de communication par satellite, il est important d'obtenir une interconnexion excellente entre les stations terrestres.
Cet article expose l'exploitation de la technique "SS/FDMA" afin d'obtenir cette interconnexion. La bande de fréquence est réparti en n sous-bandes différentes utilisant des filtres. L'interconnexion est réalisée en rangant la connexion de ces filtres avec les faisceaux sortant dans chaq'un des n sousbandes.
Si chaque faisceau doit-être connecté à tous les autres faisceaux, donc, on a besoin d'un nombre de sous-bandes égal au nombre des filtres est égal au carré du nombre des sous-bandes. La dérivation de ces nombres est donnée pour des nombres de faisceaux différents.
L'article expose aussi la situation arrivant dans le cas où il y a plus qu'une seule source de trafic destinées simultanément aux faisceaux différents. Dans ce cas- là , un code de destination est émis accompagnant le signal modulé afin de allouer le zone demandé.
Au satellite, un decodeur doitêtre placé avant chaque filtre de canalisation. Le systéme introduit, montre un degreé relative de simplicité , et conséquemment il est plus acceptable dans les applications militaires.

UTILIZATION OF SATELLITE FOR DETERMINING THE ROUTE OF THE TRAFFIC

Dr. F. EL MANSY

Abstract:

One of the most interesting problems in satellite communication is the problem of interconnection between various ground stations belongs to the satellite. The aim of this paper is to illustrate the possibility of utilizing the FDMA technique for providing such excellent interconnectivity. The work has been extended for discussing the situation when more than one source of traffic are intended simultaneously for different zones. In addition a practical connection for a system operates on the previous basis is introduced.

I- INTRODUCTION

In the satellite communication area a primary concern is to obtain an excellent interconnection among the earth stations connected to the satellite. This paper discuss the utilization of the frequency division multiple access technique (FDMA) for providing such interconnectivity. This is done by dividing the whole frequency band by means of channelizing filters into different sub-bands. The required interconnectivity is then obtained by arranging the connection of these filters to the output beams in each of the sub-bands. If each beam is required to be connected to all other beams, a number of sub-bands equal to the number of beams are required while the number of channalizing filters needed in this case will equal to the square of the number of beams.

These numbers are mathematically derived starting from considering that the connection is required between two zones, three zones, and n zones. The work discuss also the problem of interconnection especially when more than one source of traffic are intended for different ground stations simultenously. In this case a distination code which is specified for each zone, is necessarily transmitted with every modulated signal. of course this will requir to add before each filter in the satellite board a decoder for detecting its suitable code of distination. A practical connection of a system operates on the previous technique is introduced also in the work. For this system the distination code which is used for assigning the required zone is sent with the transmitted modulated signal to the satellite board. There its correspondant decoder will interchange the up-link frequency to the down-link frequency of the required receiving zone. The suggested system provides a relative degree of simplicity and is suitable also for military purposes.

2- SS/FDMA technique :

Before discussing the SS/FDMA technique, it is better if we illustrate the main problems envolving the utilization of the TDMA. In case of SS/TDMA, the required interconnectivity is provide by cyclically inter-connecting the TDMA signals among beams in a rapid sequence through the so called microwaveswitch matrix (MSM), [3]. This matrix must be designed to be small in size and power consumption with minimum in weight Moreover, the switching speed, insertion loss, and isolation between paths must be considered. For practical system designing based on this technique, a redundant configuration of the MSM will be necessary to improve the reliability of the system. For SS/FDMA, as our concern is to provide (or obtain) an excellent interconnectivity between earth stations, the whole frequency band B_T is divided into n sub-bands $B_1, B_2, \ldots, B_n$, i.e

$$B_T = \sum_{i=1}^{n} B_i \quad , \quad i = 1, 2, \ldots, n.$$

The division of the whole bandwidth is obtained by means of filters at the board of satellite. Hence, each beam of traffic will be assigned for its suitable sub-band w.r.t both the frequency and the proper arrangement of the connection of filter to the output received beam. As said before, if one beam is required to be connected with the other (n-1) beams, n^2 filters are needed. For better illustration of the necessary number of sub-bands and filters which provide the required interconnectivity. Fig. (1) shows the possible ways of connecting the traffic among ground stations (zones). From this fig. we can see that each zone or spot beam (i.e the earth stations belongs to the satellite, each contains the transmitter and receiver equipments with their antennas)

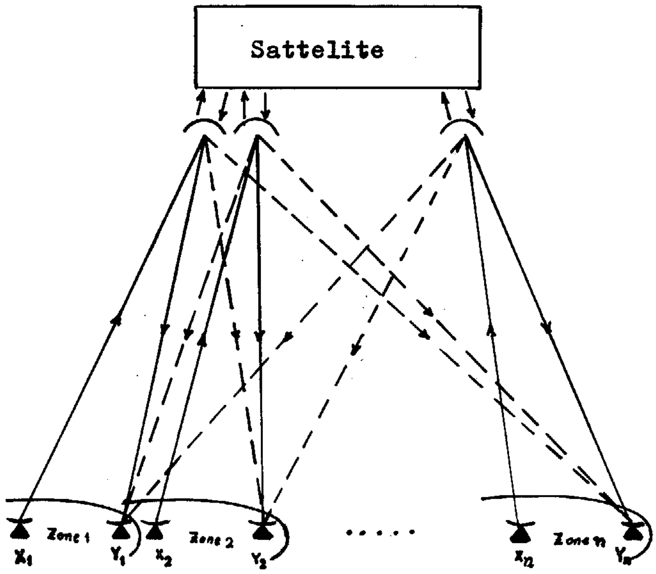

Fig.(1) Possible ways of connection between ground stutions.

is represented by (x_i , y_i). where, x_i is the total transmitted traffic from the i-th zone and Y_i is the total received traffic by the i-th zone. consider now the connection between two zones only, then two beams will be required for the transmission and reception for both zones. Denote these beams as(X_1 , Y_1) and (X_2 , Y_2), then according to fig.(1), the possible ways of connection can be tabulated as shown in table (1)

to / from	Y_1	Y_2
X_1	F_{11}	F_{12}
X_2	F_{21}	F_{21}

Table(1) possible ways of connection between(x_1 , Y_1) and(x_2 , Y_2)

It is easy to see from table (1) that the number of beams and the number of sub-bands required for performing this connection are equal to two,while the needed number of channelizing filters(F_{ij}) is four. similarly for three spot beams: (x_1 , Y_1),(X_2 , Y_2) and (X_3, Y_3),the possible ways of connection between them are summerized in table (2), from which we see that both the number of beams and the number of sub-bands are 3, while the number of required channelizing

to / from	Y_1	Y_2	Y_3
X_1	F_{11}	F_{12}	F_{13}
X_2	F_{21}	F_{22}	F_{23}
X_3	F_{31}	F_{32}	F_{33}

Table(2) ways of connection between three zones.

filters are 9. For n spot beams:(x_1 , Y_1), (x_2 , Y_2), ...,(X_n, Y_n), the possible ways of connection is given in table (3). From this table we can see that both the number

to / from	Y_1	Y_2	. . .	Y_n
X_1	F_{11}	F_{12}	. . .	F_{1n}
X_2	F_{21}	F_{22}	. . .	F_{2n}
⋮	...	...	. . .	...
X_n	F_{n1}	F_{n2}	. . .	F_{nn}

Table (3) connection between n number of zones.

of beams and the number of sub-bands are equal to n, while the number of channelizing filters are n^2 . when more than one traffic source are intended for different zones at the same time, then the problem of interconnectivity will be rather complicated. In order to overcome such difficulty a specific distination code is sent simultaneously with each modulated signal for the assignment of the correct zone. In this case we must add before each channelizing filter, at the satellite board, a decoder which detect the correct distination code and to shift the frequency from the up-link to the frequency of the down-link of the received zone.

3-SYSTEM DESCRIPTION

The resulting obtained signal by summing the transmitted signal and the destination code is transmitted to the required zone through satellite channels employing different decoders and filters, as shown in Fig.(2). The decoders are used to detect or recover the code which accompany with the transmitted signal. Hence the required signal will be correctly passed through the channelizing filter to the desired zone. For further illustration, consider the communication between the three zones e, h and g with operating frequencies f_e , f_h and f_g respectively. when zone e transmits signals for h and

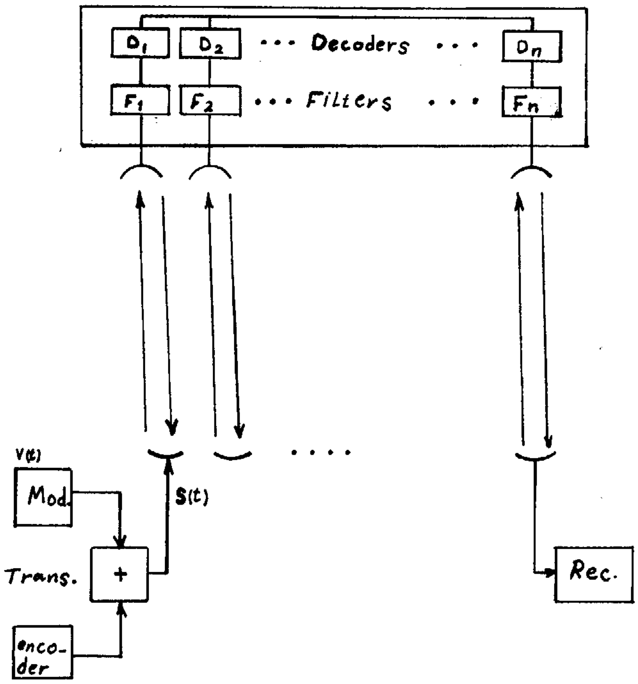

Fig.2 Simplified scheme of SS/FDMA system (transmitter of one ground station is shown)

g simultaneously, the h decoder will detect the distination code only and the signal frequency f_e is converted to the down-link frequency of zone h, thus the communication is completed through the h-filter to the h-zone. In the same time the g-decoder will similarly detect its specific code only, thus the communication is done also between e and g. In fig.2 the transmitting receiving stations are represented by up and down links. The base-band signal v(t) is applied to the modulator (AM,FM or PM) and the output signal S(t) added to the specific code is transmitted to the satellite through a beam antenna. The encoder at the transmitting station is used to produce a destination code which will be added to the modulated signal through a summing circuit. All other stations will transmitt to the satellite by the same way.The decoders at satellite board recevers their correspondance code and the required shift of frequency is done.

4- CONCLUSION:

SS/FDMA technique provide the necessary and required interconnection among the ground stations connected to the satellite. This is done by using a number of channelizing filters equales to the square of the number of the traffic beams. The specific destination code added to each transmitted signal will provide the possibility of correct connection and also the necessary security. The suggested system is considered more suitable for military purposes.

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