UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC., LG ELECTRONICS INC., SAMSUNG ELECTRONICS CO., LTD., AND SAMSUNG ELECTRONICS AMERICA, INC.

Petitioners

v.

UNILOC Luxembourg SA.

Patent Owner

U.S. Patent No. 6,868,079

DECLARATION OF JACOB ROBERT MUNFORD

---

1. My name is Jacob Robert Munford. I am over the age of 18, have personal knowledge of the facts set forth herein, and am competent to testify to the same.

2. I earned a Master of Library and Information Science (MLIS) from the University of Wisconsin-Milwaukee in 2009. I have over ten years of experience in the library/information science field. Beginning in 2004, I have served in various positions in the public library sector including Assistant Librarian, Youth Services Librarian and Library Director. I have attached my Curriculum Vitae as Appendix A.

3. During my career in the library profession, I have been responsible for materials acquisition for multiple libraries. In that position, I have cataloged, purchased and processed incoming library works. That includes purchasing materials directly from vendors, recording publishing data from the material in question, creating detailed material records for library catalogs and physically preparing that material for circulation. In addition to my experience in acquisitions, I was also responsible for analyzing large collections of library materials, tailoring library records for optimal catalog search performance and creating lending agreements between libraries during my time as a Library Director.

4. I am fully familiar with the catalog record creation process in the library sector. In preparing a material for public availability, a library catalog record describing that material would be created. These records are typically written in Machine Readable Catalog (herein referred to as "MARC") code and contain information such as a physical description of the material, metadata from the material's publisher, and date of library acquisition. In particular, the 008 field of the MARC record is reserved for denoting the date of creation of the library record itself. As this typically occurs during the process of preparing materials for public access, it is my experience that an item's MARC record indicates the date of an item's public availability.

5. I have reviewed Exhibit 1008, a book edited by John Everett entitled *VSATs Very* Small *Aperture Terminals* (referred hereto as 'VSATs') as published by Peter Peregrinus Ltd on behalf of the Institution of Electrical Engineers, copyright 1992.

6. Attached hereto as Appendix EV01 is a true and correct copy of 'VSATs'. I secured scans of the book cover, spine, publication data, title page, publication date page and table of contents for 'VSATs' from the University of Pittsburgh's library. In comparing EV01 to Exhibit 1008, it is my determination that Exhibit 1008 is a true and correct copy of 'VSATs'.

7. Attached hereto as EV02 is a true and correct copy of the MARC record from 'VSATs' from the University of Pittsburgh's library. I secured this record myself from the University of Pittsburgh's online catalog. The 008 field of this MARC record indicates 'VSATs' was first cataloged by the University of Pittsburgh as of February 20, 1993. Considering this information, it is my determination that 'VSATs' was first made available to the public shortly after February 20, 1993.

8. I have been retained on behalf of the Petitioner to provide assistance in the above-illustrated matter in establishing the authenticity and public availability of the documents discussed in this declaration. I am being compensated for my services in this matter at the rate of $100.00 per hour plus reasonable expenses. My statements are objective, and my compensation does not depend on the outcome of this matter.

9. I declare under penalty of perjury that the foregoing is true and correct. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: 1/9/19

Jacob Robert Munford

Appendix A - Curriculum Vitae

Education

University of Wisconsin-Milwaukee - MS, Library & Information Science, 2009
Milwaukee, WI

- Coursework included cataloging, metadata, data analysis, library systems, management strategies and collection development.
- Specialized in library advocacy and management.

Grand Valley State University - BA, English Language & Literature, 2008
Allendale, MI

- Coursework included linguistics, documentation and literary analysis.
- Minor in political science with a focus in local-level economics and government.

Professional Experience

Library Director, February 2013 - March 2015
Dowagiac District Library
Dowagiac, Michigan

- Executive administrator of the Dowagiac District Library. Located in Southwest Michigan, this library has a service area of 13,000, an annual operating budget of over $400,000 and total assets of approximately $1,300,000.
- Developed careful budgeting guidelines to produce a 15% surplus during the 2013-2014 & 2014-2015 fiscal years.
- Using this budget surplus, oversaw significant library investments including the purchase of property for a future building site, demolition of existing buildings and building renovation projects on the current facility.
- Led the organization and digitization of the library's archival records.
- Served as the public representative for the library, developing business relationships with local school, museum and tribal government entities.

- Developed an objective-based analysis system for measuring library services - including a full collection analysis of the library's 50,000+ circulating items and their records.

November 2010 - January 2013
Librarian & Branch Manager, Anchorage Public Library
Anchorage, Alaska

- Headed the 2013 Anchorage Reads community reading campaign including event planning, staging public performances and creating marketing materials for mass distribution.
- Co-led the social media department of the library's marketing team, drafting social media guidelines, creating original content and instituting long-term planning via content calendars.
- Developed business relationships with The Boys & Girls Club, Anchorage School District and the US Army to establish summer reading programs for children.

June 2004 - September 2005, September 2006 - October 2013
Library Assistant, Hart Area Public Library
Hart, MI

- Responsible for verifying imported MARC records and original MARC cataloging for the local-level collection as well as the Michigan Electronic Library.
- Handled OCLC Worldcat interlibrary loan requests & fulfillment via ongoing communication with lending libraries.

Professional Involvement

Alaska Library Association - Anchorage Chapter

- Treasurer, 2012

Library Of Michigan

- Level VII Certification, 2008
- Level II Certification, 2013

Michigan Library Association Annual Conference 2014

- New Directors Conference Panel Member

Southwest Michigan Library Cooperative

- Represented the Dowagiac District Library, 2013-2015

Professional Development

Library Of Michigan Beginning Workshop, May 2008
Petoskey, MI

- Received training in cataloging, local history, collection management, children's literacy and reference service.

Public Library Association Intensive Library Management Training, October 2011
Nashville, TN

- Attended a five-day workshop focused on strategic planning, staff management, statistical analysis, collections and cataloging theory.

Alaska Library Association Annual Conference 2012 - Fairbanks, February 2012
Fairbanks, AK

- Attended seminars on EBSCO advanced search methods, budgeting, cataloging, database usage and marketing.

Appendix EV01 - Scans

MMUNICATIONS SERIES 28

VSATs

very small aperture terminals

Edited by

JOHN EVERETT

Peter Peregrinus Ltd. on behalf of the Institution of Electrical Engineers

JOHN EVERETT

VSATs very small aperture termin

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Series Editors: Professor J. E. Flood
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Professor J. D. Parsons

VSATs

very small aperture terminals

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Volume 22 **Data communications and networks II** R. L. Brewster (Editor)
Volume 23 **Radio spectrum management** D. J. Withers
Volume 24 **Satellite communication systems II** B. G. Evans (Editor)
Volume 25 **Personal mobile radio systems** R. C. V. Macario (Editor)
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VSATs

very small aperture terminals

Edited by
JOHN EVERETT

Peter Peregrinus Ltd. on behalf of the Institution of Electrical Engineers

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Contents

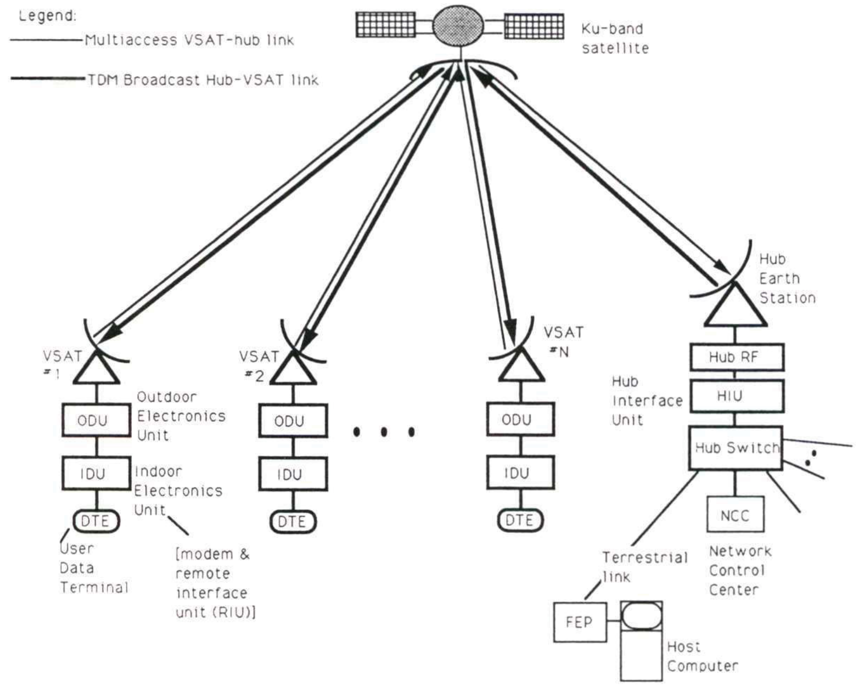


Fig. 7.1 *Typical star architecture VSAT network*

than bandwidth is often the limiting resource in VSAT networks, permitting the use of relatively inefficient protocols without significant impact on system capacity. Thus, for the interactive data VSAT network environment, low delay, simplicity of implementation and robust operation are generally of greater importance than the bandwidth efficiency achieved. Observe that some of these goals are analogous to those which drove the evolution of channel sharing protocols for local area networks (LANs). It may be expected that, as the industry matures, a limited number of 'standard' VSAT protocols (analogous to CSMA/CD [1] and Token Passing [2] for LANs) will emerge.

The problem of developing suitable multiple access techniques for ground radio, LAN and satellite wide-area network scenarios with bursty interactive traffic has attracted considerable research attention since the introduction of the ALOHA protocol (which offers low delay, minimal implementation complexity and robust operation at the expense of low throughput) in 1970 [3]. A detailed survey of multiaccess protocols that have been developed for all of the above broadcast channel scenarios has been given by Tobagi [4]. Another review paper by Lam [5], emphasises the satellite scenario, which is characterised by channel propagation delays that are much greater than the message transmission time. From References 4 and 5, it is clear that the desirable combination of high throughput, low delay and simple implementation is readily achieved in local area and ground radio networks with short channel propagation delays, but is much more difficult to achieve in the satellite environment. In Section 7.2, a survey is presented of many of the available alternatives for VSAT multiaccess, covering both established approaches discussed in References 4 and 5 as well as some more recent developments in the area. The review is followed by Section 7.3, which presents a fairly detailed performance comparison between a selected number of 'first generation' VSAT protocols applied to an interactive data network scenario.

7.2 Review of satellite multiaccess protocols for VSAT networks

The discussion is commenced by defining some of the important performance attributes which will serve as the basis for comparing dissimilar multiaccess techniques. The key issues to be considered in selecting a channel sharing protocol for the VSAT scenario are:

(a) The *efficiency* or *throughput* of channel sharing (i.e. the fraction of time useful traffic is carried by the multiaccess channel). The term *capacity* is used to denote the maximum operating throughput of the protocol. It is important to compare protocols on the basis of *net*, rather than nominal capacity, because of wide variations in transmission overheads.
(b) The *access delay* (i.e. time between the arrival of a message at a VSAT and the start of its successful transmission on the channel), both in terms of average and distribution characteristics. Note that the *total* delay in transmitting the message is the sum of the access delay and the message transmission time.
(c) The *stability* properties, relating to the possibility of undesirable long-term congestion modes.
(d) *Robustness* in presence of channel errors and equipment failures.
(e) *Operational properties* relating to start-up, addition of new stations or traffic types etc.
(f) The *implementation cost/complexity*, related to the VSAT hardware/software required.

The classification of access protocols is determined as follows. A multiple access protocol is a set of rules by which a number of distributed remote stations communicate reliably over a shared channel*. It is convenient to classify such protocols as 'slotted' or 'unslotted' depending on whether or not continual time synchronisation between stations is required for the specified operation. A different dimension for classification is based on the qualitative nature of the message transmission discipline used. Typically, message access can be of three types: *fixed assigned*, *contention* (*random access*) or *reservation* (*controlled access*). Hybrids between contention and reservation are frequently proposed, and for simplicity, such protocols will be placed in the reservation category for the purposes of this discussion. Table 7.1 provides a listing of many conventional and new satellite

*Note that although VSAT networks are most often based on the star architecture of Fig. 7.1, the protocols discussed in this Chapter are equally applicable to mesh (fully connected) satellite networks which may become more viable as satellites become more powerful. In the discussions that follow, the usual convention of describing protocols in the context of a broadcast (i.e., mesh) channel will be observed.

Section 7.2 has been adapted from: RAYCHAUDHURI, D., and JOSEPH, K.: 'Ku-band satellite data networks using very small aperture terminals — Part 1: Multiaccess protocols', Int. J. of Satellite Comms., *1987, pp. 195–212*

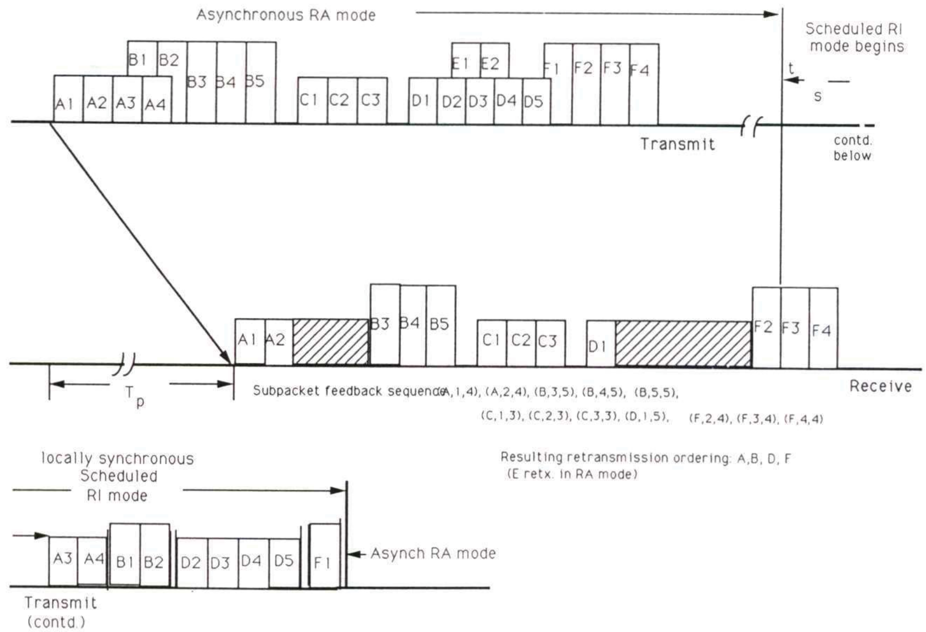


Fig. 7.9 *Illustration of channel events in SREJ–ALOHA/FCFS channel*

ity and delay (both average and distribution) properties over a wider range of traffic profiles.

7.2.2.8 *RA–CDMA* In addition to providing the ability to operate in power spectral density and interference limited environments, spread spectrum transmission can be used to modify (and possibly improve) random access performance. Specifically, spread spectrum coding permits 'colliding' ALOHA packets to encounter multiple interferences without being destroyed, potentially resulting in better random access throughput-delay and stability characteristics.

As illustrated in Fig. 7.10 for an asynchronous, unslotted, RA–CDMA channel, changes in the number of interfering transmissions results in a varying bit error probability over the duration of a transmitted packet. Packets that are received

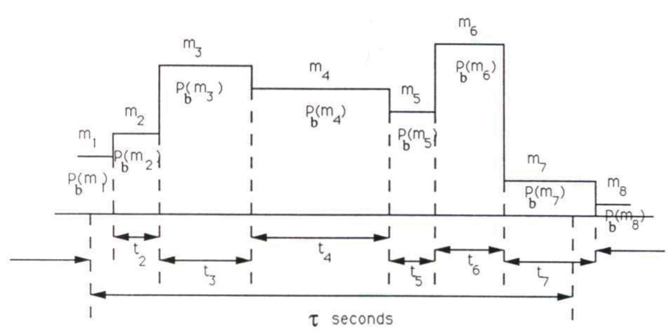


Fig. 7.10 *Example of interference pattern experienced by a τ second message packet on an asynchronous RA–CDMA channel*

with errors are retransmitted with random delays, similar to the strategy illustrated in Fig. 7.3 for pure ALOHA. The ability to support multiple simultaneous transmissions results in lower access delay than non-spread ALOHA, although the normalised capacity (i.e. maximum throughput divided by the bandwidth spreading factor) of uncoded random access CDMA is typically in the same region as pure ALOHA (i.e. ~0·1). However, with powerful FEC, it is conceivable that the capacity can be improved to the region of 0·2–0·3, as suggested by preliminary results [28, 29]. Of course, the associated spread spectrum/FEC hardware adds to VSAT complexity, relative to a system based on non-spread ALOHA.

As in non-spread systems, slotting can be used to reduce the collision probability of packets in random access CDMA systems. Slotted RA-CDMA has been considered in References 30 and 31. The qualitative performance is similar to unslotted CDMA discussed earlier, with achievable (bandwidth normalised) capacity being somewhat higher. It is interesting to note that, as the SSMA spreading factor increases, the advantage due to slotting becomes substantially less than the 2 : 1 advantage of slotted ALOHA over pure ALOHA. Particularly for variable length message traffic, there does not appear to be a compelling reason to add the complexity of slotting to a random access CDMA system.

7.2.3 *Reservation/controlled access*

Demand assigned multiple access (DAMA) is a widely advocated solution to bursty satellite data communications. In DAMA systems, there are two layers of channel access: the first level of access is for short reservation packets containing information regarding the station's demand, while the second level of access is for the actual data messages (which are typically longer than the request packets). Access at the reservation level may be provided using any of the fixed assigned or contention access methods described in Sections 7.2.1 and 7.2.2. Once a reservation is successful, data messages can be scheduled in a conflict-free manner by processing the reservation information in a distributed or centralized global queue. Thus, if the data messages are long relative to request packets, it is possible to achieve reasonably high overall net channel throughput. Appropriately designed DAMA systems are well suited to variable length message traffic, and can handle mixed interactive/file-transfer traffic. However, note that, as illustrated in Fig. 7.2, the higher throughput is accompanied by a relatively large (> 0.5 s) minimum latency delay associated with the reservation mechanism, although this is partially offset by low access delay variance.

The early applications of satellite DAMA were in the context of circuit switching, e.g. the SPADE system [32], in which FDMA/SCPC channels are assigned based on reservations made on a single TDMA channel. For the VSAT scenario, a typical DAMA system is based upon a TDMA-like channel format, with periodic frames containing a number of small slots for reservation and large slots for data messages. The relative proportion of data and reservation slots used depends upon a number of factors including the anticipated traffic profile and the specific fixed assigned/contention mechanism used for reservation access. A few popular DAMA approaches are discussed below.

7.2.3.1 *DAMA with TDMA reservations* In this technique, channel frames are formatted into request and message transmission intervals, as shown in Fig. 7.11,

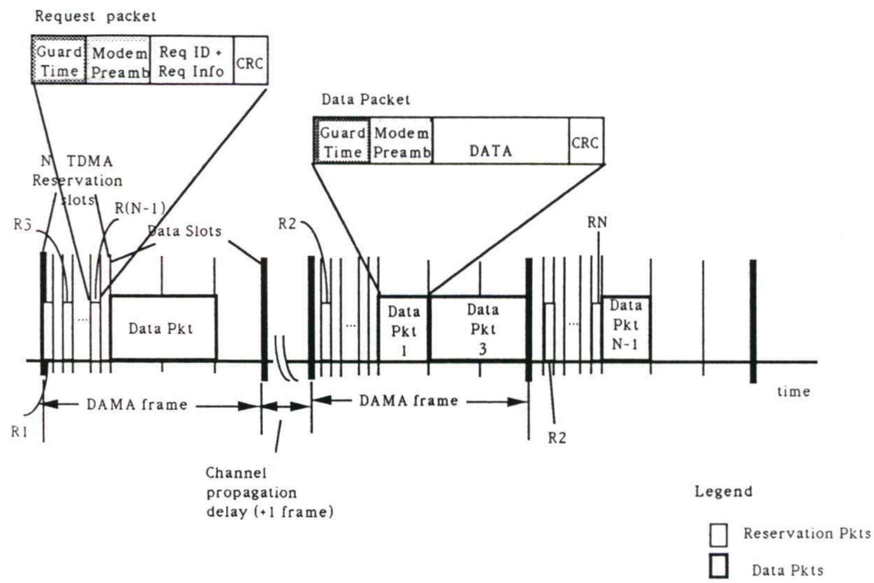


Fig. 7.11 *Illustration of channel events for DAMA with TDMA access*

with a short request slot allocated to each VSAT in every frame. Once in each frame, a VSAT may place a request for one or more data slots. In star VSAT networks, the request packet will be received by the central hub station, and an allocation (based on the status of a global queue) will be sent back to the station over the TDM broadcast channel. Note that, owing to satellite propagation delays and the TDMA frame structure, such protocols are generally characterised by a relatively high latency delay ($\sim$ 0·6–0·7 s), and are limited in terms of the maximum number of stations that can be supported. Of course, since the actual transmission of data messages is conflict-free, the data portion of the frame can be utilised with high efficiency.

DAMA with TDMA access is thus appropriate for VSAT applications with a relatively high traffic volume per site, particularly when messages are long and variable in length. In spite of the lack of contention inefficiency, the need for sufficient guard time and modem acquisition preamble for reservation packets makes it difficult to achieve a maximum throughput much higher than 0·5–0·6. An example of such a DAMA system is the priority-oriented demand assignment (PODA) system [33], running in the FPODA or fixed assignment mode. This protocol has the additional feature that the relative capacity assignments for the reservation and data packets are changed in response to long term variations in input load. This type of adaptation in operating parameters is generally necessary for practical operation of a DAMA system of this class. As might be expected, the synchronisation, global queue maintenance and parameter adaptation requirements lead to significantly higher complexity and poorer robustness than for the random access protocols discussed earlier.

7.2.3.2 *DAMA with slotted ALOHA reservations* DAMA can be used to support large station populations when contention access is used instead of fixed assigned TDMA for the reservation messages. A typical implementation of DAMA for this as the network operator, but it is often difficult for the satellite operator, in isolation, to identify interference which disrupts the VSAT network. To protect the availability of the network, the VSAT network operator must take the initiative to detect and identify interference to the network.

Interference has a number of origins. Some sources may be immediately identified and removed, while others may have to be tolerated and this may require reconfiguration of the network; e.g. the reallocation of operating frequencies, to overcome the disruption to the network operation.

The low power transmissions of a VSAT terminal are generally more vulnerable to interference than high power carriers from hub terminals. Networks operating on frequency reuse transponders, where orthogonal polarisations are used to provide isolation, are likely to experience problems if high power carriers are used on the orthogonal channel. For systems using, for example, linear polarisation this may become an even more significant issue with adverse weather conditions where the cross-polar isolation is further eroded.

It is the role of the policing system to be able to detect the symptoms of interference and, if necessary, and usually under manual control, reallocate network frequencies to avoid the degradation of the VSAT transmissions due to this interference. It may also be necessary to adjust VSAT transmission EIRP to overcome specific problems.

The policing system must also be responsible for the prevention of interference to other spectrum users as a result of the operation of the VSAT network. Under normal operating conditions there should not be a problem, but in the event of equipment failure or malfunction the likelihood of generating interference is greatly increased. It is therefore necessary for the policing system to be aware of the functional state of the network and thus be able to detect any anomalies that could presage the possible occurrence of interference to other users.

10.8 Identification and monitoring of network parameters

The following discussion presents some of the important network parameters which may require monitoring and suggestions are made on how this monitoring might be achieved. The parameters of relevance to a particular VSAT system will, of course, depend on the system design and implementation but it is intended that the discussion will review the essential features of the monitoring methods.

A system log may be kept to record a history of events. This log may take the form of a policing system database and would act as a structured depository of information that may be reviewed by an operator to aid diagnosis of suspected system faults.

10.9 Monitoring of inbound link frequencies

This parameter may be assessed for each VSAT by monitoring of the carrier recovery circuits of the hub demodulators. This provides an indication of the Doppler shift present on the link, and, assuming the VSATs are not located over a large latitude range, will provide a reasonable estimate to facilitate tracking of the Doppler shift with time.

Should a particular VSAT exhibit an unexpected offset in transmit frequency as measured at the hub demodulator, the incident can be logged, correction with other transmissions from the unit, and, if appropriate, a correction factor can be calculated and transmitted to the VSAT to bring it within the required limits.

10.10 Monitoring of the presence of inbound link signals

Signal presence may be detected by monitoring the power level at the hub demodulator after channel filtering has occurred: this would indicate whether an inbound channel was occupied. The communications protocol may be used to ascertain whether a certain channel should be occupied and this can be compared with the actual occupancy detected by the monitoring system. This allows the policing system to identify unexpected transmissions and indicate the possibility that a VSAT may be unavailable through an equipment failure. This is particularly useful in the monitoring of burst transmissions which are difficult to check in any other way. Should a VSAT not be present in a channel when the protocol system indicated it should be, it is essential to correlate this event with the unexpected occupancy of another channel which might imply that the VSAT has developed an error in the frequency of transmission.

The use of the hub demodulators as signal detectors implies that signal power is available in the appropriate channel. This method does not allow the monitoring of out of band signals and is not appropriate for identifying interference. For these purposes it may be of benefit to utilise a spectrum analyser to sweep the band of interest to allow the identification of anomalies. This will be discussed in more detail in Section 10.17.

10.11 Monitoring of signal power and quality

Useful information on the level of the power transmitted by a VSAT can be obtained by monitoring the signal power received by the hub. There is also benefit in monitoring the signal to noise in the VSAT to hub link as this gives a direct indication of the likely signal quality and thus the expected data integrity of the link. Estimates of both the received signal power and signal to noise ratio of a VSAT transmission may be obtained from the hub demodulator system. The signal power may most usefully be estimated from the signal power after channel filtering; the signal to noise may be estimated by measuring the increase in power of the signal above the system noise floor and the assessment of the effective 'eye diagram' opening of the signal (assumed to be PSK), after carrier recovery has been achieved.

10.12 Monitoring of phase noise distortions on the inbound link

The phase noise characteristics of the inbound link may be determined by monitoring of the carrier recovery circuits in the hub demodulator. The stress observed in the recovery loop provides information on the phase stability of the

Table 18.1 *Typical link budget for regional satellites*

	Hub to VSAT		VSAT to HUB	
	4/6 GHz	11/14 GHz	4/6 GHz	11/14 GHz
EIRP earth station	51 dBW	55.2 dBW	37.9 dBW	42.1 dBW
Free space loss	200 dB	207.7 dB	200 dB	207.7 dB
Satellite G/T	− 2.5 dBK	1.0 dBK	− 2.5 dBK	1.0 dBK
C/K_t uplink	77.1 dBHz	77.1 dBHz	64.0 dBHz	64.0 dBHz
Satellite EIRP	17 dBW	17 dBW	3.9 dBW	3.9 dBW
Free space loss	197 dB	205.4 dB	197 dB	205.4 dB
Earth station G/T	14.5 dBK	23.2 dBK	24.5 dBK	29 dBK
C/K_t down	63.1 dBHz	63.2 dBHz	60 dBHz	55.9 dBHz
E_b/N_0 at receiver	10 dBHz	10 dBHz	18 dBHz	15.9 dBHz

18.2 Operation of the Fastar SCPC DAMA network

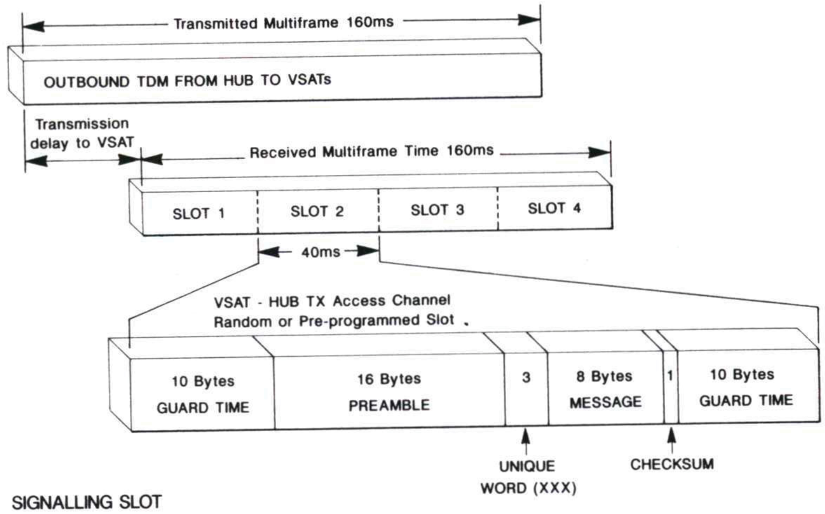
18.2.1 *System architecture*

The basic Fastar SCPC DAMA network (Figs. 18.1 and 18.3) comprises 20 × 9·6 kbit/s timeslots, plus overhead and framing, to make a 204·8 kbit/s outbound channel. Signalling through the system is achieved by use of one of the inbound SCPC channels (access channel) and time division slot 1 (control channel) on the outbound TDM frame. In a standard network the inbound channels consist of one access channel and 19 SCPC (message) channels, whilst the TDM outbound channel contains one signalling timeslot and 19 message timeslots for the TDM DAMA channels.

18.2.2 *Channel assignment*

The assignment of a bi-directional channel from VSAT to hub (Fig. 18.3) is achieved in the following manner: the VSAT detects data present at either its voice or data interface and inhibits real-time transfer until a channel has been assigned. The VSAT then uses the access channel at frequency f_1, requesting either connection to another VSAT via the hub or connection to a hub direct line. The hub, accordingly, informs both the VSAT originating the transmission and the VSAT receiving the transmission which frequency channel and timeslot respectively to use. The hub also informs both the originating and receiving VSAT of the timeslot and frequency channel respectively that will be used for the reverse link. The hub contains a 20 channel cross point switch which allows VSAT to hub line connections to be made.

Termination of a call is the exact opposite of request for transmission: on receiving an end of message signal from the data port the originating VSAT terminates the transmission and signals to the hub, via the access channel, that the working channel is no longer required. The hub acknowledges this request via the control channel (timeslot T1) and both transmitting and receiving VSAT cease data transmission.



SIGNALLING SLOT

GUARD TIME at start of slot	10 Bytes	8.3ms
PREAMBLE	16 Bytes	13.3ms
UNIQUE WORD	3 Bytes	1 part in 10^7 misdetection probability
MESSAGE	8 Bytes	
CHECKSUM	1 Byte	summed over 8 message Bytes
GUARD TIME at end of slot	10 Bytes	8.3ms

Fig. 18.5 *VSAT–Hub random or slotted access channel*

18.2.3 *Access channel*

The access channel (Fig. 18.5) provides all the signalling information from VSAT to hub. Within the Fastar SCPC DAMA system all VSATs use a pre-assigned channel (typically channel 1) to communicate signalling to the hub. Every request to open and close a channel from VSAT to hub is sent on this particular channel. The protocol of the access channel is shown in Fig. 18.5. The access channel utilises a slotted random access system (slotted ALOHA). The synchronisation occurs via the incoming TDM frame using the transmitted multiframe as a start marker with a known transmission delay to the VSAT included. This transmission delay can be adjusted to compensate for VSATs operating in vastly different geographical locations. Using the multiframe timeslot of 160 ms, the access channel is further sub-divided into 40 ms slots. Each of these slots is further sub-divided into guard time, preamble time, unique word, message and checksum. The guard time at the beginning and end to the access message prevents the corruption of data due to the overlap of ALOHA slots caused by timing errors due to geographical location. The 16 byte preamble is sufficient to allow the hub burst demodulator to lock onto the signal and recover the message. The transmission from VSAT to hub via the access channel does not use forward error correction.

As the network increases in size or the activity on the network expands, the incidence of collisions on 'request for access messages' will increase. This is resolved by action at both hub and VSAT. Once a collision is detected, the contending VSATs retransmit after individually pseudo-randomly determined delays. The likelihood of a subsequent collision is considerably reduced. On entry

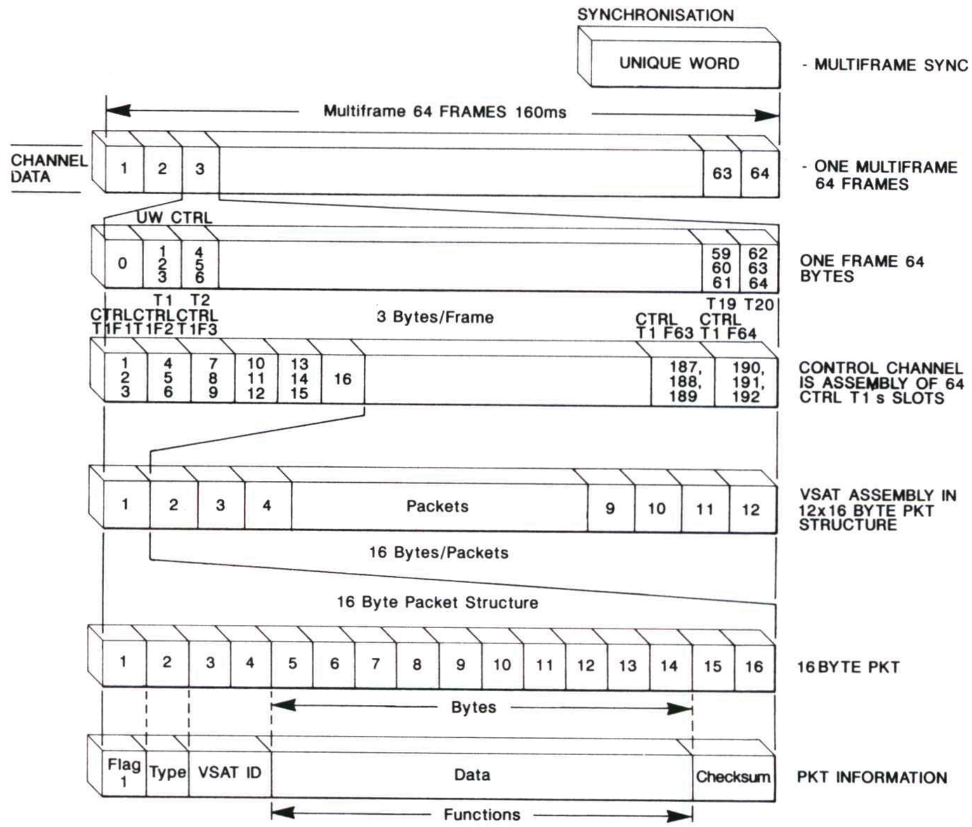


Fig. 18.6 *Control channel (hub to VSAT signalling)*

into the system the number of previous attempts is logged at the hub. In the case of large numbers of VSATs indicating delays on entry, the hub will send out a multiplier function to increase the randomisation.

The VSAT can send the following types of messages to the hub via the access channel:

(*a*) Request a channel
(*b*) Clear a channel
(*c*) VSAT data } specialised data messages
(*d*) Hub data } specialised data messages
(*e*) Forced clear

These allow calls to be originated, channels cleared for end of transmission confirmation and for priority override by forcing a specified channel clear.

18.2.4 *Control channel*

The control channel shown in Fig. 18.6 is the signalling channel used by the hub to respond to VSAT requests on the access channel or to pass overall network data to all VSATs, i.e. a bulletin board feature. The control channel is derived from timeslot T1 on the received TDM frame at the VSAT. This TDM frame is based on the standard IBS frame structure in Fig. 18.7. The 3 bytes of timeslot

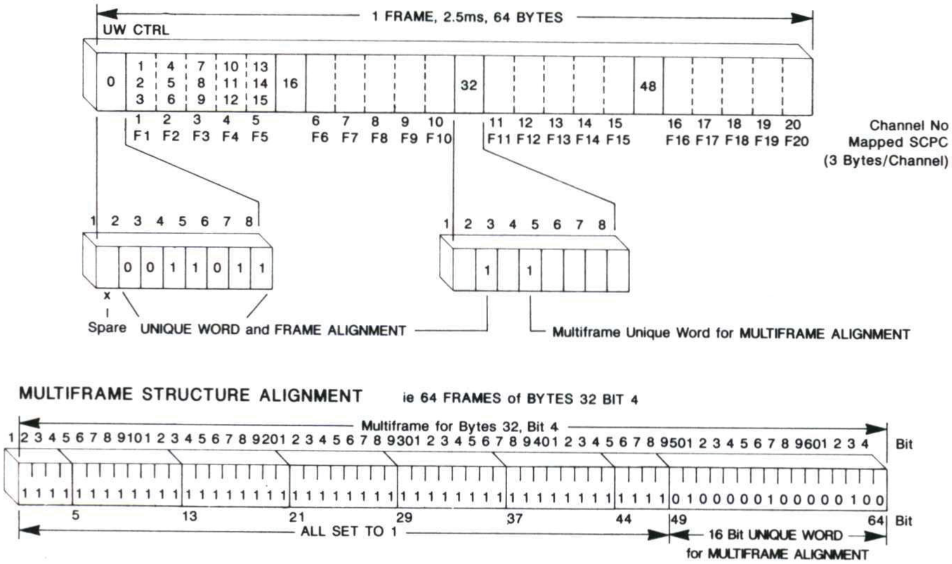


Fig. 18.7 *IBS frame structure*

Frame structure

1 Frame = 60 bytes of information + 4 bytes framing, 2·5 ms, Information rate = 204·8 kbit/s

1 multiframe = 64 frames, 160 ms

1 in each frame are demultiplexed to form the packet structure shown; each multiframe provides 12 packets, each packet containing 16 bytes.

The control channel has a defined packet structure to allow simple responses to VSAT:

(*a*) *Bulletin board*: An overall message transmitted to all VSATs with system information present, e.g. loading, randomisation, interval charge rate
(*b*) *Bulletin board 2 and 3*: These show status of the network by indicating if channels are busy or clear
(*c*) *Acknowledge channel*: Used to send back, 'clear' to transmit, to VSAT, channel number to use
(*d*) *Allocation*: To inform receiving VSAT to await transmission on a particular channel
(*e*) *Timing correction*: Used by hub operator to send auto-timing correction when VSAT is first switched on for delay equalisation on access channel caused by geographical location

These standard messages are used by the hub to respond to VSAT requests for channel allocation and perform the housekeeping and policing functions required by the system.

18.2.5 *Sizing of the VSAT network*

The number of VSATs that can be supported by a system of a particular size (i.e. number of channels) can be determined by using the Erlang criteria (depicted in Fig. 18.4), originated for telecommunication use. The main assumption for these

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005 20180803185518.0
008 930220s1992 enka b 001 0 eng d
010 __ **|a** gb 93005991
015 __ **|a** GB93-5991
019 __ **|a** 27813401
020 __ **|a** 0863412009
035 __ **|a** (OCoLC)27475213
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049 __ **|a** PITT
082 04 **|a** 621.38254 **|2** 20
090 __ **|a** TK5102.5 **|b** .I5 v.28
090 __ **|a** TK5104 **|b** .V748 1992
245 00 **|a** VSATs : **|b** very small aperture terminals / **|c** edited by John Everett.
260 __ **|a** London : **|b** Peter Peregrinus Ltd. on behalf of the Institution of Electrical Engineers, **|c** c1992.
300 __ **|a** xxvii, 543 p. : **|b** ill. ; **|c** 24 cm.
440 _0 **|a** IEE telecommunications series ; **|v** 28
504 __ **|a** Includes bibliographical references and index.
650 _0 **|a** Artificial satellites in telecommunication.
700 1_ **|a** Everett, John **|q** (John L.)
710 2_ **|a** Institution of Electrical Engineers.
948 __ **|a** o:dsh;cm:amk

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