Frequency Hopping within the SatNet DVB-RCS System

1. INTRODUCTION

There is a great deal of confusion in the industry when assessing basic capabilities in various DVB-RCS standard and proprietary VSAT products. A DVB-RCS system operates in Multi Frequency TDMA (MF TDMA) mode. In a true MF TDMA system, as opposed to the more numerous FM-TDMA VSAT systems, movement from one carrier to another is possible by a method that does not prevent the terminal from carrying traffic for any great length of time. This means that the terminal is not required to log off or in any other way be disabled whilst completing a frequency transition. Many proprietary TDMA systems also operate in this way, but the MF TDMA designation in no way regulates the time taken for the terminal to "hop" from one carrier to another, nor does it specify any guard time between bursts or the frequency span over which a terminal can "hop". Therefore a number of openly proprietary or pseudo standard, even "DVB-RCS Like" or "DVB-RCS Ready" systems exist with various claims on the speed of hopping. Indeed, many systems claim to have MF TDMA hopping capability, but are in fact only able to move frequencies at a frame boundary where there is a large amount of guard band available. Other more capable systems employ very large guard bands between bursts, therefore sacrificing frame efficiency for an ability to hop between a burst. In these systems terms such as "fast hop", "slow hop" and "burst to burst hopping" are used with a great deal of licence and it is impossible to determine from specifications or market claims what is the true capability of these products.

2. DVB-RCS SYSTEMS

The DVB-RCS specification (ETSI EN301790v1.3.1, http://www.etsi.org, for an electronic copy please go to http://pda.etsi.org/pda/home.asp?wki_id=gnEppxL0c'4658BDrhvw5) was developed over a number of years. From its inception, DVB-RCS was designed to have very good burst and frame efficiencies. To achieve this, the specification has defined the most aggressive short preamble burst structure ever seen in an MF TDMA system. This was achieved by utilizing the very latest in carrier frequency and symbol timing recovery techniques available. Further, the initial specification determined a technique that was designated "Fast Hop" which clearly specified an ability to hop between two adjacent bursts, within a designated guard band (section 6.7.1.3). In later evolutions of the specification, a major effort was made to reduce the cost of DVB-RCS terminals, whilst retaining the high frame and burst efficiencies that were the hallmark of a DVB-RCS system. This effort resulted in the designation of "Slow Hop" (section 6.7.1.3) which allowed the terminal to take a full TRF burst to settle when moving across the designated MF TDMA frequency range. This method was anticipated to have minimal impact on the capability and performance of the terminal, whilst allowing a major reduction in the cost and complexity of the terminal hardware.

3. THE SATNET DVB-RCS SYSTEM

From inception, SatNet has embraced the concept of high frame and burst efficiency allowed within the DVB-RCS specification. Having pioneered the development of short preamble MF TDMA, within their Comtel subsidiary in the mid 80's, SatNet was able to define a very short burst without compromising on the necessary guard band or performance in a demodulator. In fact the SatNet guard band is only 6 symbols and the SatNet system is specified to operate with this guard band and a 48 symbol short preamble even in the most onerous burst option allowed within the DVB-RCS specification (TRF = 1 ATM cell). Early SatNet terminals, such as the series 2000 implemented frequency hopping according to the ETSI "Fast Hop" designation. This meant that the terminal had the capability to hop across the operating frequency range, within the 6 symbol guard band. With the development of newer generation terminals,

such as the series 3000, SatNet wanted to take advantage of the new “Slow Hop” designation, but was unwilling to sacrifice any degradation in capability or performance. This resulted in the development of an innovative scheduling technique within the SatNet DVB-RCS hub. Taking advantage of the powerful processing engine within the SatNet Return Link Sub System (RLSS), SatNet was able to mimic a scheduling system first developed to increase efficiency on computer hard drives. In this method, instead of the traditional two pass assignment algorithm, common in most TDMA systems, which results in terminals having scattered assignments across the time/frequency sectors of a frame, SatNet introduced a third pass to the assignment process. This results in all of the assignment needs, including that of the Free Capacity Assignment (FCA), of the terminal population being discovered by the scheduler before making any actual assignment. Then in a third pass actual assignments are made. In this way an individual terminal is never normally asked to hop within a frame, thus negating the need for frequency hopping within the individual terminals. In fact the frequency hopping capability of the terminal is only needed to position the terminal to its carrrier at the beginning of each frame and to move within the synchronization overhead area, which can be very controlled and deterministic. The assignment process also insures that there is no inefficiency caused by unusable or “lost” slots another potential problem encountered on some early TDMA scheduling algorithms. By this method SatNet was able to reduce the cost of its terminal and reinvest these savings into increased throughput capability and other more customer centric features. In summary, although in its literature SatNet remains true to the ETSI designations, Series 2000 (Fast Hop) and Series 3000 (Slow Hop), there is in fact no operational, capability or performance difference between these terminals in this functional area and certainly no inferiority with respect to terminals that other manufacturers may designate as “Fast Hop”.

4. DVB-RCS SPECIFICATION FACTS

Close inspection of the ETSI DVB-RCS specification (EN 301 790) reveals that the above review is not the whole story. Although all SatNet terminals have been proven to have equivalent to “Fast Hop” performance in a very efficient frame and burst environment , closer examination of the specification, particularly the allowed guard time reveals a potential danger in accepting “Fast Hop” as a meaningful aspect in determining actual capability of a terminal, in isolation from the system in which it is operating.
For example, in the section on allowed guard time (section 6.5.4) it is specified that in fact a guard time can be set to almost any length. In fact the only maximum guard time refered to in the specification calls for it to be shorter than half an MPEG2-TRF traffic burst. As the shortest MPEG burst would be around 1200 symbols, it can be seen that the guard time between burst in a compliant DVB-RCS system could be as long as 600 symbols. When compared with the SatNet 6 symbols guard time this reveals a potentially large negative impact on frame efficiency is possible, whilst still claiming to still be compliant to the “Fast Hop” designation. Compared to this, it is clear that a combination of an SatNet terminal, even one designated with “Slow Hop” when combined with an SatNet hub with advanced three pass scheduling is a far superior combination for burst and frame efficiency and MF TDMA performance. The above facts reveal that merely claiming “Fast Hop” compliance tells very little about true terminal performance, within a system.