On typical Service Bit Rates and Delivery in DVB-H networks

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1. Scope

This white paper briefly describes the relation between the services provided in DVB-H networks, the respective bit rates and the time slicing procedure. It also provides explanation on the power savings achieved by utilizing the time slicing procedure.

2. The Available Bit Rates

The maximum bit rate available for delivering either legacy DVB-T service or new DVB-H services is 31.7 M Mbps for any OFDM mode (2k, 4k and 8k modes).

The bit rate depends on the modulation parameters used by the transmitter:

The punctured convolutional encoder coding rate (CR), The Reed Solomon rate (RSR), the guard interval duration (GI), the number of bits transmitted over each sub-carrier (M), the number of data sub-carriers (N) and the symbol duration (T).

Accordingly, the bit rate can be calculated as follows:

$$BitRate = \frac{M * N}{(T + GI)} * CR * RSR \qquad (1)$$

The maximum bit rate is compelled by choosing CR=7/8, GI=T/32, M=6 (for QAM64).

RSR is by definition 188/204, N can get 1512, 3024 and 6048 for 2K, 4K and 8K modes respectively, T can get 224, 448 and 896 micro seconds for 2K, 4K and 8K modes respectively.

3. Data Rates Profiles for Video and Audio

The designated data rates profiles for video and audio services, defined by the DVB guidelines [1], are as follows:

TYPE OF DVB RECEIVER	H.264/AVC LEVEL	VIDEO RESOLUTION	MAXIMUM BITRATE	TYPICAL APPLICATION
A	1	QCIF (180*144)	128Kbps	Cellular phone
B	1.2	CIF (360*288)	384Kbps	Cellular phone, PDA
C	2	CIF (360*288)	2Mbps	Pocket receiver
D	3	SDTV (720*576)	10Mbps	Regular TV set, Car TVs, Laptops
E	4	HDTV (1920*1080)	20Mbps	High-end TV set

Table 1: DVB-H profiles

Typically, the profiles which will be used by DVB-H are A, B and C, whereas B is likely to be the most common.

4. Time Slicing

Time slicing is the method used by DVB-H to achieve power saving and by this to enlarge battery life time. Services are transmitted in Time Division Multiplex (TDM) method and enable the receiver to be active only for a fraction of the time, which correspond to the actual time division over which the service is transmitted. Practically, services are aggregated into 2Mbit bursts; each burst is transmitted for a fraction of time over the continuous link which uses the modulation parameters as defined previously. For example, for time slicing with duty cycle of 90% and continuous bit rate of 20Mbps, the DVB-H terminal can receive services of approximately 2Mbps during the 10% active time.

DVB-H services can be broadcasted over two types of networks: Shared networks (DVB-T and DVB-H) and dedicated DVB-H networks.

In shared networks, a DVB-T multiplex (i.e. MPEG-2 TS multiplex) can share the link with burst DVB-H services in the following manner:

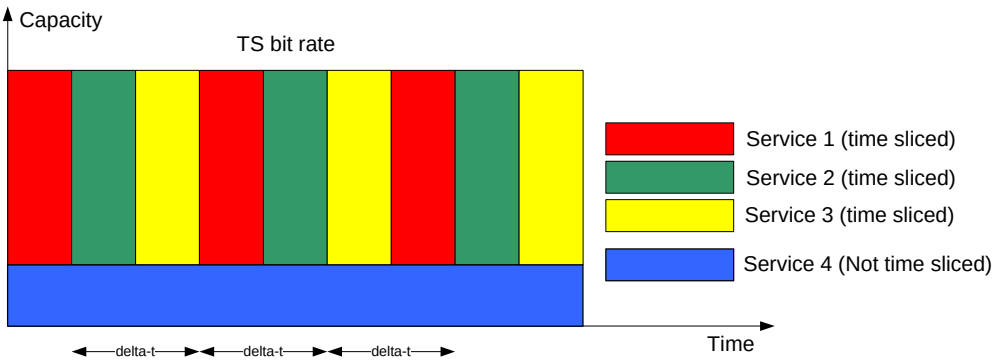

Figure 1: Combination of Time-Sliced and non Time-Sliced Services in DVB-T/H Shared network

Where Service 4 is a MPEG-2 TS multiplex that is not time sliced and Services 1-3 are DVB-H services, transmitted in a TDM manner.

In dedicated DVB-H networks, the time axis is divided between the different DVB-H services: Services 1-3 are DVB-H services, transmitted in a TDM manner, as shown in figure 2

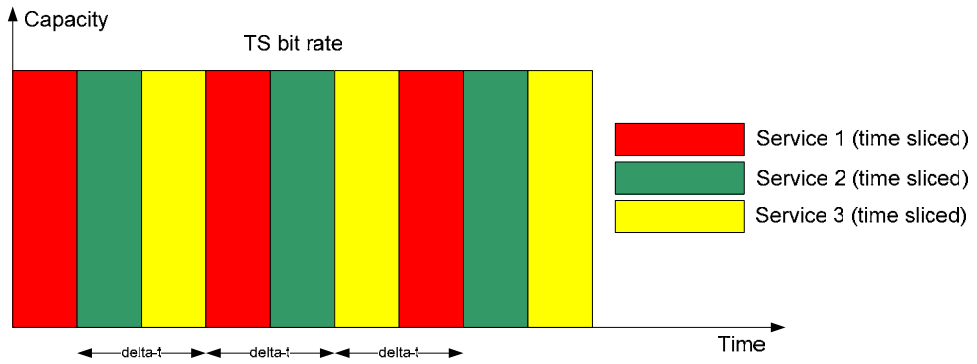

Figure 2: Combination of Time-Sliced and non Time-Sliced Services in Dedicated DVB-H network

A handheld device that wishes to tune to a time sliced service, needs only to detect in which slice the required service exists (using the network's PSI and SI information that are never time-sliced), where the time between the end of a burst and beginning of the next burst is called delta-t and is signaled from the transmitter to the handheld device.

Recalling the example above, in a 2Mbit burst that is received once every second (i.e. a 2Mbps effective bit rate), 25% of the information in the burst is used for error correction (called MPE-FEC). The remaining data can contain up to four 384Kbps or up to twelve 128Kbps services, alternatively any combination of different services can be multiplexed as well, as long as the over all data rate is not exceeded.

The following table compares between typical DVB-T and DVB-H services, carried over a single channel.

	DVB-T	DVB-H
Typical total bit rate used	15-24 Mbps	11-13 Mbps
Typical bit rate per program	4-5 Mbps	128-384 Kbps
Typical number of programs	3-5 (large screen)	13-18 (small screen)

Table 2: Services in DVB-H compared to DVB-T

It is worth mentioning here that there are also few other considerations which are taken for determination of service delivery and time slicing parameters:

- For ease of management and efficient power consumption at the receiver, a single-service-per-burst can be implemented. In such a case, the burst is perfectly adjusted to the size of the service, with no additional services involved.
- For zapping services and simultaneous reception of different services, multiple services can be combined into a single burst.
- For obtaining short service access time, the received burst size, as well as the off period is shortened. For example, if we take DVB-H profile 1.2 (table 1) and continuous bit rate of 20Mbps (like in the example above) and we consider synchronization time of 80ms, we get access time (which correspond to off periods) of 2.5 seconds and 5.1 seconds for burst sizes of 1Mbits and 2Mbits respectively.

4.1 On the relation between power saving and service bit rate

The following graph shows the relation between power saving and service bit rate [2]:

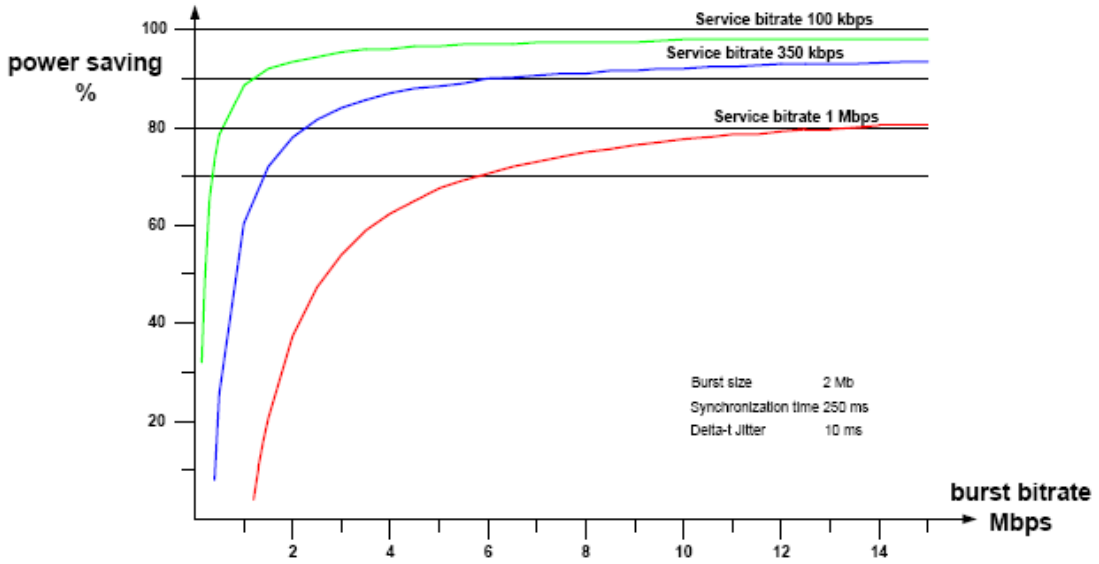

Figure 2: Power Saving Profiles with Various Bit-Rate Services [taken from the DVB-H implementation guide]

These graphs are generated using the following formulas and the following parameters: Burst size is 2Mbits, receiver synchronization time is 250ms and delta-t jitter is 10ms (delta-t is the time between a time slice and the following one, as signaled by the transmitter to the receiver).

Bd	Burst Duration (seconds)
Bs	Burst Size (bits)
Bb	Burst Bitrate (bits per second)
Cb	Constant Bitrate (bits per second)
Ot	Off-time (seconds)
St	Synchronization Time (seconds)
Ps	Power Saving (per cent)
Dj	Delta-t Jitter (seconds)

$$Bd = \frac{Bs}{Bb \cdot 0.96}$$

$$Ot = \frac{Bs}{Cb \cdot 0.96} - Bd$$

$$Ps = \left(1 - \frac{(Bd + St + (3/4 \cdot Dj)) \cdot Cb \cdot 0.96}{Bs}\right) \cdot 100\%$$

For example, a 350Kbps constant bit rate service and a burst bit rate of 6 Mbps would yield power saving of 89%.

5. Acknowledgment

The authors would like to thank Mr. Tommi Auranen, DVB-H Technology Manager from Nokia Complementary Wireless, for the review and the meaningful comments.

6. References

[1] ETSI TR 102 005

[2] DVB-H Implementation Guideline

7. Contact Siano

Siano develops silicon receivers for the emerging mobile digital TV (MDTV) market. Highly integrated, and tailored specifically for mobile communications and entertainment devices, the company's multi-standard solution overcomes formidable engineering challenges such as mobility reception, hand-offs, power consumption, form factor and single antenna reception.

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