

Generic Stream Encapsulation

Enabling the carriage of IP directly over DVB networks



What is DVB-GSE?

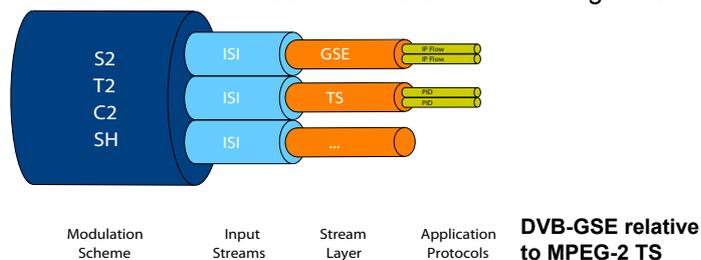
DVB **G**eneric **S**tream **E**ncapsulation (DVB-GSE) provides a means of carrying IP based content on DVB physical layers. Conceptually it is at the same level in DVB systems as the Transport Stream, offering an alternative means of carrying whatever audio, video and data is being broadcast. All DVB second-generation physical layer standards (e.g. DVB-S2, DVB-T2, etc...) will be “multi-mode”, offering the option of using either the traditional MPEG Transport Stream or DVB-GSE. DVB-GSE was published as a formal ETSI standard (TS 102 606) in October 2007 and an implementation guideline (TS 102 771) was published in June 2009. In 2013 a new version of DVB-GSE was published supporting a reduced complexity profile called GSE-Lite and Robust Header Compression (ROHC) for broadcast streams

Background

Convergence has become a key idea in broadcasting, communications and related domains over the past few years and it is IP, or Internet Protocol, that has become the key “convergence layer”. The first generation of DVB standards only supported the carriage of data using the MPEG Transport Stream (MPEG-TS). MPE, or Multi-Protocol Encapsulation, offered a means of encapsulating IP datagrams carrying audio, video and other data on MPEG-TS packets, thus enabling, for example, the development of the DVB-IPDC (IP Datacast) specification on top of DVB-H for the delivery of mobile TV. This method, however, does not offer the flexibility of being able to carry IP “natively” on DVB bearers. This first became possible with DVB-S2, the second-generation satellite transmission system, which introduced DVB-GSE, allowing the native carriage of IP with a significant reduction in the overhead required compared to using MPE. DVB-GSE will now be an option for all DVB second-generation modulation systems.

How does it work?

In the overall DVB system architecture, GSE conceptually resides at the same level as the MPEG-2 TS. In fact, all 2nd generation DVB broadcast bearers provide a “compatible broadcast mode” for carrying MPEG-2 TS as well as a “generic mode” for carrying variable size, generic data in base-band frames. So GSE does not replace the MPEG-2 TS, but rather complements it (see Fig. 1). The term “Input Streams” in Fig. 1 below denotes the different user data streams serving as inputs to the modulator, which schedules their frames according to QoS and possibly other policies.



The GSE protocol has been devised as an adaptation layer to provide network layer packet encapsulation and fragmentation functions over generic streams. GSE provides efficient encapsulation of IP datagrams over variable length Layer 2 packets, which are then directly scheduled on the physical layer into base-band frames. GSE maximizes efficiency of IP datagrams transport reducing overhead by a factor 2-3 with respect to MPE over MPEG-TS. This is achieved without any compromise of the functionalities provided by the protocol, due to the variable length Layer 2 packet size, suited to IP traffic characteristics.

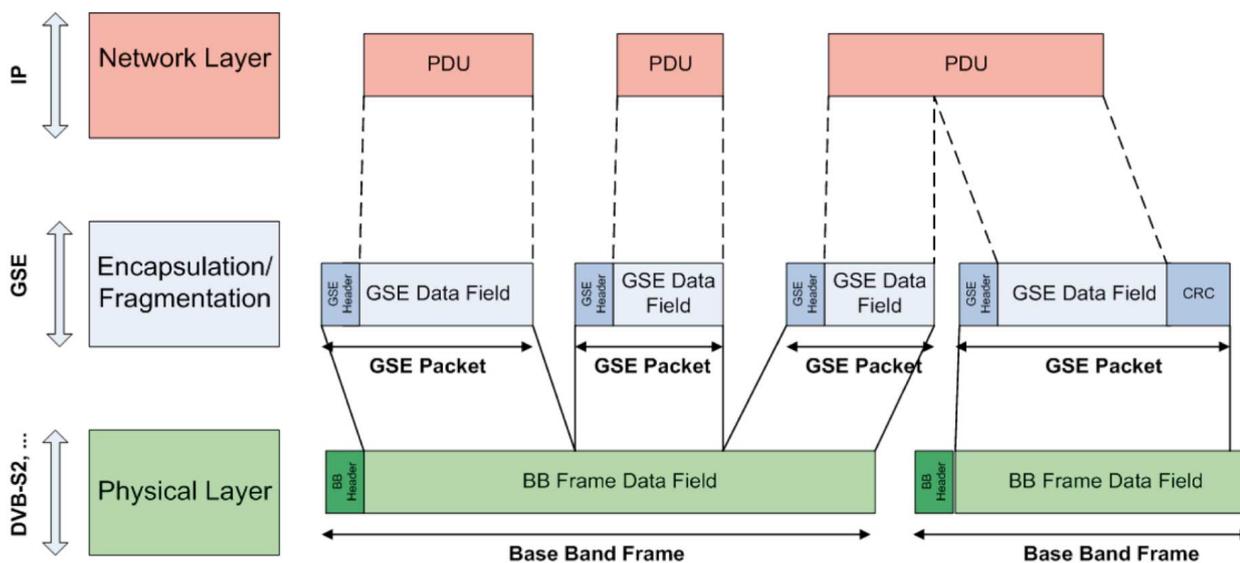
Using GSE, all 2nd generation DVB broadcast bearers appear as transparent pipes to the IP layer. Thus applications can be designed as if the satellite, terrestrial or cable broadcast paths were regular local or wide area network trunks. GSE also requires a minimum error detection probability and maximum frame error rate from the underlying broadcast bearer. Hence any application layer FEC schemes can be designed against these minimum requirements, enabling the application layer to be bearer-agnostic. The same approaches are taken in DVB-IPTV and DVB-IPDC and hence GSE enables IP as an interoperability point between the broadcast, telco and mobile application domains. It is thus a cornerstone for DVB on the way to convergence and a unified service model across these domains.

How does it work? (continued)

GSE provides additional features that increase the protocol flexibility and applicability. Some key GSE characteristics are:

- Support for multi-protocol encapsulation (IPv4, IPv6, MPEG, ATM, Ethernet, 802.1pQ VLANs, ...)
- Support of several addressing modes: In addition to the 6-Byte MAC address (including multicast and unicast), it supports a MAC address-less mode, and an optional 3-Byte address mode.
- A mechanism for fragmenting IP datagrams or other network layer packets over base-band frames to support ACM/VCM modes of operation.
- Support for hardware filtering.
- Extensibility: additional link protocols can be included through specific protocol type values (e.g. Layer 2 security, IP Header Compression, ...)
- Low complexity of hardware implementations.

IP datagrams, Ethernet Frames, or other network layer packets, which are scheduled for transmission, are encapsulated in one or more GSE Packets (see Fig. 2). The encapsulation process delineates the start and end of each network-layer PDU, adds control information such as the network protocol type and address label, and provides an overall integrity check when needed.



Fragmentation at the transition to the link layer has caused many problems in protocol and application design, so that the IETF strongly recommends avoiding IP layer fragmentation. GSE meets this key requirement in that it guarantees that no fragmentation at the IP layer occurs. Fragmentation (if any) needed to adapt to the DVB broadcast bearer's base-band frames is performed entirely within the GSE layer and thus hidden from the IP layer. The reassembly process is robust against loss of base-band frames.

Market Deployment

Several products implementing DVB-GSE have been developed and deployed for professional satellite applications. Consumer products implementing GSE have not yet been announced as of this writing. Apart from this, GSE is part of the SatLabs recommendations for DVB-RCS terminals (on the DVB-S2 forward link) in the "SatLabs system recommendations" v1.3 and v2.3 (www.satlabs.org).

GSE-Lite

In order to reduce the memory and processing requirements for transmitters and receivers, the GSE-Lite profile was created in November 2013. It provides a simpler yet completely functional sub-set of GSE to allow lower-cost consumer receivers.

The key differences with the main GSE Profile are:

- Maximum Memory of 7,2 kB vs 16 MB
- Maximum Latency of 64 vs 256 Baseband Frames