

## TPEG – What is it all about? – January 2014

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<b>TISA Guideline</b>		

## TPEG – What is it all about?

A guideline for understanding TPEG quickly!

January 2014



### Notice

This TISA Guideline has been developed by TISA for members and non-members professional use. It may be subject to change without notice. NOTE: This edition reflects the TPEG technology state at date of publication, but is by no means complete – further editions will be issued.

## **Enjoy the read**

We hope this guideline will give you a good insight into the concepts and principles of TPEG technology and the TPEG “toolkit” that has been built by the excellent co-operation of so many actors in the TTI domain, over the last 15 years, both before and since the original booklet was published!

Please note that this current edition is far from complete. Further editions are planned with more information when editing time permits.

If you wish to contribute some content, please submit to the TISA Executive Office.

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TISA Technical and Standardization Committee Chairs

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# 1 Introduction

## EBU booklet

This guideline follows many of the ideas used in a booklet originally produced in 2003 by the TPEG Project, which was coordinated by the EBU. The text is designed for professional newcomers to TPEG technology, to provide a relatively quick read to introduce TPEG concepts, technology and its underlying philosophy. TISA, with its Mission (updated in 2013), has a significant interest to introduce the principles of TPEG and provide an “easy read” about TPEG issues, including a little history, the present situation, and future applications and to describe the so-called TPEG “toolkit”.

The original layout covered a topic per double page spread and this guideline follows the same layout. In this edition, some of the original topics have been updated and are completed for the time being, as requested by the TISA Steering Board to meet the present priority of providing an introduction as soon as possible. Other topics will be gradually updated and added into future editions, as time and priority determines.

## TPEG motivation

TPEG technology was originally motivated by the desire to develop a 21<sup>st</sup> century multimodal TTI data protocol for delivering content to the end-user. Already TPEG has proved that it can satisfy an even wider remit, covering other application areas such as weather information and perhaps some content exchange requirements. Language independence was a prime principle in the design. Various location referencing methods were developed to allow any client device to take advantage of the content with no prior installation of a location database.

## TPEG service deployment

Meanwhile TPEG service deployment is proceeding at a number of sites, validated by TISA having issued 31 Service IDs.



## The TPEG abbreviation

Nowadays almost everyone has heard of JPEG or MPEG - if one has a digital camera or a digital TV, but few probably know what these abbreviations mean. The "EG" stands for "Experts Group" - the clever people who invent systems and then write the technical standards that are used to ensure that all services and products conform and thus work together. (Incidentally the "JP" and "MP" stand for Joint Picture and Motion Picture, respectively.)

When the EBU experts came together for the first time they were determined to work on systems suitable for broadcasting information to end-users and had a particular focus on Traffic and Travel Information. The idea for TPEG was discussed and it was agreed upon, quite easily, to represent Transport Protocol Experts Group. "Transport" was chosen as a "*double entendre*" meaning "Transport" as in the context of traffic and travel and also meaning "Transport" in the context of moving information (data) from a service provider to an end-user. It was foreseen that TPEG technology would be able to handle information delivery far outside the traditional TTI domain, as well as very effectively within this domain.

So the name TPEG was retained and the EBU experts were able to have some EG(gs), too!

## TPEG - nomenclature

Before you read further it is good to know that like most modern technologies, TPEG is littered with many, many abbreviations and an already complex number of TISA Specification parts, organized within two development generations. Their structure has been collected together in another TISA Guideline: TPEG Nomenclature and Abbreviations, August 2010; consult this TISA Guideline to decode much more about TPEG and any strange terms as you read this guideline, if we have left any in the text that are not so obvious. (Annex A in this guideline has the most frequently used abbreviations).

## Development history

In the early days of developing TPEG technology (circa 1997/98), it was indeed planned to develop applications which could extend multi-modal information services far beyond anything at that time attempted by such technologies as RDS-TMC. As TPEG technology gradually developed, the Road Traffic Message application was joined by the Public Transport Information application and both shared a common native Location Referencing method.

First generation TPEG application (TPEG 'generation 1') only provided a binary encoding, having in some cases a separate specification for the mapping to an XML encoding. Second generation TPEG applications (TPEG2 applications) now are specified with an UML model, from which *automatically* both a binary encoding and XML encoding are derived. A TPEG2 application specification includes both the binary and XML encodings as integral part of the specification.

Today, TPEG technology is already recognised as providing a "toolkit" for delivering various types of content (with more location referencing methods). Some of the standardized TPEG applications to date include traffic (traffic events and traffic flow and prediction), parking information, fuel price information, and weather information. In the future, it is expected that public transport arrival and departure times will be delivered (transported) using TPEG technology.

## Non-specific clients

Given that the TPEG specifications define, in effect, the "on-air" interface, the concept also embraces the idea that there will be, over a long time, many diverse implementations of TPEG client devices, used by end-users. Another important philosophy was to assume scalability of content and client devices to be necessary. Thus, a service provider may choose from the TPEG toolkit to implement very highly detailed services or rather lowly detailed services, which respectively will use more and less bandwidth and require more and less complex client devices.

## 2 TTI domain

### Introduction to TISA

Much more technical information about TPEG technology and how it fits the TTI domain may be obtained by joining the Traveller Information Services Association, TISA ([www.tisa.org](http://www.tisa.org)), which is focused on implementation and deployment issues and specifications/standards support and maintenance/development issues.

#### Vision

TISA envisions a world where open Traffic and Traveller Information (TTI) standards and policies increase the traffic safety and efficiency of travel

#### Mission

TISA's mission is to develop and promote open standards and policies that

- facilitate a timely and cost-effective deployment of TTI services and products that save end users time and money, increase traffic safety, and minimize environmental impact
- improve the quality and minimize the cost of such services and products by maximizing interoperability worldwide

#### Culture

TISA offers an environment where the values and needs of traffic and traveller information service and content providers, public authorities, auto manufacturers, product industry, broadcasters and transmission operators meet. It is an organization driven by, and growing through, the active contributions of its membership. To stimulate innovation and facilitate collaboration, TISA provides an environment, where

- existing standards and policies are well maintained and, if necessary, updated for adapting to the fast-changing ITS world
- efficient processes and tools are provided to support timely standardization or publication of the work results produced within TISA
- a high level of quality is maintained for all work created by TISA through rigorous review and approval processes
- intellectual property is valued and TISA supports its protection
- active liaisons with adjacent/related organisations, such as GENIVI, WorldDMB, RDS Forum, and DATEX-related activities, facilitate cross-cutting activities

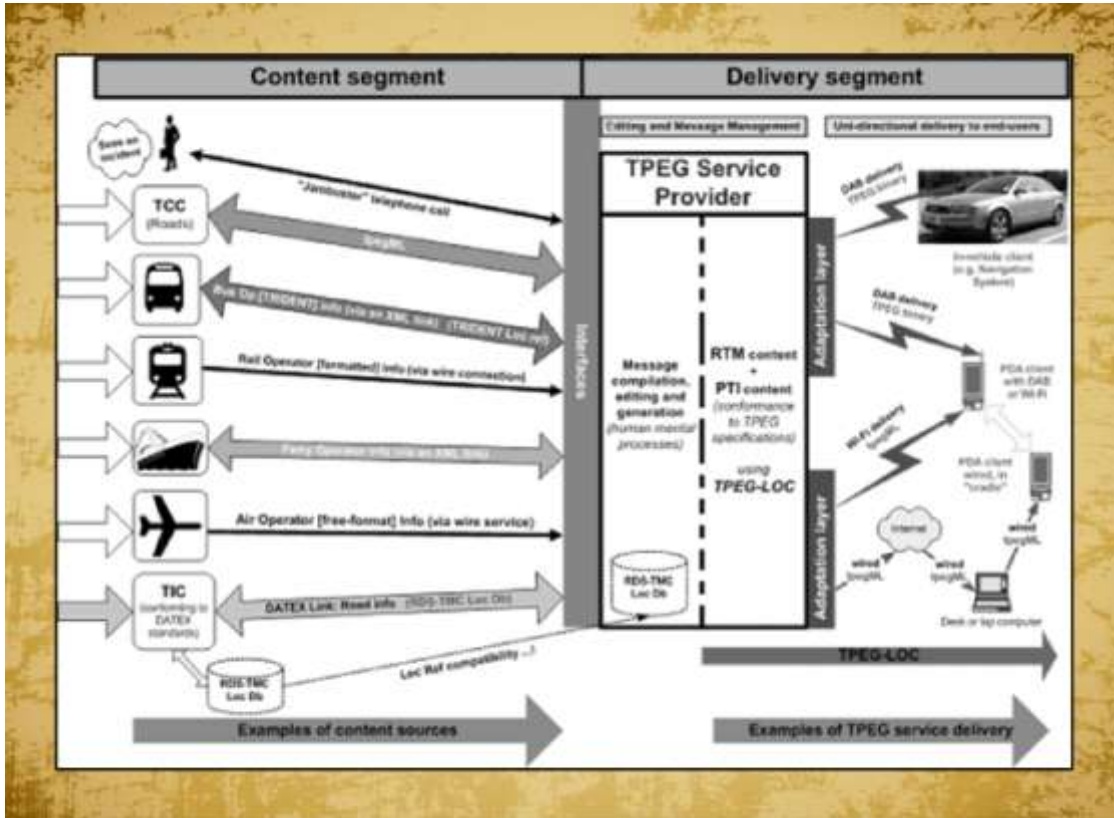
TISA strives to utilize the synergies of its membership and to exploit the joint expertise of all TISA members to foster business related to TTI services as well as for the benefit of the society.

## TTI domain segments

Traffic and Travel Information content is delivered to end-users by many mechanisms, notably from broadcasters who deploy spoken announcements, use RDS-TMC data, teletext in TV services and the internet to deliver such content. But, of course the content has to be collected and edited according to rigorous standards to ensure it is timely and accurate. TTI service provision is therefore all about collection, editing and delivery of information.

To facilitate a good understanding of the processes, originally the EBU devised the idea of two segments which are shown in the figure. The *content segment* covers all possible sources of information that must be collected and processed before the *delivery segment* can be deployed to send the information to the end-user.

This was visualised as follows, way back in the 1990s:



“The content and delivery segments for a TPEG service provider”

In recent years, the TISA ITS Directive Work Group has been very active and has expanded the idea of a TTI Value Chain. This is in fact a complex set of interfaces and connections that amount to some 30 identifiable activities, which are effectively in series from the point of a TTI event to finally rendering information about the event on an end-user client device.

TISA has now published a Position Paper that details many issues of further explanation for the use of a value chain (EO12013 - TISA Definition ITS value chain). The following picture shows the TISA value chain at its highest aggregation level. For further details, please refer to the EO12013, which is published on the TISA website at [www.tisa.org](http://www.tisa.org).



“The simplified TISA Value Chain”

## 3 TPEG design philosophy

### TPEG core principles

The following principles were assumed to be essential in the development of the TPEG protocol, structure and semantics (Reference ISO/TS 18234-2):

- TPEG is unidirectional
- TPEG is byte-oriented, where a byte is represented by eight bits
- TPEG provides a protocol structure, which employs asynchronous framing
- TPEG includes a CRC error detection capability applicable on a variety of different levels
- TPEG assumes the use of a transparent data channel
- TPEG assumes that underlying systems will have an appropriate level of reliability
- TPEG assumes that underlying systems may employ error correction
- TPEG has a hierarchical data frame structure
- TPEG is used to transport information from database to database
- TPEG provides service provider name, service name and network information
- TPEG permits the use of encryption mechanisms, if required by an application

### TPEG additional capabilities

- TPEG domain has two most significant segments: Content and Delivery
- TPEG allows services to be free of location database synchronism with clients
- TPEG extends applications to multimodal services
- TPEG offers very rich content with language independence
- TPEG facilitates unprecedented client device filtering options for end-users
- Designed for "thick" and "thin" client devices \*
- No need for preloaded location database
- Scalable message content
- Adaptation to delivery bearers is simple

\* NOTE: In TPEG end-user devices are known as 'clients', whereas for RDS-TMC end-user devices are known as 'terminals'.

### TPEG has no need for a location database in client devices

Service Providers collect and deliver wide ranging multimodal content, but the possibility for data delivery provided by Europe's first TTI data technology RDS-TMC had significant limitations. That system is essentially limited to inter-urban road events and *every* decoder terminal must have a location database to interpret *any* message received. This has created a complex situation for all end-users and this drawback has been resolved by various B2B models that cover the issues of subscription and location database updating/renewal.

TPEG technology overcomes this limitation by the introduction of various location referencing methods, which can deliver very rich location information, including on-the-fly, with every message, so that client devices do *not* need a location database. The biggest advantage is that TTI for densely populated urban areas can be delivered. Navigation systems with digital maps can "machine read" the location content and localise an event directly onto the map display. A text only client device (e.g. a PDA) is able to present locally found names such as a railway station name and a platform number, directly to an end-user as a text message.



## Language independence

RDS-TMC has shown the way for information data delivery serving a mobile end-user who wishes to obtain content when in a locality using a language other than her/his native language. The concept is implemented such that the client device presents information in the language of choice of the end-user. RDS-TMC is limited because it relies upon pre-determined phrases - often not exactly, what the service provider would wish to express.

TPEG technology goes a step further by "decomposing" the information into essentially single words, which can be more readily translated into various languages. Then the TPEG message construction concept allows for the available information about an event to be assembled into potentially very rich and informing messages, exactly as the service provider would wish.

## Multimodal applications

TPEG is the first TTI application that covers all modes of transport across the entire transport landscape. It can serve the motorist in the urban area as well as the bus passenger, the intercity traveller and the long distance driver.

In the beginning of TPEG development, the "generation 1" application TPEG1-RTM was designed to cover Road Traffic Messages regardless of location. It was aimed at urban information because of the richness of content that it could offer. Now RTM is superseded by "generation 2" TPEG2-TEC (Traffic Event Compact), which has a wider potential for this application area as it offers both cause and effect in messages. TPEG-TEC also maps well to the former RDS-TMC. TPEG2-TEC, together with TPEG2-TFP (Traffic Flow and Prediction) allows for the effective and efficient provision of all kinds of road traffic conditions.

Furthermore, TPEG technology is designed to facilitate many more applications covering many other aspects of the TTI domain. The following TPEG2 applications present some examples:

- TPEG2-RMR (Road and Multi-modal Routes) allows a service provider to provide route advice mixing various transport modalities, including public transport for a part of the route, or a last mile 'on foot'.
- TPEG2-WEA (WEAther information) allows service providers to provide comprehensive weather forecast reports, including multi-day forecasts.
- TPEG2-PKI (ParKing Information) allows service providers to provide comprehensive information on parking facilities and pricing.
- TPEG2-FPI (Fuel Price Information) allows service providers to provide comprehensive information on fuel stations and current fuel pricing.
- TPEG2-ADT, in development, will allow a service provider to deliver comprehensive public transport information about arrival and departure times of airplane, bus, ferry, tram, and train services.

Therefore, TPEG technology extends multi-modal information services far beyond anything so far attempted by such technologies as RDS-TMC and puts the delivery of TTI back on track to be a ubiquitous source of information that ideally suits mobility objectives.

## Filtering

TPEG technology has been developed in the context of broadcast service delivery, where messages are delivered to many, many client devices. At any point in time only some of the end-users would wish to receive particular information (e.g. information about traffic jams in a city more than 200 km away is not useful).

To allow large amounts of information to be delivered and yet not overload the end-users with data of little use to them, the TPEG design philosophy, through explicit coding, is built on the idea of client filtering. This allows end-users to choose messages based on any number of criteria, such as type of event, location, mode of transport, direction of travel etc. Originally when TPEG technology was planned the design philosophy was centred on the concept of delivering information to the end-user, in such a way that no prior set-up would be required when first accessing a service and that client filtering could be applied to the content to finally only present the information that the end-user required.

The expectation of the designers was that TPEG services would eventually become prolific and that TPEG client devices would be many and varied, ranging from so called "thick clients" such as in-vehicle navigation systems through to "thin clients" such as PDAs with some connectivity, wireless or wired. On this basis an end-user could be expected to want to access services in both his home territory and when out and about travelling, including when a long way from home in a territory with another language in use. Thus, TPEG technology has two key demands to satisfy: mobility of access and language independence. With mobile client devices, it was clear that any location information given to the end-user has to be both human understandable and machine-readable. TPEG originally satisfied this need with the TPEG-LOC methodology, by delivering both types of content with all messages. Subsequent developments created the concept of a 'Location reference container', such that TPEG messages could describe the location with a choice out of potentially multiple location referencing methods (on-the-fly methods and/or TMC location table based methods), to suit both thick and thin clients. This overcomes another challenge found in the RDS-TMC concept with the need for every client device to contain a location database - which must be maintained by both service provider and all client devices. By using TPEG technology, it is not mandatory for message interpretation to have any location database in the client device, although it is best to keep up-to-date maps in the client device, as in the case of navigation systems using dynamically supplied data from a TPEG service.

## 4 TPEG tables

### Introduction

TPEG technology easily satisfies the language independence requirement by using table code values across the "on-air" interface, to deliver much of the content. In this context "on-air" interface can be considered appropriate to describe the "service provider to end-user" interface regardless of connection type, which may for example be a wireless broadcast connection or a wired internet connection.

The tables are extensible, with legacy compatibility and they do not need to be available completely up-to-date in a client device.

- extensible TPEG tables
- rich message content through TPEG tables
- language independence through TPEG tables

At the core of TPEG technology is the concept that events will be described by reference to a set of tables that are predetermined to cover all possible situations that may need to be described by a particular application. A key reason for this is that the code value for a "word" is delivered to a client device and it is then rendered into displayable information for the end-user in their language of choice.

Each table may contain up to 255 "words" with a common use of code value 0 to signal the word "unknown".

Taking the TPEG2-TEC application as an example, the experts found that there were 31 so called "main causes" and the application requires 45 tables in total to describe every aspect of event information from vehicle type to network performance status (i.e. "freely flowing traffic"). The concept of "words" is paramount – there is no intention to build pre-determined phrases in TPEG technology the phrase building is done on the fly by a service provider in compiling a message, thus giving great freedom to express an event and permitting rich content possibilities. Nevertheless the "word" concept is stretched to allow single entities such as a "large 4-wheel drive vehicle" to use a single code value.

### TPEG tables – structure and three columns

In the TPEG technology specifications it is necessary to assign code values to each "word" and to determine how the Tables are used in the hierarchical structure of each message. Each Table is given a title and then the "words" are listed with their code values and two additional columns for comments and examples. These last two columns are quite sparsely populated at present and during the translation and operational testing processes it will be helpful to add any more comments and examples that could assist others to understand the detailed concept in each "word".

Code	Reference-English 'Word'	Comments	Examples
1	security alert	A security alert has been declared, possibly resulting in restrictions on traffic movement and delays.	<b>A.1.1.1.1</b> An area is closed due to a hostage situation.
2	contagious disease	A contagious disease is affecting the location potentially resulting in a movement restriction being applied.	A disease of animals such as foot and mouth or blue tongue.
3	environmental	An environmental incident has occurred, potentially resulting in a movement restriction being applied.	An area is closed due to pollution.
4	smog alert	A smog alert has been declared due to pollution levels in the air.	
5	batch service in progress	Traffic may flow in only one direction at a time. Commonly known as 'Single Alternate Line Traffic'.	One side of a single carriageway road is closed; traffic in one direction uses the remaining open side for two minutes, then traffic in the other direction uses it for two minutes; alternately.
6	road closed by the regulatory authorities	The regulatory authorities have closed the road for whatever reason.	

**TPEG table tec116: Regulatory measures, as presently specified**

The most fully populated table in TPEG2-TEC, to date, uses 32 entries, so there is plenty of room for expansion when new situations need to be detailed.

The concept of the table default word is to define a word that a client device should render if it does not have in its dataset the word for the received code value. This situation may occur if a table extension has been implemented by a service provider but the client device has not been updated.

## Reference English

In TPEG technology specifications the TPEG tables are written in so called Reference-English – this is a sort of technically acceptable use of English, which has technical definitions understood by the experts (mostly held in a data dictionary) and which should allow translation into any language. Indeed, it will be necessary to translate into GB-English, because some words would not be used by the “women or man-in-the-street”; for example: “road-rail crossing” is the Reference-English word, whereas “level-crossing” is commonly used by native English speakers, and in the USA one would rather speak of a ‘railroad crossing’.

## Table translation

TPEG tables describe single entities, coding a word or an expressions, i.e. “small car” or “large 4-wheel drive vehicle”. The translation task therefore is to find the relevant expression in a particular language with which the local end-user would be familiar, i.e. in German: “auto” or “all-radfahrzeug”. This concept assumes it will be possible to largely translate without reference to the context in which the word will be used.

A procedure for managing this activity has been established by TISA, as follows:

write Use Case Proposal (from any TISA member)	UCP registered	evaluation of UCP and allocation of work	Translation work (by e-mail working of TISA experts)	TISA website publication – public domain
to TISA Executive Office	TISA Executive Office	BAWG meeting	Translations TF	by TISA Executive Office

**TPEG tables – new words proposals and translations procedures**

## Non-specific client devices

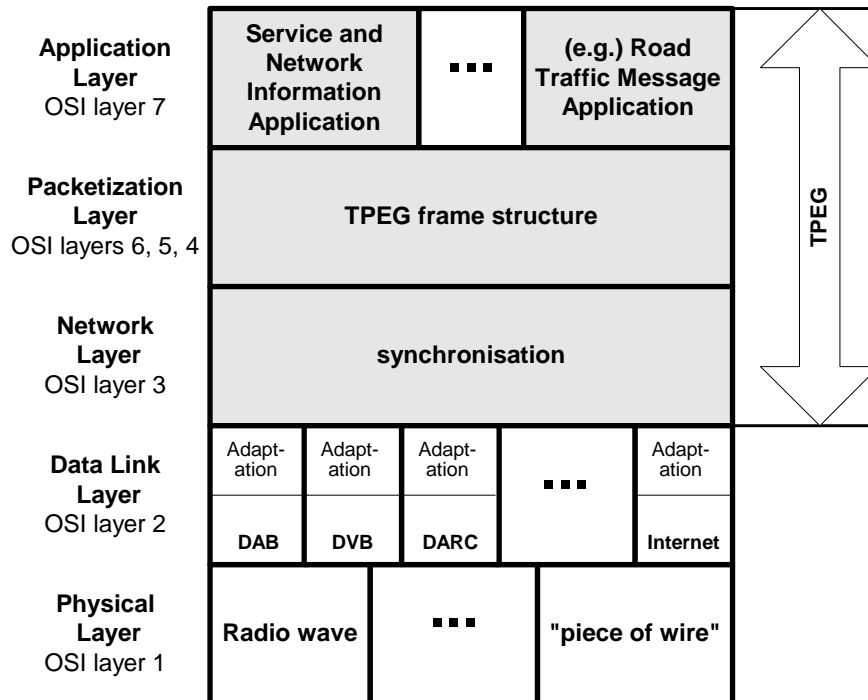
In the case of non-specific client devices (i.e. devices not built specially for TPEG services and thus not internally equipped with the TPEG tables) then table downloading (of the appropriate language required) at the time of use is implemented, such as when accessing a web service using a standard browser. Specific TPEG client devices will be manufactured with the TPEG tables already installed, appropriate to the market in which they are sold.

## 5 TPEG in relation to the ISO/OSI Layer Model

### ISO/OSI layer Model – from the TISA Specifications

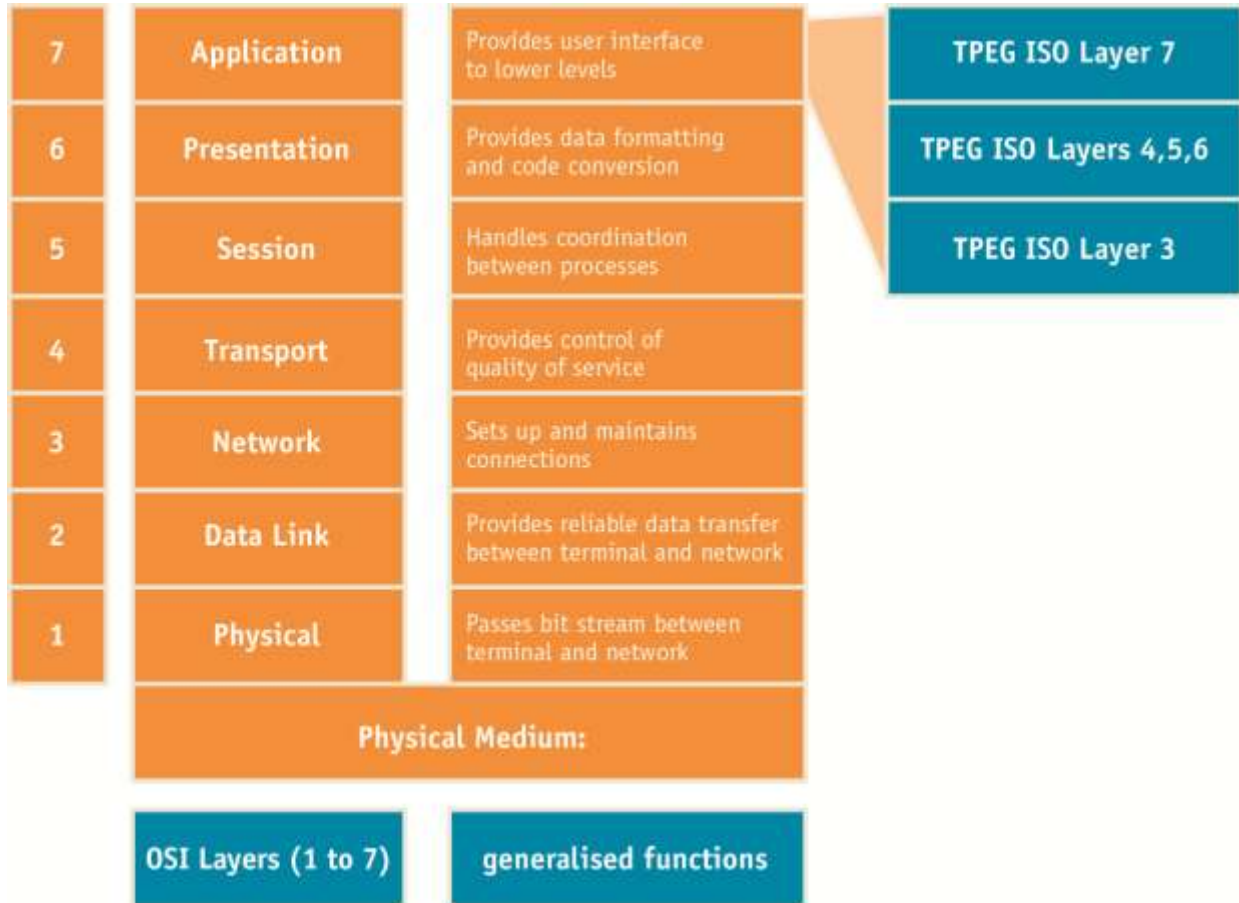
The ISO/OSI layer Model allows for a better understanding of bi-directional data communications connections and the roles played in establishing a connection.

TPEG, originally only developed for unidirectional delivery channels, nevertheless fitted well into the ISO/OSI Layer model and is shown in the Specifications thus:



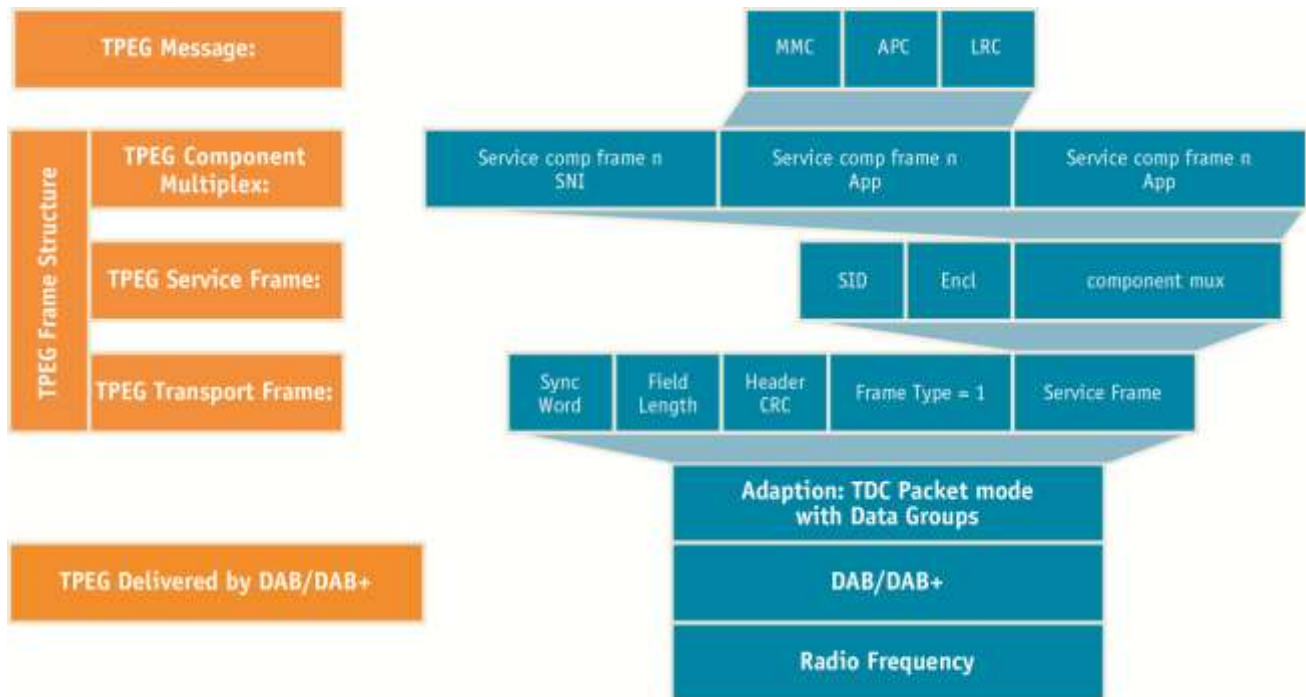
**TPEG in relation to the ISO/OSI Layer Model via different bearer channels (extracted from ISO 18234-2)**

Today nearly all digital bearer systems require TPEG to be transmitted within their application layer - to overcome the implied bearer dependence on layers 3-6, all TPEG layers (ISO Layers 3-7 are included within the bearers application layer (ISO layer 7). It is shown here in an idealised layout:



## TPEG layer Model – expanded showing three container concept and framing

Another way of looking at TPEG in the context of a protocol stack is as follows:

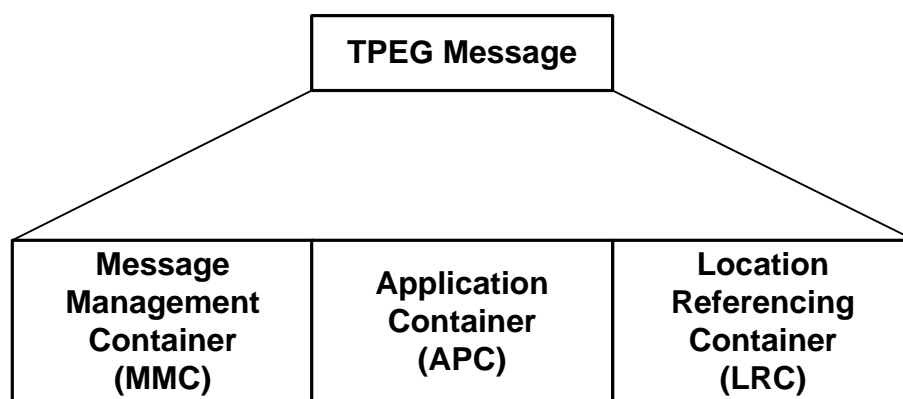


TPEG using Digital Radio adaption/delivery

### TPEG using Digital Radio adaption/delivery

TPEG technology has, in essence, been designed for “one-to-many” uni-directional delivery; nevertheless, it broadly fits within the ISO 7-layer protocol stack, thus giving it good compatibility for many future adaptation layers to be developed as needs arise.

Furthermore it is possible to see the frequently used TPEG Message construct – although drawn top downwards - which is used to understand how a TPEG Application is formed, by using a three container visualisation:



(e.g. TPEG2-TEC)

TPEG Container concept visualisation - frequently used in Specifications

## Annex: Abbreviations

Abbreviation	Explanation
ADT	Arrival and Departure Time information – a TPEG2 application
APC	Application Container
CEN	Comité Européen de Normalisation
DAB	Digital Audio Broadcasting (aka Digital Radio)
DATEX	Data Exchange - protocol for exchanging traffic management information
EBU	European Broadcasting Union
EC	European Commission
FPI	Fuel Price Information – a TPEG2 application
IPR	Intellectual Property Right
ISO	International Standards Organisation
JPEG	Joint Picture Expert Group
LRC	Location Reference Container
MPEG	Motion Picture Expert group
MMC	Message Management Container
OSI	Open Systems Interconnection - an ISO concept
PDA	Personal Digital Assistant
PKI	ParKing Information – a TPEG2 application
RDS	Radio Data System
RDS-TMC	RDS-Traffic Message Channel - a feature of RDS
RMR	Road and Multi-modal Routes – a TPEG2 application
TEC	Traffic Event Compact – a TPEG2 application
TFP	Traffic Flow and Prediction – a TPEG2 application
TPEG	Transport Protocol Experts Group
TPEG1	TPEG Generation 1
TPEG2	TPEG Generation 2
TPEG1-LOC	Location referencing - a TPEG1 Binary application
TPEG1-RTM	Road Traffic Message - a TPEG1 Binary application
TPEG-SNI	Service and Network Information - a TPEG1 and TPEG2 application
TS	Technical Specification – the status of an ISO standard
TTI	Traffic and Travel Information
WEA	WEAther information – a TPEG2 application