Testing Video Transport Streams Using Templates

Using Templates to Ensure Transport Stream Performance

As the number of digital television services being distributed around the world increases, the need to monitor the vital MPEG transport streams being transmitted becomes ever more important.

Why Use Templates?

Various strategies are employed in the MPEG-2 environment to test the integrity of the digital transport stream. These strategies range from monitoring and analysis of the various component parts, to protocol and packet-level tests, to the timing and synchronization elements, through the basic structure of the compressed picture stream.

Various standards and test techniques have evolved to ensure interoperability and the integrity of the transport stream as it passes from its origin, through processing and networking equipment, and then transmission over cable, satellite, or terrestrial RF channels to the consumer's digital set-top box.

However, simply monitoring the components and syntax of an MPEG transport stream according to test standards, such as the classic DVB test standard ETR290, and now TR 101 290, is not enough to guarantee that the correct information is being delivered to the viewer's receiver.

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The Service Plan

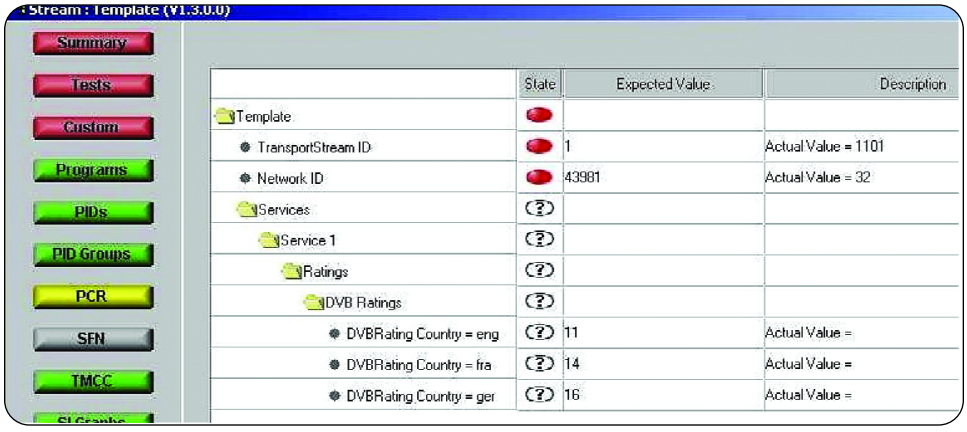
Ensuring that the contents of the transport stream are correct requires the monitoring equipment to have prior knowledge of what the broadcaster plans to transmit. One method of achieving this is to enable the broadcaster to identify a small number of key parameters that can be used to verify the contents of the transport stream. These parameters form a service plan, or template, in which the operator enters the values that are expected to be present in the transport stream. The monitoring equipment extracts the actual values from the transport stream and compares them against the template, indicating when a discrepancy occurs. Tektronix monitoring equipment, such as the new MTM400, has a user-defined template option which enables content verification on the transmitted steam. There are six steps in this process:

Step 1 – Determine template requirements

Tektronix provides everything that most broadcasters might need to define the template tests required inside the transport stream. This can start at the highest level with the "transport stream ID," an identifier number that is unique to the whole stream, then perhaps the set of services or programs within the multiplex. It may need to cover the set of stream types (video, audio, data, etc.) within a given program or service, the PID or packet identifiers that contain those services, and the service name for each of the required services. It is likely to check the PCR PID (the timing reference that is vital to each service) and then specific service-related parts of the service information tables. These tables may vary according to the region and DTV standard; e.g., SDT (service descriptor table) is just one example for DVB, and there are other and similar service information tables for ATSC or Japanese ARIB services.

Another check might be that specific scrambled PIDs retain their scrambled state in order to maintain conditional access security over valuable revenue-generating Video-On-Demand services such as film channels.

The list of check items can extend to lower levels inside the tables, such as the Parental Rating Descriptor, which can be important on satellite services where it may vary within the satellite's footprint from country to country. The provider, or broadcaster, can choose which elements are most important and incorporate those in the template itself, as shown in Figure 1.



▶ ***Figure 1.*** *Typical ratings check.*

Step 2 – Create the template

There are many methods to enter the template that performs template checking on broadcast test equipment. A user can select from a list of the items to check, feeding in specific PID and service parameters to a forms-entry program. Another way is to edit a previously used template file, adding and changing specific numbers and service identifiers to meet your requirements. Figure 2 shows a typical template file.

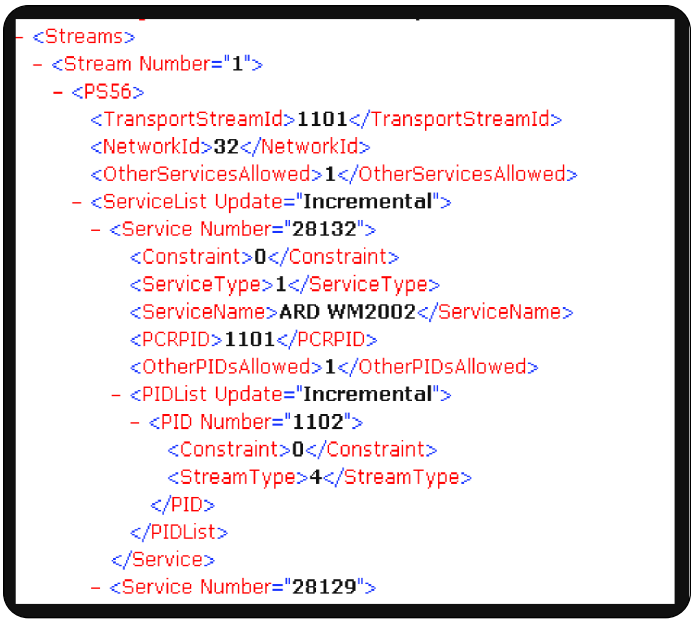
You can also create the template file from first principles, following user-guide instructions. These template files can be in different formats depending on vendor and equipment.

You can also use a "template capture" system, where a broadcaster feeds a reference or "golden stream" into the test equipment and, on command, creates the template file from what is found in the stream. Here, the user still must select which of the captured parameters is important enough for the stored template to check, and of course, the reference stream itself must be correct, or else subsequently-applied template tests may be flawed.

Once created, the final template file, if in a commonly used format, can be transferred between monitoring equipment and even to other third-party systems such at industry-standard databases and service planning networks. Tektronix templates are created in XML format to facilitate interchangeability.

Step 3 – Load the template slots

Tektronix templates form part of a "slot configuration file." There are eight slots or "preset memories" to which you can upload configuration files. You can amend or add to the configuration file in a given slot by uploading another whole or partial configuration file. The command "Incremental" adds the new entries; the command "Absolute" replaces entries. You can also download a configuration file from any of the slots.



▶ ***Figure 2.*** *Typical template file.*

Templates are not necessarily stream- or device-specific and can be loaded and applied to any stream or device. In this way, they can be made to "pass" all streams with a particular configuration; e.g., with the same Network Identity.

Step 4 – Schedule the templates

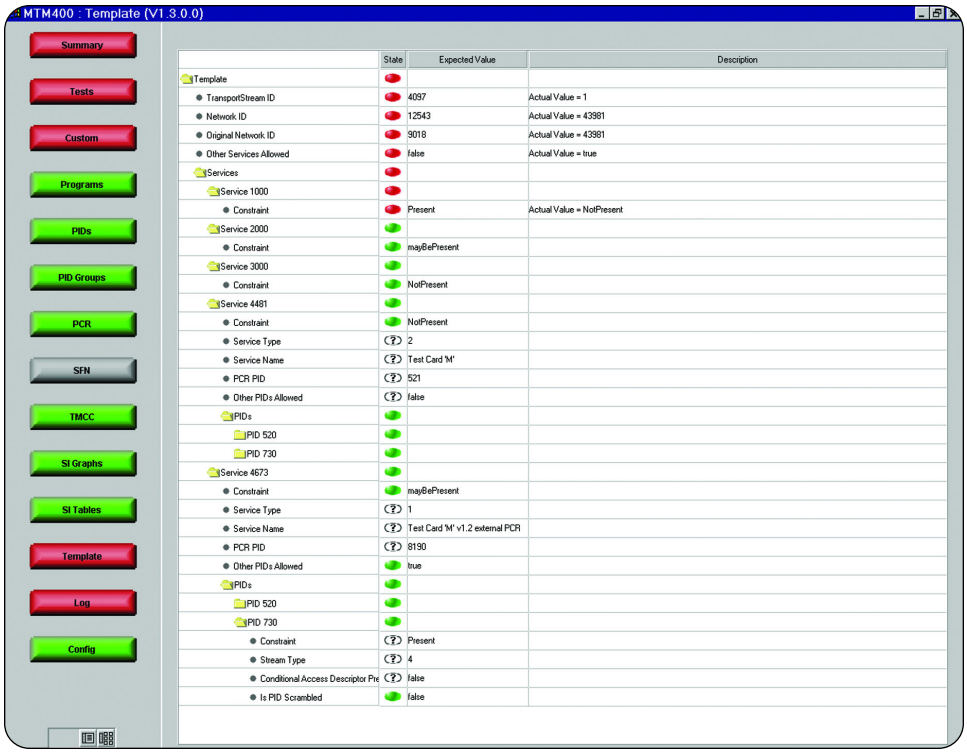
There is an "active configuration slot" into which one of the other eight slots can be loaded at manual activation or "scheduled event" time, according to day of the week and the time.

Step 5 – Apply the template

The template file generates a template test menu on the measurement device which can be viewed remotely. It groups the tests hierarchically within folders, so groups of alarms/tests can be easily seen, then subsequent tests can be easily expanded by a mouse click.

In the example screenshot shown in Figure 3, the user is checking for the presence of four services (numbers 1000, 2000, 3000, and 4481) in a transport stream (ID 4097). Additional details of the service and associated PIDs are also checked.

It is also possible to disable a test group or specific test (it grays out) if a common known template violation needs to be ignored. If the element conforms to the template setting, the State icon will be green. Continuous failure to conform is indicated by a red icon. Note that if any element failed in the past but has since been corrected, the Template button will be yellow.



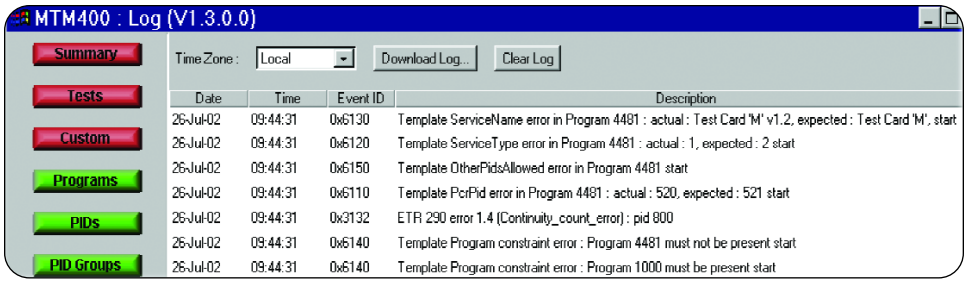
▶ ***Figure 3.*** *Typical template test.*

Step 6 – Use the test results

Initially, a template test failure can raise either an audible, visible, or electrical alarm. This can alert a local operator, automated station management system, or even a remote person over a network who might detect the problem on a countrywide mapping system (with Tektronix red "Hotspot" map display, for example), providing an alert on a control console. Using Tektronix WebMSM control client, the user can "drill down" the system diagram level to the specific probe monitoring point, and then "pull-up" the template fault list to identify which service element has failed. Further measurements can be taken and tests can be performed, enabling the user to determine the appropriate corrective action. All of this can be done either at a local or a remote control console.

Log Detail

The error log contains a full description of which template test has failed, a time-stamp to identify when it failed, identity of which stream failed, the value it expected to find, and what value was found. This is particularly useful for intermittent errors that may occur at a remote transmitter site at early hours of the morning or on week-ends when monitoring staff are not present to hear or see the alarms. Figure 4 shows an example error log.



▶ ***Figure 4.*** *Example error log.*

Account has been taken in these log entries so the user can determine if the date and time is recorded as "local time" at the monitoring unit, universal time (such as GMT time), or time at the remote monitoring point. All these times can be synchronized to the probe clock, network (SNTP time), or to LTC (timecode) time, to ensure accuracy.

Other Technical Issues Addressed

Tektronix template test and scheduled loader system does far more than mere template testing. The templates form part of a larger configuration file system, allowing major test system setups to be loaded from stored presets at scheduled test times. Following are some of the other tests and settings that can be done in conjunction with template loading:

Tune: At the scheduled changeover point, a remux router can apply a signal over another feed channel. The configuration file can be ready for this by re-tuning the QAM or L-Band interface, preparing them to receive another channel. Then, similar or even new service plan tests are subsequently applied.

Merge: Not just tuning settings, but all the other test settings comprise part of the configuration file. The MTM400 provides the capability for an incremental or merge of the configuration/template file for the working parameter set. This means that new template or other settings can be added into the slot, rather than simply completely replacing the existing active parameter set.

Hold-off period: Because of the way transmission chains are designed, there are delays around the various automated control systems driving routers and re-multiplexing systems. These all come into play at crucial changeover points in the service allocations at scheduled times during the day.

To cover these uncertainties, Tektronix systems apply a programmable "holdoff" period preceding and after a specific scheduled template change. These can then suppress alarm generation until the new service plan is in force and, if desired, allow or suppress template errors written to the error logs.

Remote template edit: Templates and the configuration file that contains them, can be downloaded over the network (or Internet) to a remote client control PC. The templates can then be modified and, when ready, uploaded to a nominated preset slot ready for use in the monitoring device. They can be immediately loaded or loaded at a scheduled time when the template tests are due to be applied.

Conclusion

Addition of template testing makes Tektronix test systems such as the MTM400 a very powerful and cost-effective way of applying scheduled service and related tests to specific target probe points. Transmission-chain errors can be detected and pinpointed promptly by strategically placed minimal staffing. This allows users to take remedial action before problems develop to the point that service is jeopardized or transmissions wrongly routed or interrupted with the resulting loss in revenue and performance levels.

MTM400 MPEG Transport Stream Monitor

Whether in its basic confidence monitoring configuration or expanded with diagnostic options, the Tektronix MTM400 real-time transport stream monitor provides a cost-effective solution for transport stream monitoring.

WebMSM MPEG Monitoring System Manager

View error status, configure, and remotely control MTM400 transport stream monitors anywhere in the transmission network from a central WebMSM console for a complete monitoring solution.

Visit www.tektronix.com/mpeginfo to get your free copies of this educational material:

- MPEG-2 Transport Stream Poster – DVB or ATSC PSIP Tables
- AD920 Technical Application Note "MPEG Confidence Testing Using the AD920"
- MPEG Technology Primer "A Guide to MPEG Fundamentals and Protocol Analysis"

Contact Tektronix:

ASEAN / Australasia / Pakistan (65) 6356 3900
Austria +43 2236 8092 262
Belgium +32 (2) 715 89 70
Brazil & South America 55 (11) 3741-8360
Canada 1 (800) 661-5625
Central Europe & Greece +43 2236 8092 301
Denmark +45 44 850 700
Finland +358 (9) 4783 400
France & North Africa +33 (0) 1 69 86 80 34
Germany +49 (221) 94 77 400
Hong Kong (852) 2585-6688
India (91) 80-2275577
Italy +39 (02) 25086 1
Japan 81 (3) 3448-3111
Mexico, Central America & Caribbean 52 (55) 56666-333
The Netherlands +31 (0) 23 569 5555
Norway +47 22 07 07 00
People's Republic of China 86 (10) 6235 1230
Poland +48 (0) 22 521 53 40
Republic of Korea 82 (2) 528-5299
Russia, CIS & The Baltics +358 (9) 4783 400
South Africa +27 11 254 8360
Spain +34 (91) 372 6055
Sweden +46 8 477 6503/4
Taiwan 886 (2) 2722-9622
United Kingdom & Eire +44 (0) 1344 392400
USA 1 (800) 426-2200
USA (Export Sales) 1 (503) 627-1916
For other areas contact Tektronix, Inc. at: 1 (503) 627-7111

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