Bitrate adaptation for transmodulation

Carrying out a transmodulation system is not an easy work.
Depending on the input and output bitrates the adaptation is different.
We have defined 3 cases with 3 respective adaptation methods:

1 – input rate < output rate
2 – input rate is equal or slightly greater than the output rate
3 – input rate > output rate

1. Introduction to the MPEG2 Transport Stream

MPEG2 has defined the "**Transport Stream**" also called **TS** to convey video broadcasting. TS is a packet multiplexing that can transport a set of real-time or non real-time streams over different labels called **PIDs**.

TS is a contiguous stream of packets of 188 bytes. To maintain a constant rate, a special NULL packet has been defined.

To deploy real-time services like video broadcasting, the source emitter and the receiver must use the same clock. This clock is defined as a standard clock of 27MHz and is **called Program Clock Reference (PCR)**. The encoding of the PCR is placed by inserting a value of a free running counter of this clock at a regular interval.

This mechanism works only if the PCR jitter is really low. The MPEG2 specify an jitter window of +/- 500 ns.

The TS structure allows easy packet manipulation in order to insert or extract services.

2. DVB Service Information

To identify services, MPEG2 standard defines a set of tables that are defined under the name **PSI**.

The PSI mandatory tables are:

PAT : Program Allocation Table, uses the PID 0. It lists the programs of the TS and there respective PMT.
PMT : Program Map Table, uses arbitrary PID. It lists all the PIDs that compose a program multiplex.
CAT : Control Access Table, uses the PID 1, informs of PIDs of control access management.

DVB has defined a set of extra tables called **Service Information (SI)** to complete MPEG2 information.

The SI mandatory tables are:

NIT : Network Information Table, PID 16, describes the operator network.
SDT : Service Description Table, PID 17, provides information of the services.
EIT : Event Information Table, PID 18, describes programs events.
TDT : Time and Date Table, PID 20, provides UTC time and date.

A DVB TS must incorporate the PSI/SI that corresponds to the all previous tables. These tables must be accurate to be qualified as compliant.

3. Case 1: input rate < output rate

It is the common case when connecting a DVB-S to a DVB-C. The output bit rate is imposed by the modulator parameters. The adaptation of bit rate is made by inserting NULL packets. A FIFO must be used to resynchronize the inputs packets. However this function will generate an important jitter on PCR due to moving temporally packets. The PCR values must be recomputed by adding the shift offset introduced.

☞ **MVD modulators cores provide such bit rate adjustment with PCR correction, so the user doesn't have to worry about the understanding of how to implement the function.**

4. Case 2: input rate is equal or slightly greater than the output rate

When regenerating the DVB-C or DVB-T with the same parameters, the bit rate are similar in theory. But in practice the two clocks are different.
Let's take the case when the input bit rate is slightly upper. Due to the different clocks we must use a FIFO to resynchronize but this one will always overflow. A TS flow always incorporate NULL packets. So, the bit rate adaptation must be made by removing NULL packets and of course correct PCR values. But if the input bit rate is slightly lower, we must implement the case .

☞ **MVD has developed the "Adaptative Bitrate" core that allows to remove/insert NULL packets to make a seamless connection to the modulator.**

5. Case 3: input rate > output rate

To make a transmodulator from DVB-S to DVB-T will not be as simple as case 1 or 2. First we should remember that the maximum bit rate in DVB-T is 31.7 Mbits/s and the most used configuration in DVB-S is 38Mbits/s.
The bit rate difference is too much important to pass all the services. So we will need a smart and complex system to remove the selected programs. This function is called a **re-multiplexer**. It will analyze the PSI/SI tables and regenerate a new stream with new PSI/SI tables. The new stream should comply with the MPEG2 and DVB standards – this means PCR jitter, tables content, tables repetition, …

☞ **The MVD solution is based in a System-On-Chip (SoC) architecture that allows to implement an entire core inside an FPGA. The solution is capable of working up to DVB-S2 rates. The core only regenerates NIT, PAT and SDT.**

6. Conclusion

Re-multiplexing is the key feature to convey a TS from one network to another. Depending on the two bit rates, MVD has developed a set of cores that requires only needed resources.
MVD is always creating new cores for proposing new solutions that will ease and reduce system cost.
New re-multiplexer with multi inputs/output are under development. Due to a lot of encrypted programs we are preparing the next generation with the **"Common Interface" (CI) command"** to drive a **"Conditional Access module" (CAM)**.
Using MVD cores guarantees 100% successful designs without needing the knowledge of FPGA, multiplexing or modulator. Seamless implementation with two days of remote technical support (email/phone) are included in the cores prices.
For particular projects or conditions, customers may need some additional technical support for the cores implementation. MVD can propose this additional technical support remote or on site.