How to use the "Double Streaming" system

Contents

1. Context

Audio transmission over IP (AoIP) is sometimes subject to data losses for various reasons, as for instance:

- In case of network congestion, the overloaded routers happen to drop packets without forwarding them.
- On mobile radio links, radio signal loss or fading cause temporary interruptions, that can last for a rather long time.

Such problems are more common on connections via the Internet.

Packet losses cause disturbances, ranging from light artefacts to the complete muting of the signal for several seconds or minutes.

The AETA "Double Streaming" system is an efficient way of strongly increasing the robustness of an AoIP link, thanks to the use of two simultaneous links:

- A redundant link allows to compensate for losses on the main link;
- Alternatively, the data stream can be distributed over two links in order to reduce the bit rate to be transmitted on each link.

2. Presentation of the "Double Streaming" system

Let us consider a classical AoIP link between two audio codecs:
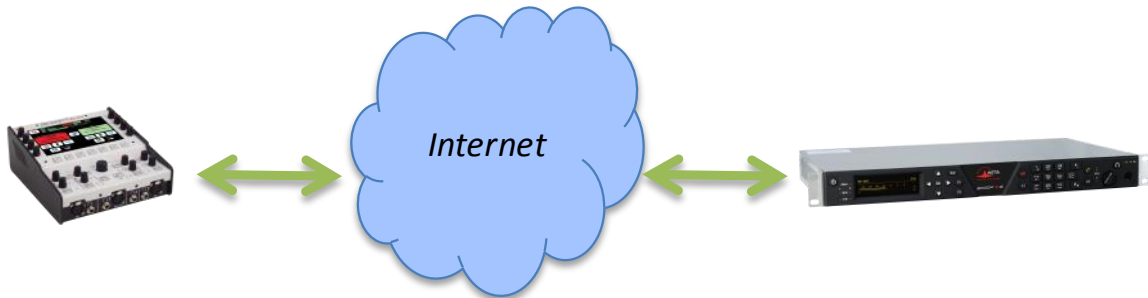
At each end the codec accesses the Internet through an interface which can be of various types:

- Ethernet connection
- Mobile access (integrated or USB device)
- Wi-Fi access

Packet losses can be experienced in various locations on the path between the two units, and/or the bandwidth can be limited one end.

2.1. General principle of operation

Double Streaming relies on setting up two SIP links, simultaneous but via two separate routes:
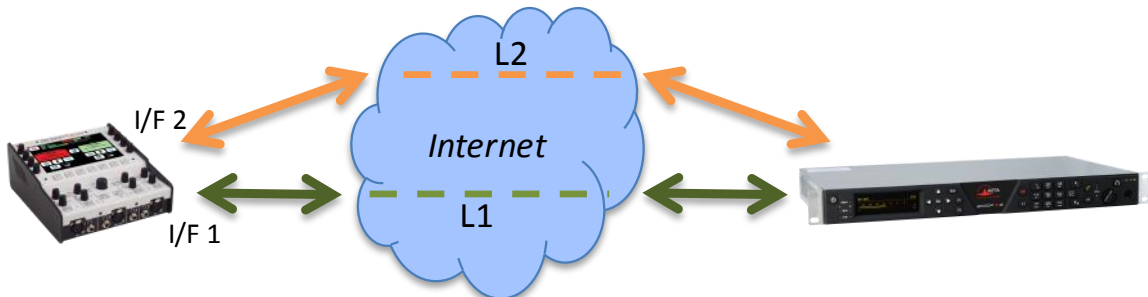

In addition to the "main" SIP link, a "secondary" SIP link is set up between the units.

On each codec, a specific transmission interface can be selected for each of the two AoIP connections. In this way two independent routes are created, whose possible losses are not correlated. The two routes can be used with the following techniques.

2.1.1. Redundancy: "diversity" mode

The secondary link transports a copy of the audio stream of the main link. The codec which receives the two (normally) identical streams recombines them, discarding the duplicates:
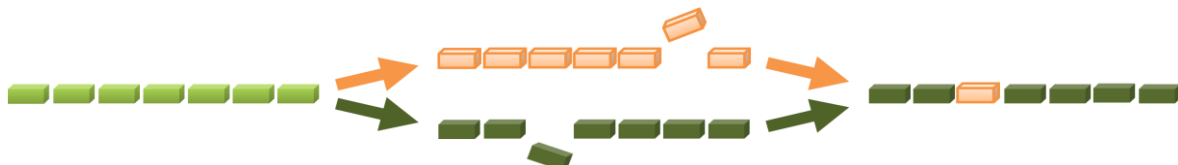
Whenever a packet is lost on the transmission, its copy from the other link compensates the loss, and a 100% lossless stream is delivered at the end of the process.

In an extreme case, if one of the two links is totally interrupted, the complete original stream is still available at the output. The few losses on the remaining link are no more compensated for, but they are much less noticeable than a complete loss.

2.1.2. Load balancing: "bonding" mode

The initial stream from the audio encoder is distributed over the two links. On receipt of the two streams at the other end, the data is recombined to reconstruct the initial stream.

Therefore each link carries a lower bit rate (halved in the above example with a "50/50" balance), more likely to be transmitted correctly if the links have a constrained bandwidth.

Two variations are available with asymmetric balancing:

"66/33" variation:

"33/66" variation:

2.1.3. Benefits of the SIP protocol

The usage of SIP is a specific advantage of AETA's Double Streaming:

- The system works on a normal SIP architecture, and is compatible with any SIP server.
- The system is easily "portable", specifically it allows using mobile links.
- Like for a normal SIP link, an acceptable security level can be reached.

Double Streaming is available with all AETA codecs of the following product ranges:

- ScoopTeam
- Scoopy+ S
- Scoop5 S and Scoop5 S-IP
- µScoop
- MultiScoop

Chapter 3 describes the operating instructions for using it.

2.2. Some examples of operation setups

The examples described below are the most remarkable use cases among various possible configurations.

2.2.1. Case 1: Redundancy on one end

In this first case, a redundant network access is used on one end of the link only, and the two redundant links are merged on a single network access on the other end.

The end with redundancy is protected against faults encountered on the main link, either at the local access level or on the path over the network towards the other end.

Conversely, the network access on the other end gets no additional protection.
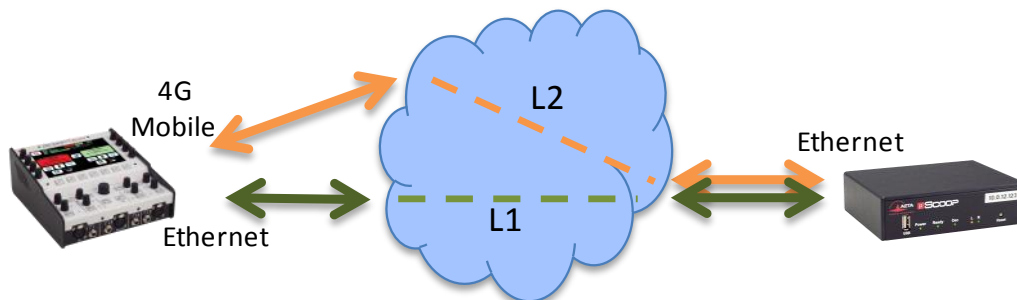
Example 1: Remote report, wired connection secured by a mobile link.

In the above example, in the field (left side on the picture) a 4G network connection is used for securing a main link via an Ethernet connection. On the control room side, the two streams are merged on a high reliability wired network that needs no redundancy.

2.2.2. Case 2: End-to-end redundancy

In this case, a redundant network access is used at each end.

A maximum protection is then available against faults experienced either at the network access level or inside the network.
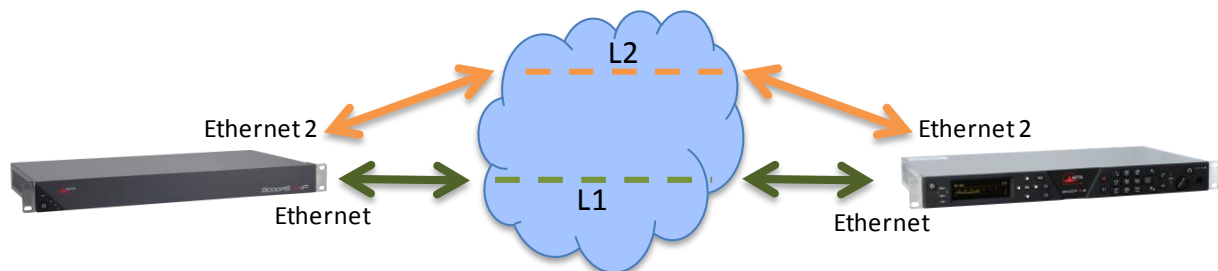

Example 2: Wired link, secured end-to-end by a secondary link

In the above example, the secondary link may for instance rely on cheap ADSL connections for providing high-grade availability at a moderate cost.

2.2.3. Case 3: Bonding with load balancing on one end

Like in the first case, an additional network access is used on one end of the link, and the streams converge on a single network access on the other end. But here, instead of duplicating the stream on both links, the stream is distributed in order to get a lower bit rate to be carried over each link.
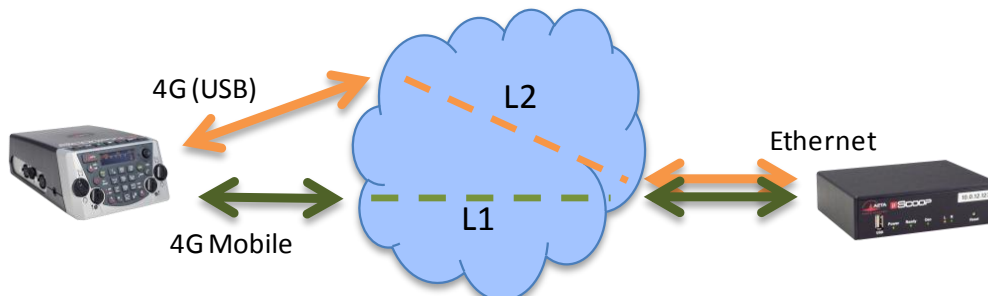
Example 3: Remote report, transmission distributed over two mobile links

In the above example, in the field (left side on the picture) two 4G network connections are used for distributing the data stream to be transmitted. On the control room side, the two streams are merged on a high speed wired network.

3. Setting up a link with Double Streaming

Important notice: as it makes use of two SIP connections, Double Streaming cannot be used together with the "double codec" mode on the products that feature such capability. The device must be in a "single codec" configuration for using Double Streaming.

3.1. Pre-requisites

Each codec involved must have:

- Recent firmware, supporting the "Double Streaming" feature. *The feature must be enabled on both codecs.*

- Two network interfaces (depending on the unit: Ethernet, auxiliary Ethernet, integrated mobile, USB mobile device, Wi-Fi…). However it is possible on one end to use the same interface for both connections, like for instance in *Case 1* or *Case 3* above.

- For links with a SIP server, one or two accounts on a SIP server. The first account is assigned to the main link, the second one is for the secondary link (it is optional if both links use the same interface, like on the non secured end in *Case 1* above). *It is possible not to involve a SIP server, but with same drawbacks as for regular links (i.e. without redundancy).*

Recent[1] AETA codecs are fitted with "factory" SIP accounts on the AETA SIP server, usable for Double Streaming. Other accounts and servers can be used as well.

3.2. Preparing the codecs

The following is to be done on each of the codecs involved in the link:

1. Make sure the default protocol is SIP, at least for the codec that will call the other one to initiate the link.

2. **Enable "Double Streaming"**
   ScoopTeam, via menu: **Network > AoIP settings**
   Scoopy+ S and Scoop5 S, menu: **Setup > Network > AoIP Parameters**
   All products, html pages: **NETWORK** tab, **AoIP PARAMETERS** page
   Warning: you must possibly check SIP is the default protocol and, where appropriate, disable the "double codec" mode, as it is not compatible with Double Streaming.

3. **Via the same menu, select the "streaming pattern"**
   - Diversity 100/100: 100% redundancy, stream duplicated on both links
   - Bonding 50/50: stream distributed with 50% data over each link
   - Bonding 66/33: stream distributed with 2/3 data over main link, 1/3 over secondary link
   - Bonding 33/66: stream distributed with 1/3 data over main link, 2/3 over secondary link
   *This choice is essential for the codec that will **initiate** the connection, as it is the one that will impose the scheme. The called codec will automatically "follow" this choice.*

4. **Set up the network interfaces** that will be used (refer to the instructions of the user manual).

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[1] Scoop5 S, Scoopy+ S, µScoop, ScoopTeam and MultiScoop product ranges, produced since May 2017.

5. **Set up the two SIP accounts**, main and/or secondary (except if you do not intend to use a SIP server).

ScoopTeam, via menu:	**Network > AoIP settings > Account 1 / Account 2**
Scoopy+ S and Scoop5 S, menu:	**Setup > Network > AoIP Parameters**
All products, html pages:	NETWORK tab, AoIP PARAMETERS page

For reloading the factory AETA accounts, if needed:

ScoopTeam, via menu:	**Tools > Troubleshooting > Reset,** "Reload the factory SIP Accounts" option
Scoopy+ S and Scoop5 S, menu:	**Tools > Misc > Reset,** "Factory SIP Accounts" option
All products, html pages:	MAINTENANCE *tab,* RESET *page,* "Factory SIP Accounts" option

6. **Select the main interface** as for a single link (without redundancy):

ScoopTeam, via menu:	**Network > Network for Outgoing Calls**
Scoopy+ S and Scoop5 S, menu:	**Setup > Network > Change Network**
All products, html pages:	NETWORK tab, CHANGE NETWORK page

7. **Select the secondary interface**:

ScoopTeam, via menu:	**Network > Secondary IP Network for Double Streaming**
Scoopy+ S and Scoop5 S, menu:	**Setup > Network > Secondary Network**
All products, html pages:	NETWORK tab, SECONDARY NETWORK page

Note: it is possible to select the same interface as for the main link: end without redundancy in Case 1, for instance. For a µScoop this is always the case, because this product only features a single interface.

3.3. Establishing the link

Once the above preparation is performed, normally the situation should be as follows:

- The interfaces used (possibly just one) are connected and active.
- The codec registers on the server[1] with the main SIP account (SIP 1) via the main interface.
- The codec registers on the server with the secondary SIP account (SIP 2) via the secondary interface. *If it is the same as the main interface (Case 1, end without redundancy), this secondary registration is not required.*

Check that the SIP registration indicators are OK:

- On the ScoopTeam display, the secondary indicator is the one on top right.
- On Scoop5 S or Scoopy+ S display, you should see the "S_1" and/or "S_2" indicators.

The unit is now ready for receiving a call in Double Streaming mode.

For initiating a call (launching an outgoing call), the procedure is very similar to a regular call, using the two identifiers of the destination codec: SIP URI or IP addresses.

Call from a ScoopTeam:

Enter the two identifiers, separated by a comma: *dest_1,dest_2*   (example 902942,9029422)

If you enter just one identifier, it is used for both links (in such case only one interface is involved on the remote codec, as in Case 1 on the end without redundancy).

Launch the call as for a regular call.

Call from a Scoopy+ S or a Scoop5 S:

Enter the first identifier and press the call key 🔄. A prompt for entering a second identifier is displayed: enter it and press the call key 🔄 again.

If you press the key without entering a second identifier, the first one is used for both links. In such case only one interface is involved on the remote codec, as in Case 1 on the end without redundancy.

Call from the embedded html CONNEXIONS page:

Enter the two identifiers in the two adequate fields: "Remote Number" and "2nd Remote Number". Click the "Dial" button.

If you leave the second number blank, it is automatically copied from the first one (in such case only one interface is involved on the remote codec, as in Case 1 on the end without redundancy).

What happens then: the codec calls destination 1 via the main interface, and makes a second call to destination 2 via the secondary interface. The link is established and secured.
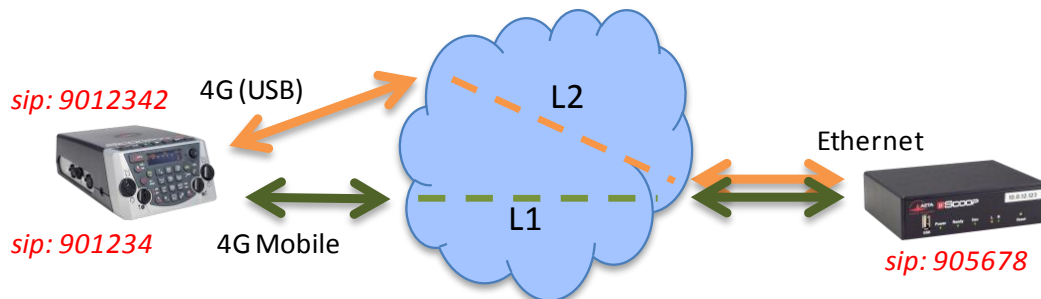
3.4. Releasing the link

The operation is just the same as for a regular single link. The codec automatically releases the two connections of the Double Streaming link.

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[1] Except if a SIP server is not used.

4. Implementation examples

4.1. With single-ended redundancy

sip: 9012342   4G (USB)   L2   Ethernet

sip: 901234   4G Mobile   L1   sip: 905678

Outside remote, double mobile connection

This example involves:

- A Scoopy+ S on the outside location with 4G network access (integrated module), secured by a second mobile access (4G USB key with a SIM card from a different operator).
- A µScoop on the MCR side, with a high reliability wired Internet connection.

On the Scoopy+ S, two SIP accounts are used, for instance the integrated "factory" accounts.

In the MCR, a SIP account is used, for instance the integrated "factory" account. "Double Streaming" is enabled.

For a **"regular" call from the Scoopy+ S** without redundancy via the main 4G interface:

- Double Streaming disabled.
- Check the SIP 1 registration (integrated 4G interface).
- Call the SIP number of the µScoop: 905678 in this example.

For a **Double Streaming call from the Scoopy+ S**:

- Double Streaming enabled.
- Check the SIP 1 registration (integrated 4G interface) and the SIP 2 registration (4G mobile via USB).
- Call the SIP number of the µScoop: 905678 in this example.

For a **Double Streaming call from the µScoop**:

- Double Streaming enabled on both units.
- Check the SIP registration.
- Call the SIP numbers of the Scoopy+ S: in this example, 901234 and 9012342.

With the same operating mode, you can use "bonding" to balance the stream over two mobile links, and thus reduce the demand on either link. On the other hand, you don't get in such case the increase in robustness provided by the "diversity" redundancy mode.

4.2. With end-to-end redundancy
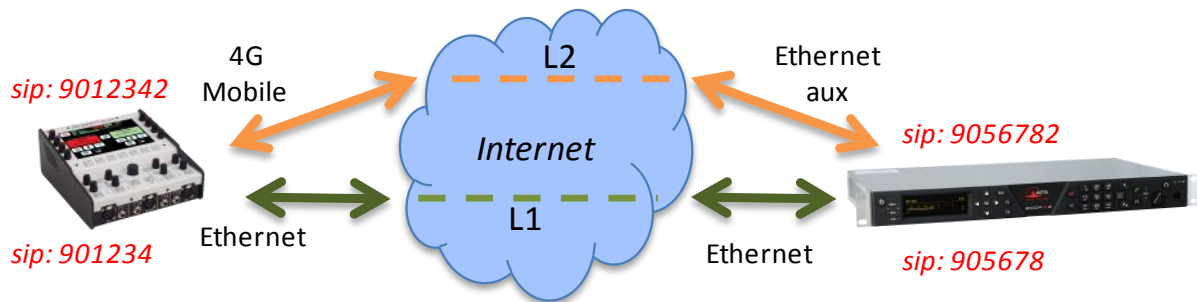
Outside remote, wired connection secured by a mobile link.

This example involves:

- A ScoopTeam on the outside location with 4G network access for securing a main link via Ethernet access.

- A Scoop5 S on the MCR side, with a main wired link, secured by a cheap ADSL connected through a second Ethernet interface (USB adapter).

On the ScoopTeam, two SIP accounts are used, for instance the integrated "factory" accounts.

In the MCR, two SIP accounts are needed, for instance the integrated "factory" accounts. "Double Streaming" is enabled.

For a **"regular" call from the ScoopTeam** without redundancy via the Ethernet interface:

- Double Streaming disabled.

- Check the SIP 1 registration (Ethernet interface).

- Call the SIP 1 number of the Scoop5 S: 905678 in this example.

For a **Double Streaming call from the ScoopTeam**:

- Double Streaming enabled.

- Check the SIP 1 registration (Ethernet interface) and the SIP 2 registration (4G mobile).

- Call the SIP numbers of the Scoop5 S: 905678,9056782 in this example.

For a **Double Streaming call from the Scoop5 S**:

- Double Streaming enabled on both units.

- Check the SIP 1 and SIP 2 registration.

- Call the SIP numbers of the ScoopTeam: in this example, 901234 and 9012342.

5. Additional information

5.1. Notes about the network settings

5.1.1. AoIP settings

Protocol: only the SIP protocol is supported with Double Streaming.

QoS: it is possible to use packet duplication (except with "bonding"), like for a regular link. This results in both "temporal" redundancy inside each link (packet duplication) and "spatial" redundancy/diversity between the two links (Double Streaming). Of course, the global cumulative bit rate is then quadrupled.

5.1.2. Parameters of the IP interfaces

The **Network Quality** setting, as it affects the size of the reception buffer, can have a significant impact on the performance of Double Streaming.

For correct operation of Double Streaming, this setting must be identical on both interfaces involved. If the settings are different, the codec will automatically apply the higher buffer size of the two for both links (corresponding to the poorer quality).

For better performance in terms of protection against losses, it is advisable to avoid the "High" and "Very High" quality settings, which are normally applicable to transmissions of... very good quality.

In particular, if the latency is very different between the two means of transmission (this can be encountered with networks of very different technology), a low depth buffer cancels the benefit of the redundant stream.

5.2. Transmission quality monitoring

Indicators and transmission quality measurements address each link separately; for this purpose a second set of indicators/measurements is displayed during a connection with Double Streaming.

This separate monitoring allows to detect a decrease in quality that might affect one of the SIP links. This is especially useful in the redundancy scheme, as this can warn of a strong degradation on one of the links, even while the overall resulting quality is still very good thanks to redundancy.

With "bonding", the separate information possibly show which interface should be given up because its transmission quality is too poor.

5.3. Interoperability

If a codec configured for Double Streaming receives a regular SIP call from any SIP device: the call is processed normally on the interface corresponding to the identifier that has been called.

Conversely, if a codec configured for Double Streaming calls an unsupported unit, or a unit not configured for Double Streaming: the call fails with rejection.