Aukua MGA2510 Tech Note

Capturing Auto Negotiation exchange on an 8b/10b encoded Ethernet line

The following outlines the steps to capture Auto Negotiation exchanges using the MGA2510 L1 Bit Capture Analyzer.

The MGA2510 allows you to trigger your L1 capture based on PCS ordered sets that are outlined in the IEEE 802.3 standard such as the delimiters for Auto Negotiation (AN) information. These ordered sets indicating AN information are outlined in Clause 36 of the standard as /C1/ or K28.5 D21.5 and /C2/ or K28.5 D2.2 – see Table 1 below.

Code	Ordered Set	Number of Code-Groups	Encoding
/C/	**Configuration**		Alternating /C1/ and /C2/
/C1/	Configuration 1	4	/K28.5/D21.5/Config_Reg[a]
/C2/	Configuration 2	4	/K28.5/D2.2/Config_Reg[a]
/I/	**IDLE**		Correcting /I1/, Preserving /I2/
/I1/	IDLE 1	2	/K28.5/D5.6/
/I2/	IDLE 2	2	/K28.5/D16.2/
	Encapsulation		
/R/	Carrier_Extend	1	/K23.7/
/S/	Start_of_Packet	1	/K27.7/
/T/	End_of_Packet	1	/K29.7/
/V/	Error_Propagation	1	/K30.7/
/LI/	**LPI**		Correcting /LI1/, Preserving /LI2/
/LI1/	LPI 1	2	/K28.5/D6.5/
/LI2/	LPI 2	2	/K28.5/D26.4/

[a]Two data code-groups representing the Config_Reg value.

Table 1: Ordered Sets - Table 36-3 of IEEE 802.3-2018

These ordered sets alternate with each other where once /C1/ is used, next /C2/ is used and back to /C1/. To capture this sequence, we will be setting our L1 capture trigger to look for /C1/ and leave enough pre-fill buffer to catch /C2/, in case this was the first ordered set in the sequence. Note: capturing on the code K28.5 alone will not be enough, since K28.5 is used extensively in other ordered sets that are very common, such as IDLEs sequences which are transmitted constantly between frames. For this reason, it's critical to trigger based on a full ordered set, and not just on a single code group out of the ordered set.

For the first step we will select the 'Analyzer' Tab when the MGA2510 is in the Inline Analyzer mode – see item #1 in Figure 1 below.

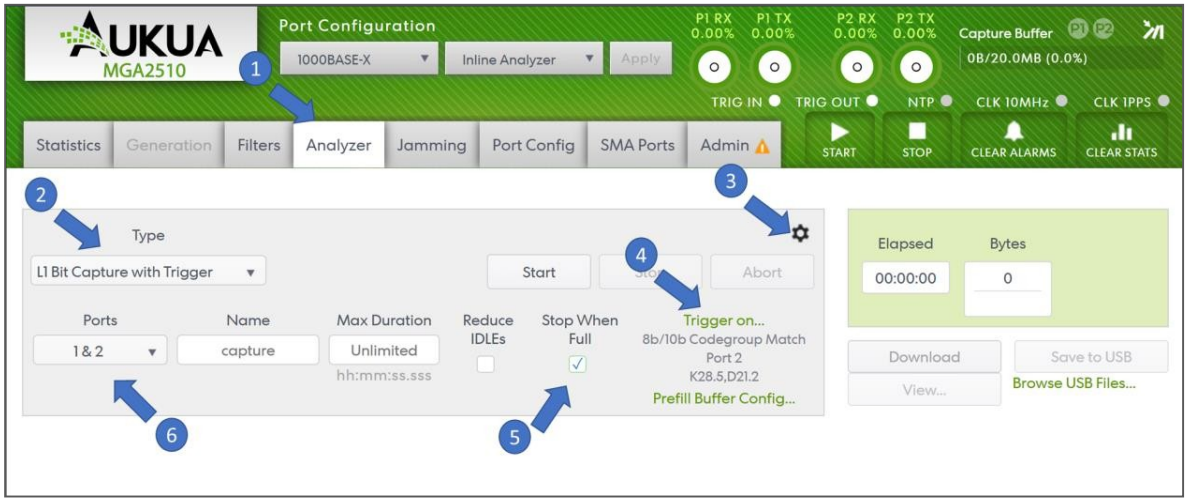

Figure 1: MGA2510 Analyzer Tab

Next, set the analyzer ‘Type’ to ‘L1 Bit Capture with Trigger’ – item #2 in Figure 1 above.

Next open the ‘Advanced Capture Settings’ window by selecting the cog icon as shown in item #3 of Figure 1. It will display the following controls:

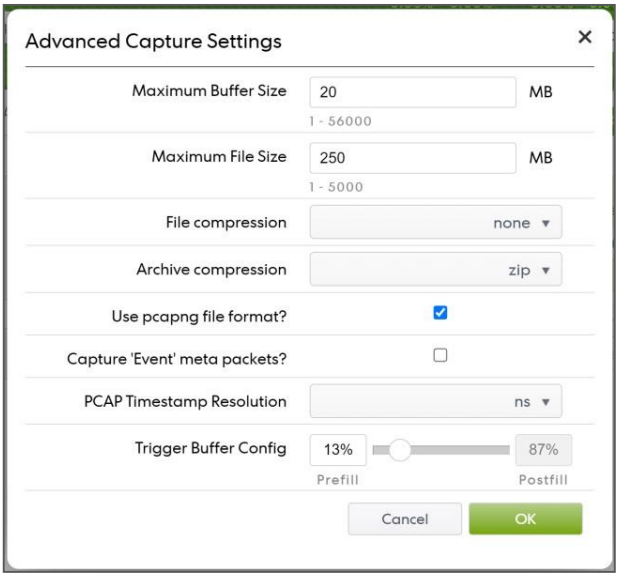

Figure 2: MGA2510 Advanced Capture Settings

Make sure you have a large enough maximum buffer size to capture all events as well as enough Prefill buffer to capture a previous /C2/ occurrence in case we trigger on /C1/ which follows a previous /C2/. Then click ‘OK’.

Next, click the ‘Trigger on..’ link shown in item #4 Figure 1.

The ‘Trigger Condition for L1 Bit Capture’ window will open as shown here:

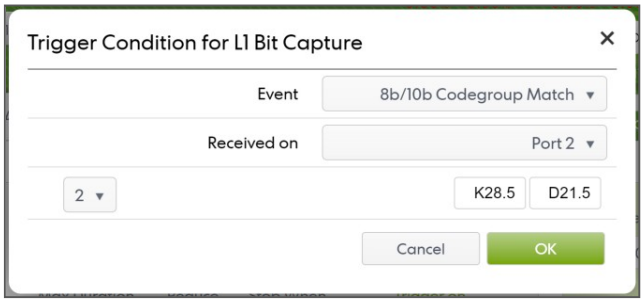

Figure 3: MGA2510 Trigger Condition for L1 Bit Capture

For the triggering ‘Event’ we will select ‘8b/10b Codegroup Match’. Select the port you’d like to trigger on (Port 1 or Port 2).

Next we would need to specify the /C1/ ordered set. Select a length of 2 (drop down selector to the left side) and enter the two code groups K28.5 and D21.5 as shown in Figure 3 above. Click ‘OK’ to accept.

Note: the ‘Stop When Full’ option shown as item #5 in Figure 1 is ignored for triggered L1 captures.

Finally, select the Port you’d like to capture from – item #6 in Figure 1. If you’d like to capture the AN exchange from both sides, select ‘1&2’.

Once you are ready, start the capture by pressing the ‘Start’ button in the ‘Analyzer’ Tab.

Once the L1 data along with the AN exchange is captured, the ‘Capture Buffer’ capacity will show the buffer is full at the top right side of the HTML GUI.

At this point, a summary analysis of the captured L1 data is shown in the bottom half of the 'Analyzer' Tab providing a snapshot of the captured ordered sets. This analysis confirms if /C1/ and /C2/ ordered sets were captured as shown here:

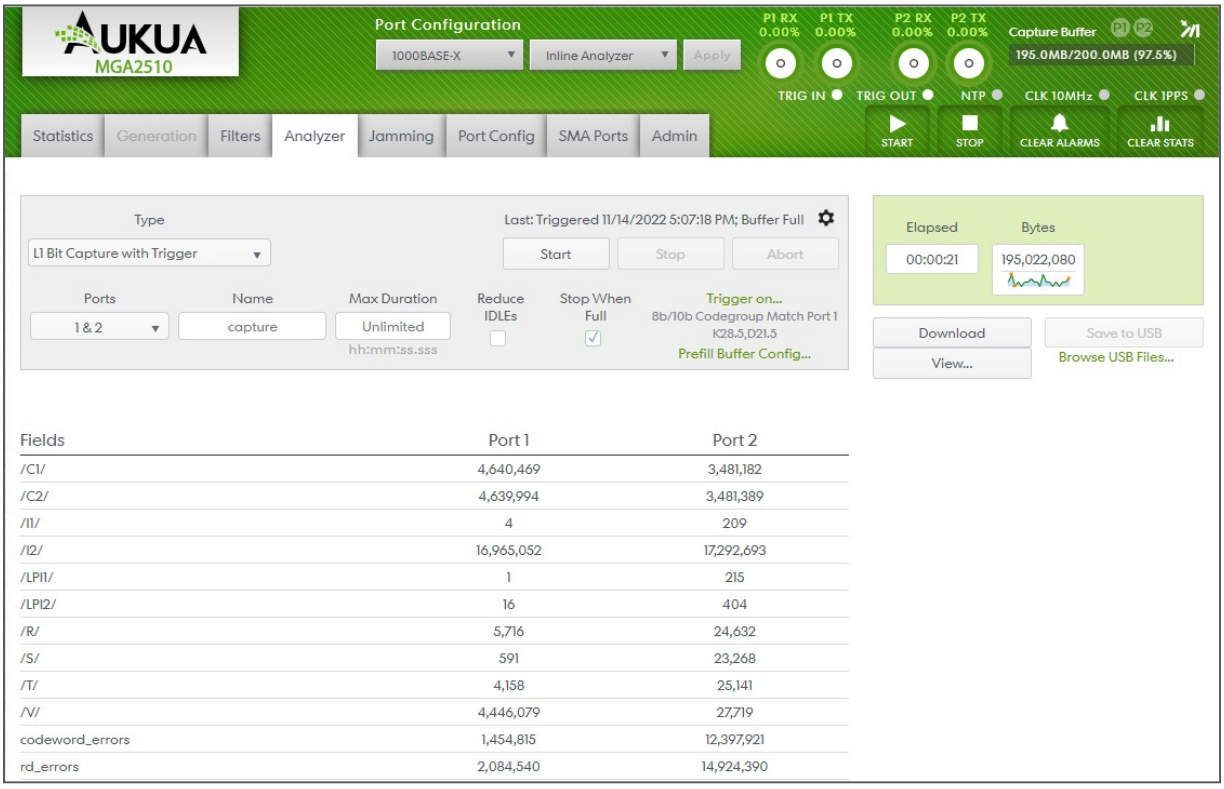

Figure 4: MGA2510 Analyzer Tab after L1 Bit Capture showing summary analysis data

To display the captured L1 PCS data in parsed human-readable text, press the 'View..' button toward the right side, and a new browser window will open where you can review the captured L1 data as shown in Figure 5 here:

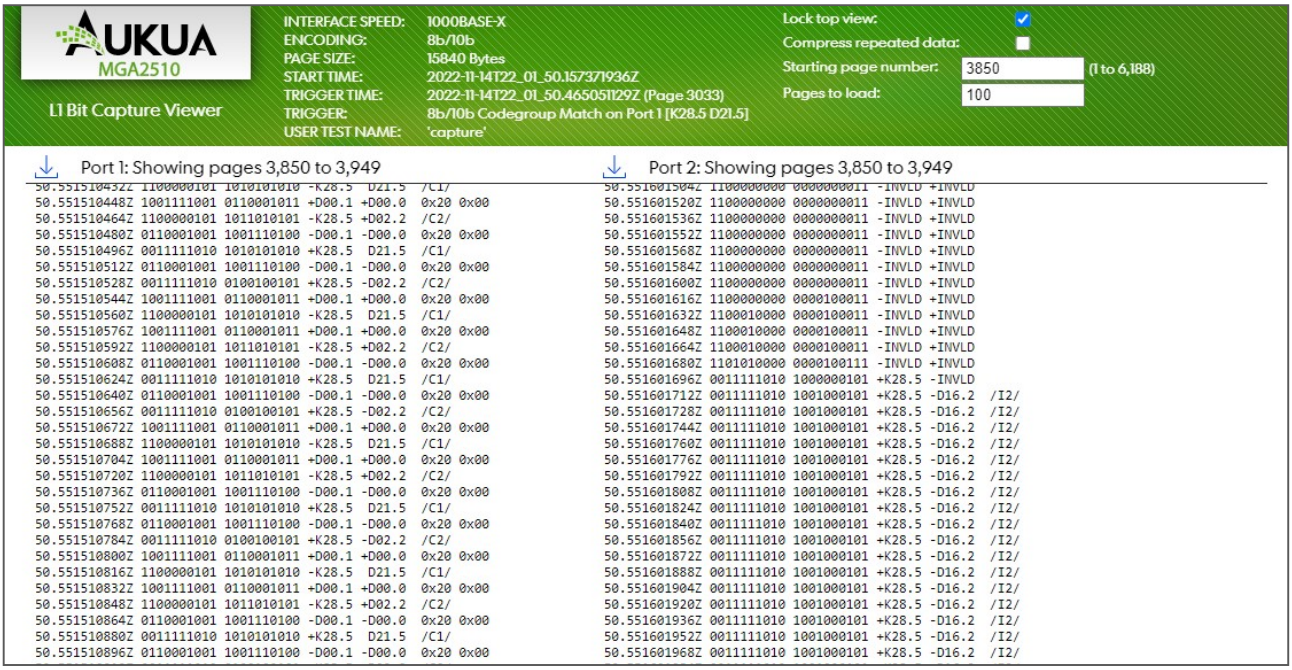

Figure 5: MGA2510 L1 Bit Capture Viewer

In Figure 5 above, you can note that the peer connected to MGA2510 Port 1 is initiating an Auto Negotiation sequence by sending /C1/ and /C2/ ordered sets towards the peer connected to MGA2510 Port 2.

Two options exist for downloading and saving the L1 capture data:

1) You can download the original raw binary L1 capture data as .al1 files from the 'Analyzer' Tab by clicking the 'Download' button.
2) In addition, from the Viewer shown in Figure 5 above, you can download the Port 1 or Port 2 parsed text data that is currently in view by clicking the blue '⭳' icon at the top of each data column.

Further Note: the 'Reduce IDLEs' option on the 'Analyzer' Tab only impacts the resulting binary .al1 capture file if downloaded. It does not impact the Viewer feature; meaning all IDLEs are still present in the Viewer. See the MGA2510 User Documentation for further details.

Related features of interest (see other Tech Notes and User Documentation for details):

- Trigger an L1 capture on an input TTL signal coming from external devices such as an oscilloscope, logic analyzer, or even the Device Under Test
- Use the SMA Trig OUT port feature to trigger L1 captures on *multiple* events
- Use the SMA Trig OUT feature to essentially create custom statistics based on detecting user-defined code-group matches. E.g., statistics that count the number of /C1/ or /C2/ ordered sets received per port
- Synchronize other test equipment to PCS events like /C1/ and /C2/ for time-correlated event analysis