



# Identifying & Resolving Connectivity Issues in Optical Ethernet with Aukua Systems and Garland Technology

Gaining visibility into the PCS layer is key to resolving 1000BASE-X connectivity issues.

### PROBLEM

Gigabit Ethernet over optical fiber, also generally called 1000BASE-X, has been around for quite some time with the IEEE specification ratified under 802.3z. The 1000BASE-X standard also includes an Auto-Negotiation operation as defined in IEEE 802.3 Clause 37.

Clause 37 describes the 1000BASE-X Auto-Negotiation function that allows a device to advertise the modes and speeds of operation that it supports to a device at the remote end of a link segment (the link partner) and to detect corresponding operational modes that the link partner advertises.

A similar Auto-Negotiation function has been defined for Ethernet over copper media (BASE-T rates) where it is mostly well understood and has been widely deployed with much success. However, the same cannot be said when it comes to the 1000BASE-X optical rates as the interpretation of the standard is widely varied. This varied interpretation can potentially cause connectivity issues on devices supporting 1000BASE-X and often results in devices not linking up with each other.

# HOW TO IDENTIFY THE PROBLEM?

Standard protocol analyzers or packet capture devices (for example, high-end Servers or Laptops running Wireshark) only provide visibility from Layer 2 and up, and therefore cannot help with these connectivity issues.

To solve low-level connectivity issues, visibility into the PCS layer (8b/10b encoding for Gigabit and 64b/66b for Multi-Gigabit) is needed. Fortunately, the Aukua MGA2510 Inline Analyzer in conjunction with Optical TAPs from Garland Technology provides complete visibility including the Physical Coding Sublayer (PCS).

### HOW IT WORKS

- 1. Taking in optical signals from both devices under test (DUT), Garland Technology network TAPs reliably provide complete link visibility including the lower layers from both devices on either side.
- 2. The optical signals from both DUT's is delivered passively to the Aukua MGA2510 Layer 1 PCS Capture for analysis.
- 3. Using the Aukua Layer 1 PCS Capture features, low-level data (for example, the Auto-Negotiation Pages that are exchanged) can be captured and then the symbols or control blocks can be analyzed for configuration and interoperability issues on the DUTs.



Code	Ordered_Set	Number of Code-Groups	Encoding	
/C/	Configuration		Alternating /C1/ and /C2/	
/C1/	Configuration 1	4	/K28.5/D21.5/Config_Reg <sup>a</sup>	
/C2/	Configuration 2	4	/K28.5/D2.2/Config_Reg <sup>a</sup>	
/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/	

Table 36–3—Defined ordered\_sets

<sup>a</sup>Two data code-groups representing the Config\_Reg value.

	INTERFACE SPEED: ENCODING: PAGE SIZE: START TIME: USER TEST NAME:	1000BASE-X		Lock top view:			
		8b/10b		Compress repeated data:			
MGA2510		Bytes	24 50 5025645207	Starting page numb	er: 1		(1 to 54)
L1 Bit Capture all Viewer		'My-PCS-Capture'		Pages to load:			
↓ Port 1: Showing pages	s 1 to 10		↓ Port 2: Show	ing pages 1 to 10			
50.5925645442 0011111010 10010	000101 +K28.5 -D16.2	/12/	50.592564544Z 00111	11010 1001000101 +K28.	5 -D16.2	/12/	
<ul> <li>repeated 5543 more times</li> <li>E036533487 1101101000 1010</li> </ul>	00101 807 7 001 1	151 ONEE	<ul> <li>repeated 5542 mor</li> <li>50 502552227 11011</li> </ul>	e times	7 0 21 2	151 AVEE	
50.5520552402 1101101000 1010.	100101 -K2/./ D21.2	0x55 0x55	50.5520552522 11011	01000 1010100101 -K2/.	021.2	/3/ 0X55	
* repeated 1 more times	100101 021.2 021.2	0,35 0,35	* repeated 1 more t	imes	2 021.2	0733 0733	
50.5926532967 1010100101 1010	00110 D21.2 D21.6	0x55 0xd5	50,5926532807 10101	00101 1010100110 D21.	2 D21.6	0×55 0×d5	
50.5926533127 1010011010 10100	11010 D05.5 D05.5	0xa5 0xa5	50,5926532967 10100	11010 1010011010 D05.	5 D05.5	0xa5 0xa5	
* repeated 29 more times			* repeated 29 more	times			
50,5926537927 1110010011 0101	00010 +D08.3 -D26.4	0x68 0x9a	50,5926537767 11100	10011 0101100010 +D08.	3 -D26.4	0x68 0x9a	
50.592653808Z 1010110010 0101	10010 -D31.4 -D15.4	0x9f 0x8f	50.592653792Z 10101	10010 0101110010 -D31.	4 -D15.4	0x9f 0x8f	
50.5926538247 1011101000 1110	01000 -K29.7 -K23.7	/T/ /R/	50.592653808Z 10111	01000 1110101000 -K29.	7 -K23.7	/T/ /R/	
50.592653840Z 0011111010 10010	00101 +K28.5 -D16.2	/12/	50.592653824Z 00111	11010 1001000101 +K28.	5 -D16.2	/12/	
* repeated 754 more times			* repeated 755 more	times			
50.592665920Z 0011111010 10010	00101 +K28.5 -D16.2	/12/	50.592665920Z 00111	11010 1001000101 +K28.	5 -D16.2	/12/	
* repeated 6335 more times			* repeated 6335 mor	e times			
50.5927672962 0011111010 10010	000101 +K28.5 -D16.2	/12/	50.592767296Z 00111	11010 1001000101 +K28.	5 -D16.2	/12/	
* repeated 6335 more times			* repeated 6335 mor	e times			
50.5928686722 0011111010 10010	000101 +K28.5 -D16.2	/12/	50.592868672Z 00111	11010 1001000101 +K28.	5 -D16.2	/12/	
* repeated 6335 more times			* repeated 6335 mor	e times			
50.5929700482 0011111010 10010	000101 +K28.5 -D16.2	/12/	50.592970048Z 00111	11010 1001000101 +K28.	5 -D16.2	/12/	
* repeated 5235 more times			* repeated 5234 mor	e times			
50.593053824Z 1101101000 1010	100101 -K27.7 D21.2	/S/ 0x55	50.593053808Z 11011	01000 1010100101 -K27.	7 D21.2	/S/ 0x55	
50.593053840Z 1010100101 10103	100101 D21.2 D21.2	0x55 0x55	50.593053824Z 10101	00101 1010100101 D21.	2 D21.2	0x55 0x55	
* repeated 1 more times			* repeated 1 more t	imes			
50.5930538722 1010100101 10103	100110 D21.2 D21.6	0x55 0xd5	50.593053856Z 10101	00101 1010100110 D21.	2 D21.6	0x55 0xd5	
50.593053888Z 1010011010 10100	011010 D05.5 D05.5	0xa5 0xa5	50.593053872Z 10100	11010 1010011010 D05.	5 D05.5	0xa5 0xa5	
* repeated 29 more times			* repeated 29 more	times			
50.593054368Z 1110010011 01013	100010 +D08.3 -D26.4	0x68 0x9a	50.593054352Z 11100	10011 0101100010 +D08.	3 -D26.4	0x68 0x9a	
50.593054384Z 1010110010 01013	10010 -D31.4 -D15.4	0x9f 0x8f	50.593054368Z 10101	10010 0101110010 -D31.	4 -D15.4	0x9f 0x8f	

To the left is a sample output of the Aukua MGA2510 Inline Analyzer with Layer 1 PCS Capture enabled showing the IEEE Clause 37 Auto-Negotiation Base Page capture.

The encoding of the ordered sets can be viewed easily via the Layer 1 PCS capture viewer built into the Aukua's web browser-based user interface.

# INTEGRATION BENEFITS

Standard protocol analyzer or packet capture devices, (for example, a PC with a NIC running Wireshark), simply do not provide the visibility needed to trouble-shoot low level issues like devices not being able to link up, etc. Leveraging Garland Technology TAPs, all data including low-level information from the devices under test is supplied to the Aukua MGA2510 Inline Analyzer. The 100% visibility enables the Aukua solution to provide complete analysis at all levels which is ideal for troubleshooting and debugging complex issues.

### About Aukua Systems

Aukua Systems builds precision Ethernet test and monitoring solutions which are powerful, affordable, and easy to use. Aukua was founded to deliver on the promise to provide easy to use test and monitoring solutions, without sacrificing performance, accuracy, and reliability. Aukua is based in Austin, Texas. For more information, visit aukua.com.

# About Garland Technology

Garland Technology is a US based manufacturer of network TAPs, Network Packet Brokers, and Inline Bypass solutions. We engineer, manufacture, and support our hardware solutions in Richardson, TX. Since 2011, we've been helping companies' network monitoring and security tools deliver on their promise of performance and protection because we reliably deliver all of the data the tools need to shine. For help with projects large and small, including installations, upgrades, and streamlines, or to learn more about the inventor of the first bypass technology, visit GarlandTechnology.com.



#### **Have Questions?**

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