

LumenX™ Programming System

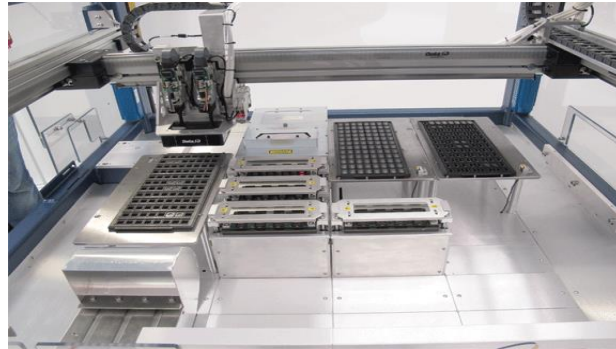
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Vice President and Chief Technology Officer

Data I/O Corporation

- Introduction to Data I/O
- Flash Technology Trends and Programming Requirements
- LumenX™ Programming Platform Introduction

“Data I/O helps enable the digital world by designing, manufacturing, and selling programming systems to global electronic device manufacturers.”



Data I/O's programming systems are used by the world's leading manufacturers, programming centers, and contract manufacturers, to program integrated circuits and bring their devices to life

**Circuits
Need To Be
Programmed**



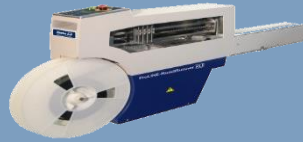
**Options for
Programming
(DAIO customers)**

OEMs

Contract
Manufacturers

Programming
Centers

**Data I/O
On-Line or Off-Line
Programming**



**Final
Assembly**

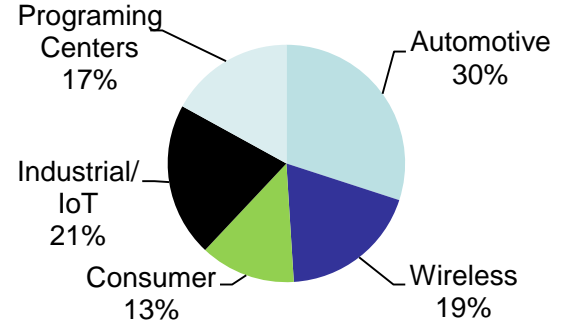


End User



- Data I/O delivers cutting edge products and technology to hundreds of customers around the globe
- Global footprint with headquarters in Redmond, Washington and offices located in Shanghai, China and Munich, Germany
- The only true global programming solutions provider offering local service and engineering support 24/7
- Eight of the top nine automotive electronics companies are customers

2014 Sales by End Markets



Sample Customers

Automotive



Consumer & Wireless



Industrial



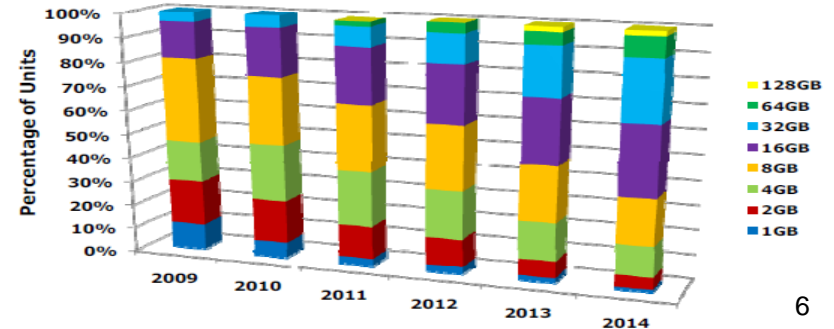
Programming Centers and EMS

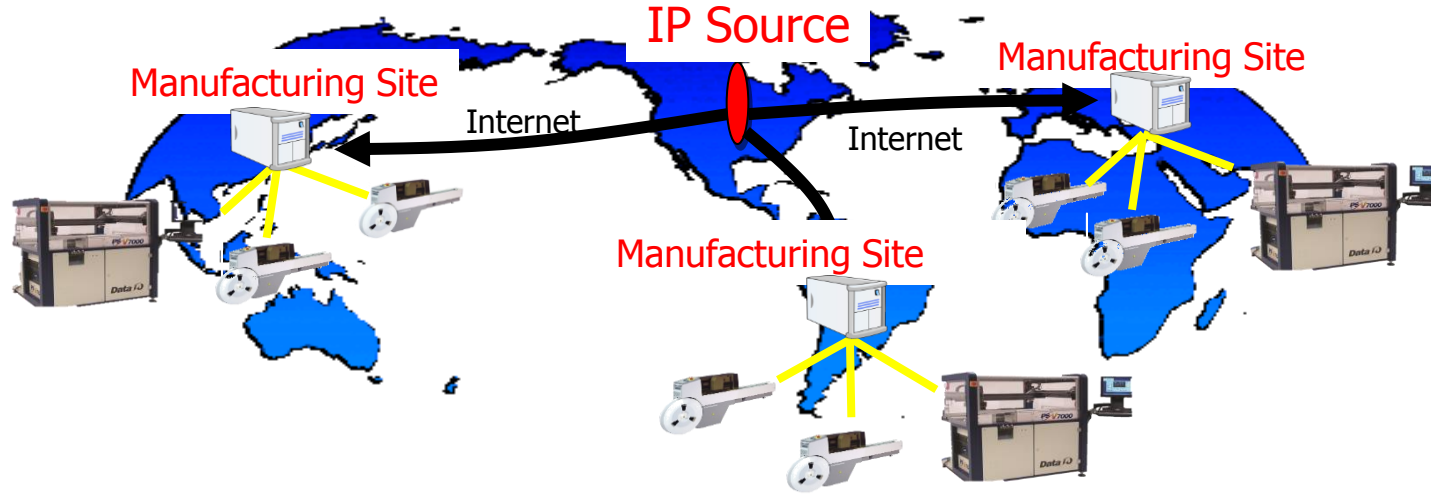


- For 2010 - 2014
 - Programming technology has not kept up with device interface and device R/W speeds

- For 2009 - 2014
 - eMMC devices commonly ship with memory densities of 16GB, 32GB, 64GB and even 128 GB
 - Product image sizes typically range from 2 GB to 32 GB and higher
 - Programming data size continues to increase at a rapid rate
 - Current programming technology limited to <~32 GB of programming data

eMMC Standard, Yr. ratified	Device Interface	Seq. Read Speed	Seq. Write Speed
4.41, 2010	52 MHz DDR	~75 MB/s	~30MB/s
4.5, 2012	200 MHz SDR	~165 MB/s	~60MB/s
5.0, 2013	200 MHz DDR	~275 MB/s	~85MB/s
5.1, 2014	200 MHz DDR	~315 MB/s	~130MB/s
Programming Technology	25 MHz SDR	~10- 20 MB/s	~10- 20MB/s











■ Global Manufacturing and Programming

- Manufacturing is Global
- Programming data is often created on one continent and programmed in another
- Frequently OEM's create programming images but CM's or Programming Centers program the data into parts
- Security and Traceability of (Programming)data is very important to OEM's

■ Technology

- Increase Programming Performance; 
- Increase Scalability; 
 - Technology should scale to 128GB of Programming Data
 - Improve programmer throughput
 - Improve programming system throughput
- Improve Programming data Security and Traceability; 
- Maintain Reliability(>99.5% programming yields); 
- Faster Custom device support; 
- Leverage Automation; 

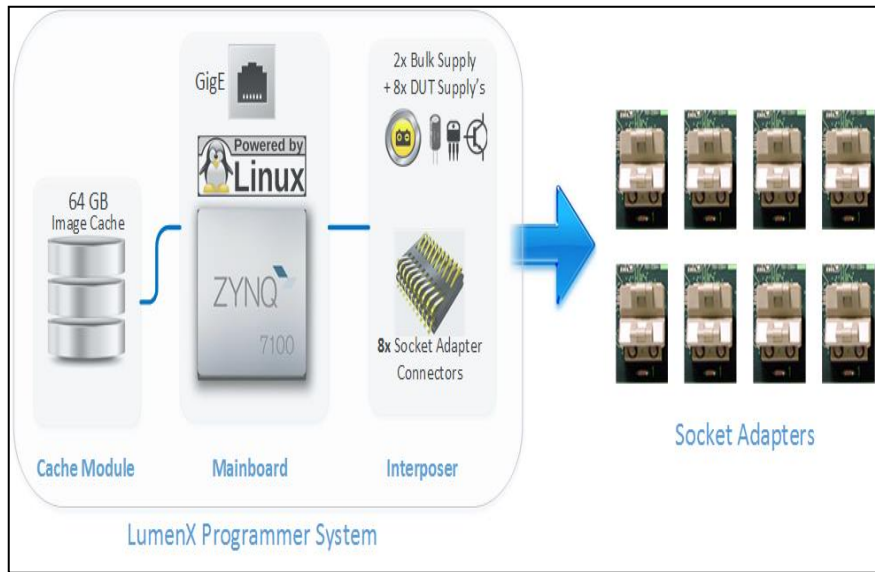
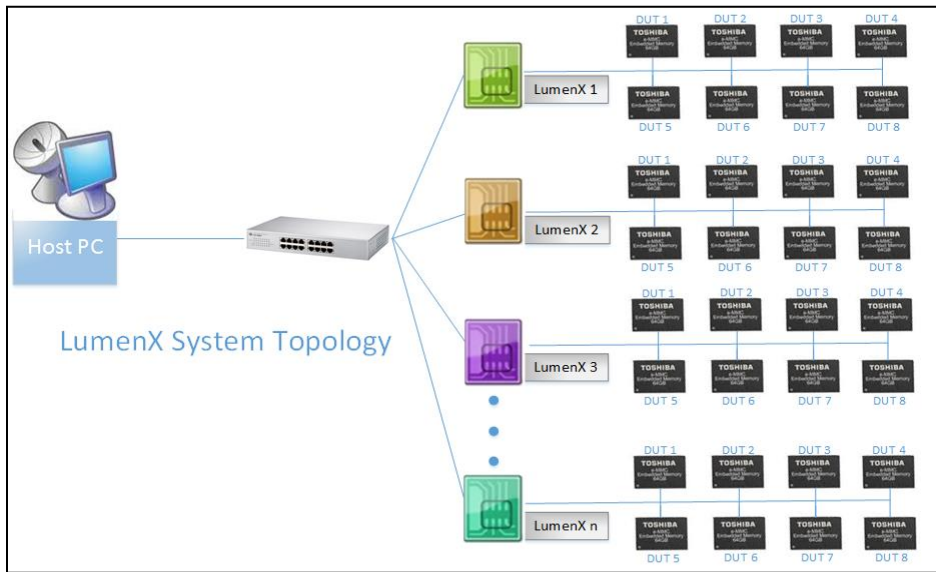
■ Business Result

- Reduce Total Cost Of Programming (TCOP) of each device; 


*A revolutionary programming platform
delivering **Managed and Secure
programming with unrivaled Performance
at an extraordinary Value.***


***The LumenX programmer is optimized for
leading high density eMMC devices
maximizing production throughput for the
lowest Total Cost Of Programming***









Key Functionality and Metrics

- Performance; 
 - Data Download Performance
 - 25MB/sec Gigabit Ethernet Data Download to Programmer(4X current technology)
 - Data Programming Performance
 - 52 MHz DDR interface (4X current technology), 80 – 100 MB/sec Program and Verify Speeds(4X current technology)

- Programmer Capacity and Scalability; 
 - 64GB local cache on Programmer. Field upgradeable to 128GB
 - 8 Programming sites per programmer(2X current technology), one socket per adapter
 - 1-14 LumenX programmers per system

- Managed and Secure Programming; 
 - Job Creation SW is distinct from Job Running SW to eliminate operator error
 - Eliminates security risks of master devices in duplicators
 - Programming metrics reporting(parts consumed, programmed, pass, fail etc.)
 - Remote Monitoring API

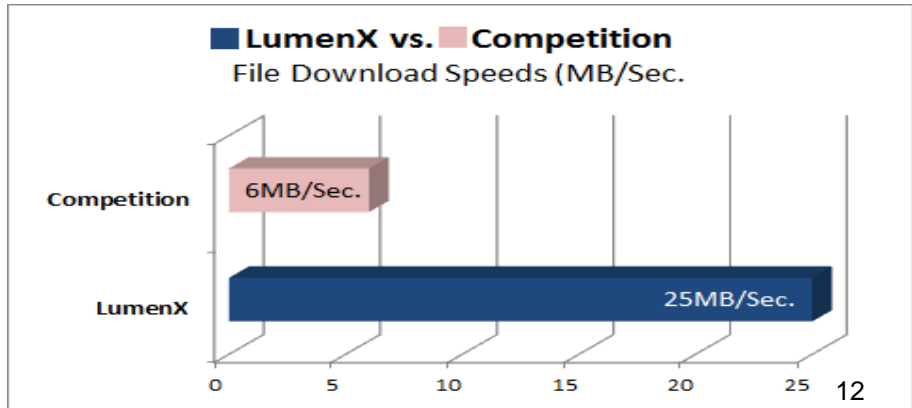
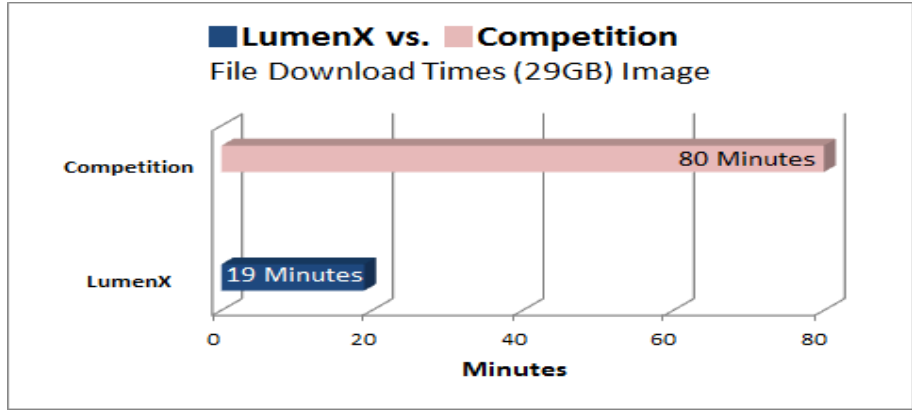
- Reliability; 
 - Partnering with flash memory vendors to enable devices per spec. Programming Yields > 99.5%
 - Partner prior to market launch

- Faster Device Support; 
- Total Cost of Programming cut by 2/3; 

LumenX™ Programmer **minimizes** setup times for (large files) for **maximum productivity**

- LumenX™ Large File Download
 - Faster setup time
 - Optimized machine utilization
 - Data I/O TCOP advantage

- LumenX™ Download Speeds
 - 25MB/bytes per second
 - Fast set-up time for large files
 - Data I/O TCOP advantage

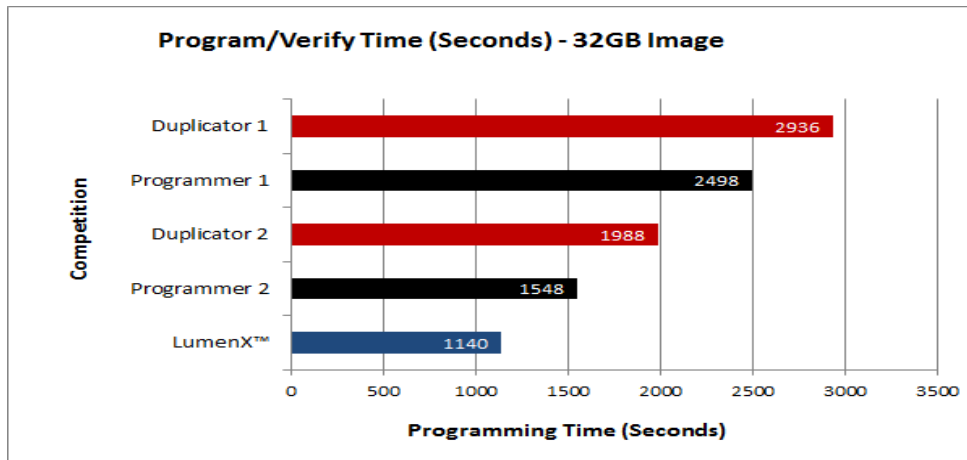


Vendor	eMMC Std. Ver.	Capacity	Interface	Seq. Write	Seq. Read	Program	Verify
# 1	5.1	32 GB	52 MHz DDR	85 MB/s	90 MB/s	75 MB/s	80 MB/s
# 2	5.0	32GB	52 MHz DDR	70 MB/s	300 MB/s	75 MB/s	85 MB/s
# 3	4.51	64GB	52 MHz DDR	50 MB/s	125 MB/s	51 MB/s	82 MB/s
# 4	4.50	16GB	52 MHz DDR	29-36 MB/s	71 MB/s	41 MB/s	82 MB/s
# 5	5.0	32GB	52 MHz DDR	70 MB/s	280 MB/s	67 MB/s	81 MB/s

- LumenX™ Programmers deliver data close to Interface speed
- Maximum Program/Verify speeds are gated by Sequential Read/Write speeds

LumenX™ programs at the speed of today's fastest eMMC devices

- Program / Verify up to 100 Mbytes/sec.
 - limited only by device speeds
- DDR 50Mhz Interface (today)
- As eMMC device speeds increase
 - LumenX will keep up while our competitors are speed limited



32GByte Image

Duplicator 1: 8 devices in (49 minutes)

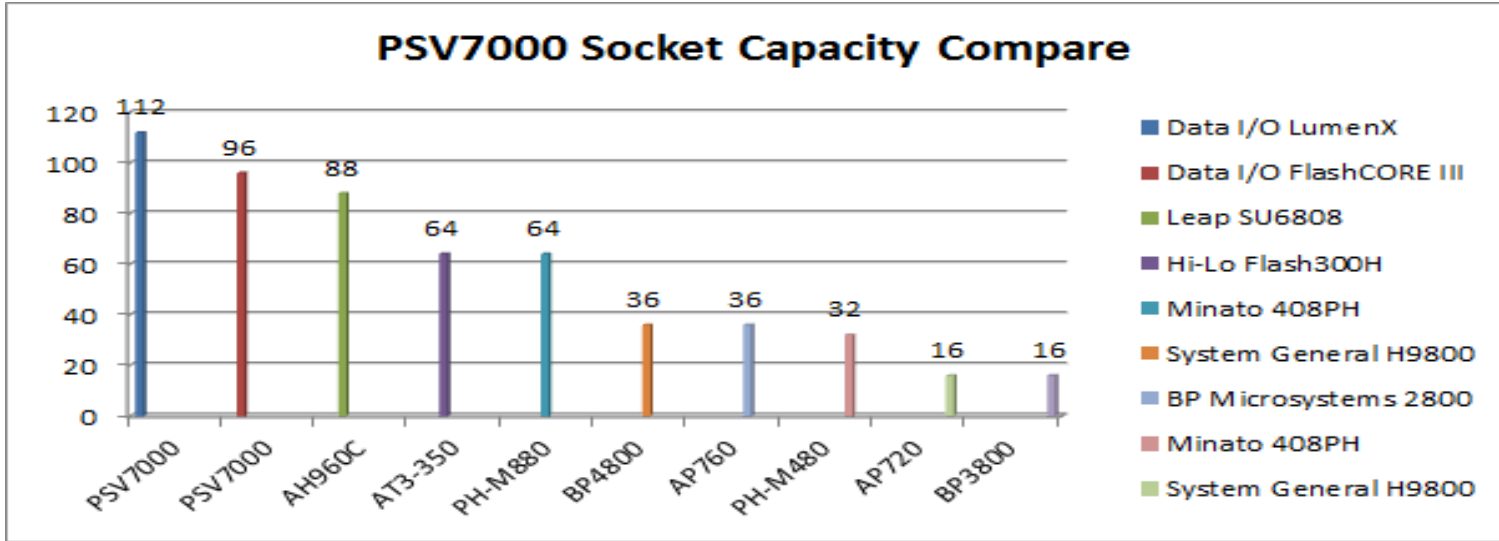
Programmer 1: 4 devices in (42 minutes)

Duplicator 2: 8 devices in (33 minutes)

Programmer 2: 4 devices in (26 minutes)

LumenX™: 8 devices in (19 minutes)¹⁴

- LumenX™ programmer supports up to 112 sockets in a PSV7000 system



- PSV7000 with LumenX™ technology
 - has more than 3x programming capacity than the competition
 - Total Cost Advantage



Flash memory vendors endorse the LumenX™ Programmer



- **Toshiba**

- *“Toshiba Semiconductor & Storage Products Company and Data I/O Corporation, have a long standing history of collaboration and teamwork to ensure the highest quality programming for our mutual customers. Data I/O’s new LumenX™ programming system delivers the highest programming speed performance (at-the-speed-of-the-device) with programming algorithms developed according to our specification for Toshiba’s latest eMMC™ 4.5, 5.0 and 5.1 devices.”*

- **Cypress**

- *“Cypress Semiconductor Corporation has onsite device support engineers trained and ready to support Data I/O’s new LumenX™ programming platform” said Adam Fogle, Sr. Manager of Failure Analysis with Cypress Semiconductor Corporation. “The LumenX™ programmer delivers superior programming performance for our latest eMMC devices with algorithms written to our product specifications. Our mutual customers have expressed their appreciation for the superior support that Cypress Semiconductor Corporation and Data I/O deliver as a team”*

- **Micron**

- *“Micron Technology, a world leader in the semiconductor industry is pleased to support Data I/O’s new LumenX™ programming platform” said Bob Baltar, Applications Engineering Director with Micron Technology, Inc. “The LumenX™ programmer delivers superior programming performance for our latest eMMC 4.5, 4.51 and 5.0 devices. Micron Technology and Data I/O have a long standing history of working together to ensure that programming algorithms for all Micron products are developed and tested according to the specifications.”*

