

Markets and Trends for Tektronix 70GHz ATI Oscilloscope

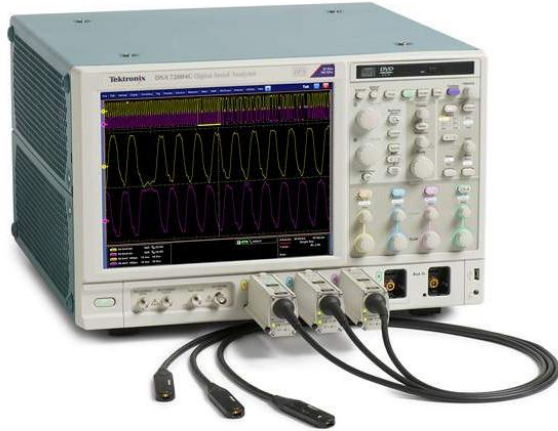
Tom Freeman, Product Marketing Manager

*WIDER
DEEPER*

2015 Tektronix Innovation Forum

MSO/DPO70000 Series Real-Time Performance Oscilloscopes

DPO70000C/DX



Digital Phosphor Oscilloscope

- General Purpose High/Ultra BW Real-Time Scope
- Bandwidths from 4GHz to 33GHz

MSO70000C/DX



Mixed Signal Oscilloscope

- High/Ultra BW Real-Time Scope with 16 Digital Channels
- Bandwidths from 4GHz to 33GHz

Market Trends



High Speed
Communications

- Carriers seeking more network capacity in transceiver design
- Small timing margins leading to new jitter separation methods
- Optical modulation analysis is a design requirement
- Instrument must provide precise low-noise, low-jitter measurements



Wideband RF
Technologies

- Meeting demands for more visibility/information
- Deploying wideband chirp technology in advanced radars
- Increase in use of microwave frequencies for communication links
- Instrument must provide wider bandwidth & higher resolution

Emerging Customer Needs

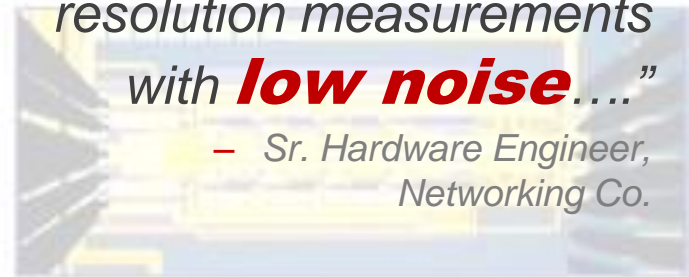
“...need to move to a **higher bandwidth** for this DP-QPSK project and I need **4 channels** of low noise A to D....”

- Optical Networks Designer, Telecommunications Mfr.



“...my low-level signals are 40-50 mVpp and I need 5 mV vertical resolution measurements with **low noise**....”

- Sr. Hardware Engineer, Networking Co.

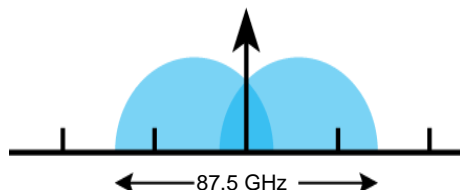


Customer Challenges for 400G and Beyond

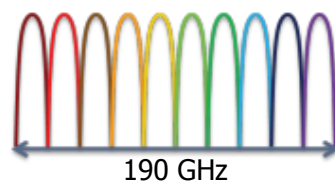
- As 100G coherent optical systems are being deployed, architecture for 400G systems and beyond are in development
 - No industry consensus on how to build superchannels for 400G
- The T&M system must have the flexibility to support any combination of system parameters

system rate	# of carriers	modulation format
400 Gb/s ¹	2	DP-16QAM
500 Gb/s ²	5	DP-QPSK
500 Gb/s ³	10	DP-QPSK
1.0 Tb/s ⁴	10	DP-QPSK
1.5 Tb/s ⁵	8	DP-16QAM

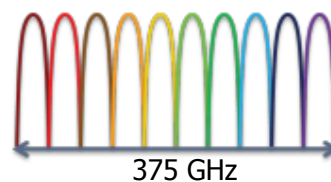
400 Gb/s, 2 carriers



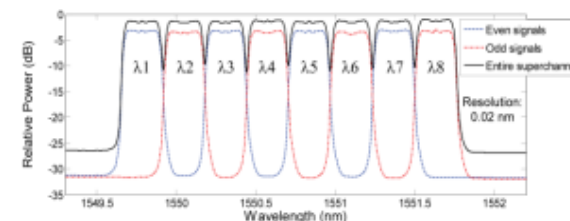
500 Gb/s, 10 carriers



1.0 Tb/s, 10 carriers



1.5 Tb/s, 8 carriers



Sources: ¹Beyond 100G, Fujitsu Network Communications, Inc.

²Dawn of the Terabit Age, Infinera Corporation

³Coherent Super-Channel Technologies, OSA Webinar, Infinera Corporation

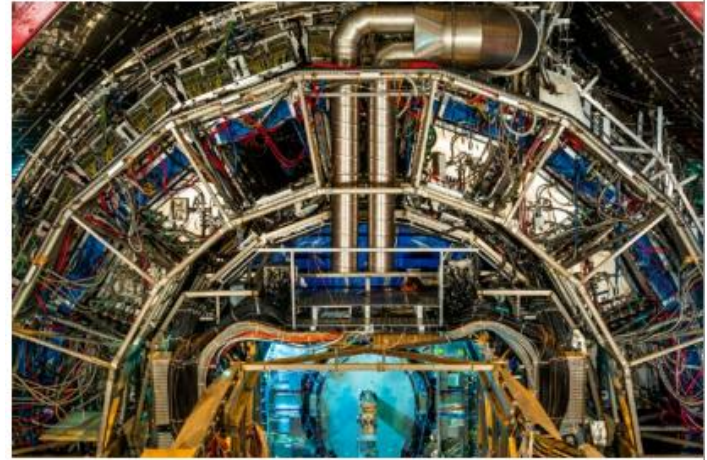
⁴Super-Channels: DWDM Transmission at 100Gb/s and Beyond, Infinera Corporation

⁵1.5-Tb/s Guard-Banded Superchannel Transmission over 56 × 100-km (5600-km) ULAF Using 30-Gbaud Pilot-Free OFDM-16QAM Signals with 5.75-b/s/Hz Net Spectral Efficiency, Alcatel-Lucent, Bell Labs

Data Capture Challenges

Accurate capture of high bandwidth single-shot signals

- Signal Fidelity
 - Low noise, high ENOB
 - Excellent single-shot fidelity needed
 - Minimum channel-to-channel jitter
- Security of data
 - Each experiment can be very expensive; must not lose data
- Small physical size
- Throughput
 - Runtimes can be very long for a single analysis



Customer Needs for Wideband Signal Analysis (>160MHz)

- Radar Target Classification
 - Chirps and phase coding
 - Narrow pulse widths

- Fat Data Pipes
 - Imagery intelligence
 - Data communications
 - Voice

- Frequency Agile Comms
 - Wide band hopping
 - Low probability of intercept
 - Spectrum efficiency

- T&M Challenges
 - Utilize real-time BWs that exceed traditional spectrum analyzer BW
 - Center frequencies extend above X-band (8-12 GHz)

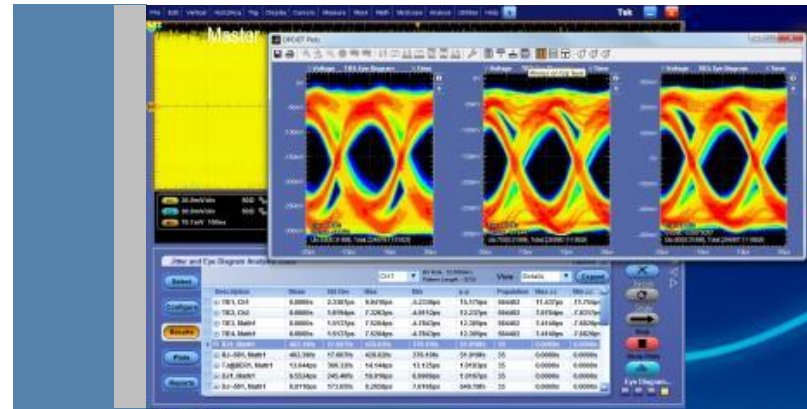


100G/400G Market Conditions

- Current NRZ designs (25GBd) have two options for throughput increase
 - 56 GBd NRZ/400G networking
 - Targeted toward supporting a broad set of reach objectives ranging from die-to-die through to chip-to-chip
 - 28 GBd PAM4, with early discussions of 56 GBd PAM4
 - Extend beyond 100mm channels
 - T&M Challenge
 - Validation and compliance techniques will require low BER measurements to ensure detection of low-probability events/floors

CEI-56G Project	Application	Loss dB	Max Reach mm
Ultra Short Reach USR	Chip-to-OE (within MCM)	not stated	10
Extra Short Reach XSR	Chip-to-OE (Chip-to-PHY)	5 to 10 @ 28G	50
Very Short Reach VSR	Chip-to-Module	10 to 20 @ 28G	100
Medium Reach MR	Chip-to-Chip	15 to 25 @ 14G	500
Long Reach LR (not a project)	Backplane (Chip-to-Fabric)	25 to 50 @ 14G	1000

DPO70000SX 70GHz ATI Performance Oscilloscope



DPO70000SX 70GHz ATI Performance Oscilloscope

- **70GHz Analog Bandwidth**
 - <6ps rise time
- 200GS/s Sample Rate
- 100fs jitter noise floor
- $\geq 25\text{GHz}$ Edge trigger bandwidth
- **Low-noise** ATI architecture
- **Best-in-class** signal capture
- **Compact, Scalable** oscilloscope package
- **Precise** multi-unit sync



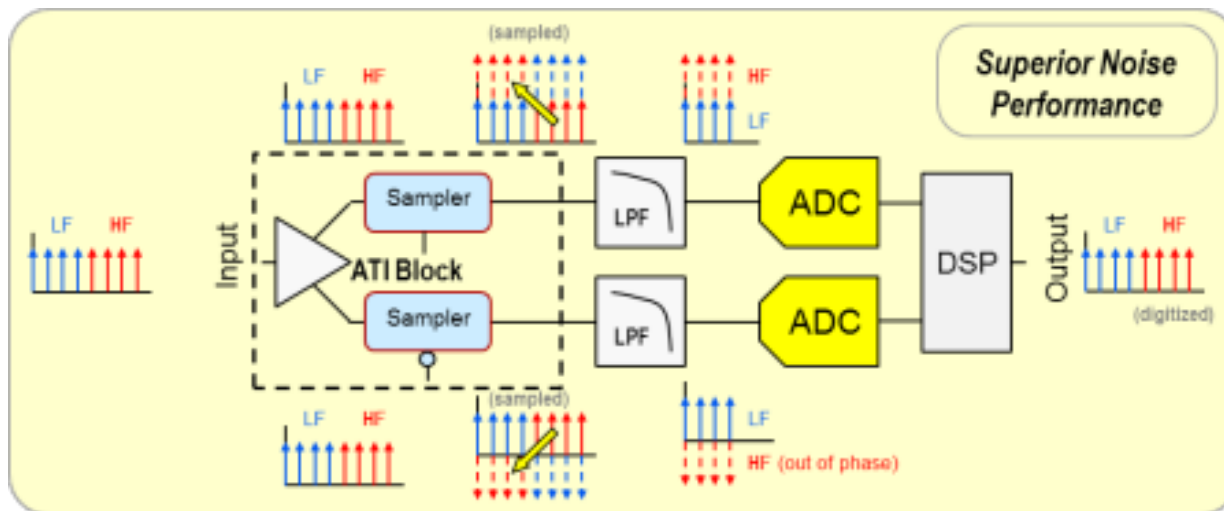
Lowest Noise. Highest Fidelity. Maximum Performance.

Asynchronous Time Interleaving (ATI) Technology

70GHz Real Time Bandwidth

- Patented signal acquisition architecture
- Unique method for digitizing full spectrum that maintains signal path symmetry
- Preserves signal-to-noise ratio for higher signal fidelity

Tektronix ATI Technology



Key Applications

Optical Modulation Analysis for Long Haul Networks

- 400GBaud requiring faster oscilloscopes
 - Including the ability to synchronize multiple high-performance oscilloscopes

Fundamental Research Applications

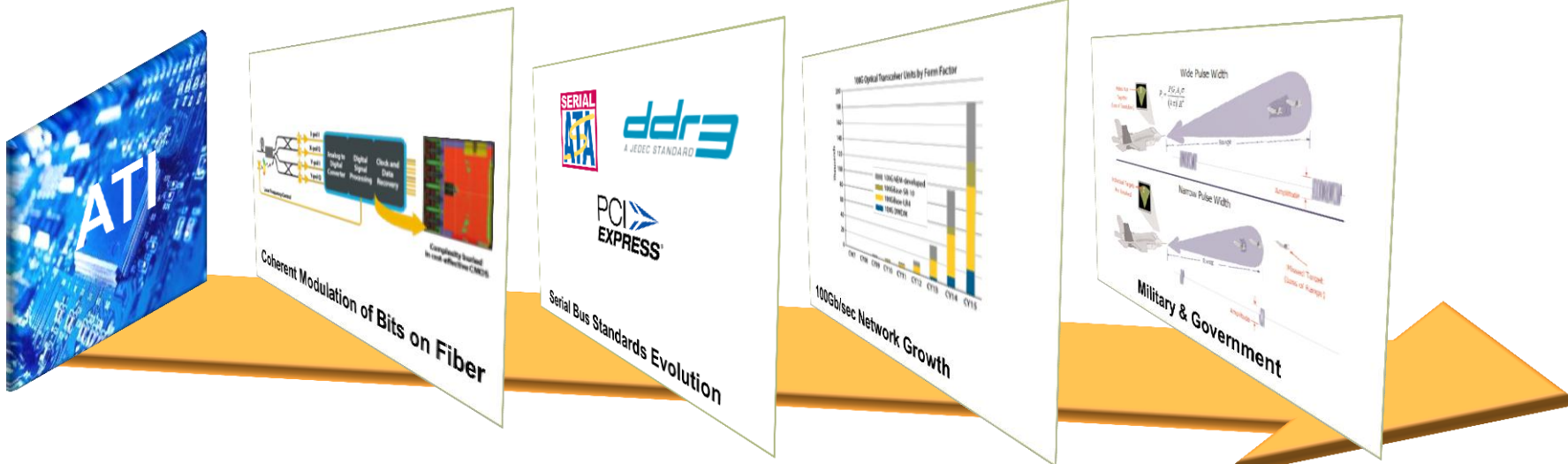
- Need accurate capture of high bandwidth single-shot signals

Wideband Radar, Advanced Communications

- Ka band (40GHz) and V band (70GHz) test & validation needed that spectrum analyzers can't support

High-Speed Datacom

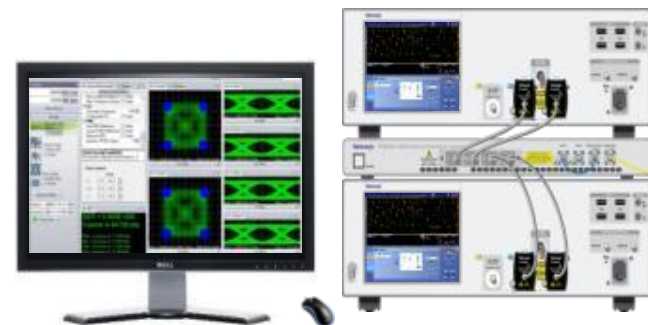
- Move to 56Gb is coming, time to validate silicon and system modules



Optical Modulation Analysis for Long Haul Networks

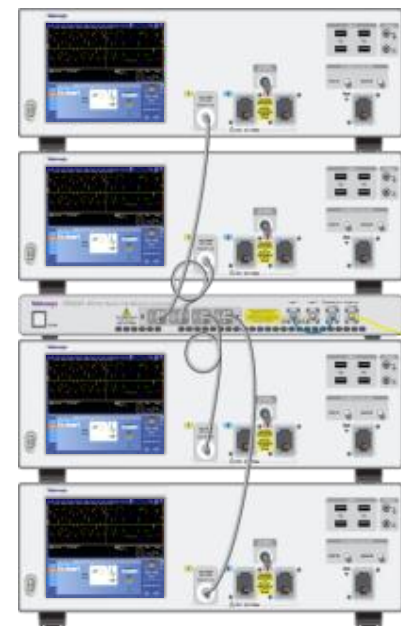
100G Coherent Optical Testing

- 4-channel (2-pol) 33GHz, 100GS/s, 1Gsample/ch
- Flexibility to configure for 1-pol 70GHz, 200Gs/s, 1Gsample/ch



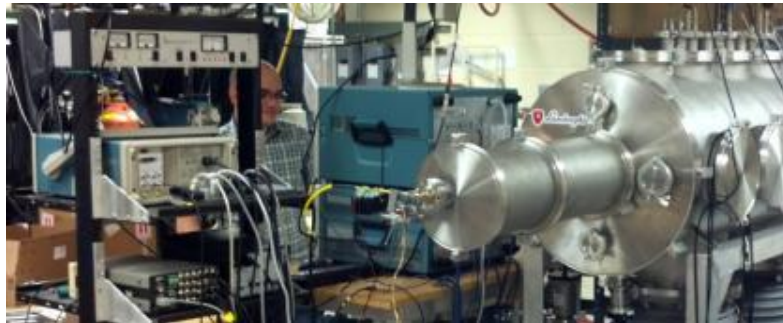
400G Coherent Optical Testing

- Used to evaluate systems ≥ 80 Gbaud dual polarization
- 2-pol 70GHz, 200G/s, 1Gsample/ch x 4 channels



Fundamental Research Applications

- Extremely precise acquisition system
 - Most accurate capture of ultra-high bandwidth signals
 - Fast trigger for narrow pulse-width capture
- Compact, scalable for high channel count data
 - Higher channel count in less rack space
 - Flexible configurations that increase channel count
 - Removable SSD for data security
 - UltraSync architecture ensures precise multi-unit timing
 - Distributed processing enables faster data results



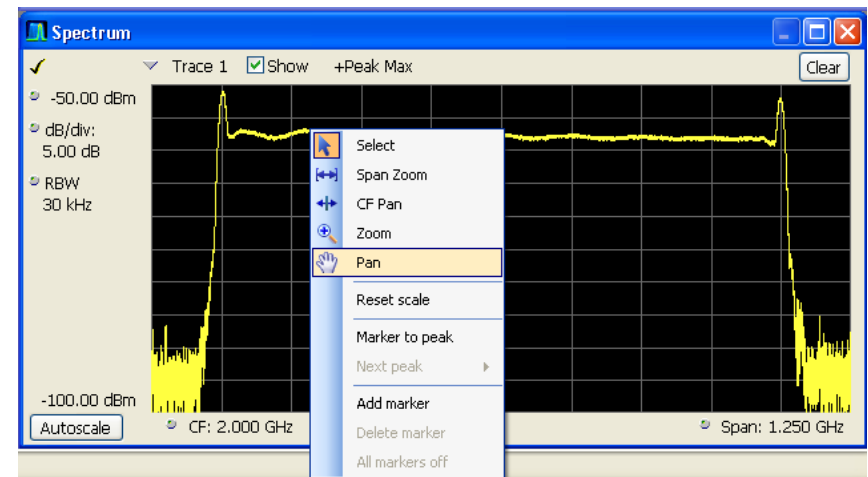
SignalVu & DPO70000SX - Integrating the Best of Both Worlds

- **Industry's most powerful scope for RF applications**
 - 70 GHz analog BW
 - Sophisticated triggering
 - Deep memory
 - Signal processing (Math)

- **Industry's most powerful user interface for RF measurements**
 - Time Overview
 - Drag & Drop Measurements
 - Pan & Zoom
 - Correlated markers (frequency, phase and time domains)
 - Automated pulse measurements
 - FastFrame segmented memory

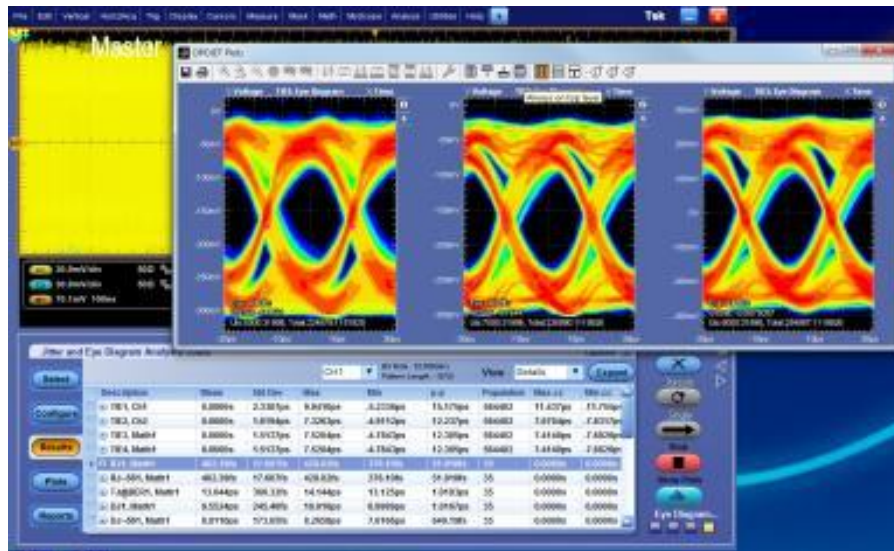


SignalVu Powerful User Interface



Measuring Differential Signals Using Scalable DPO70000SX

- Accurate performance with 200GS/s, 70 GHz Acquisition
 - Suitable for 25-32 Gb/s Characterization & 56 Gb/s Debug/Validation
 - IEEE 802.3ba Ethernet Testing
 - OIF-CEI3 Optical Interface Testing
 - Jitter Noise Floor <125 fs



Innovation at the Heart of Tektronix

Strong History of Leadership Beyond Banner Specs

- **FIRST** and only performance oscilloscope with DPX technology
- **FIRST** integrated high Performance MSO
- **FIRST** with high bandwidth (50GHz) Time Domain Reflectometry
- **FIRST** with TriMode probing



Today's Introduction Continues the Innovation Tradition

- **FIRST** with 70GHz oscilloscope leveraging patented ATI signal acquisition architecture
- **FIRST** with new innovative compact ultra-performance package
- **FIRST** completely scalable performance oscilloscope solution





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