DIFI Plugfest Update

October 30, 2023

Eric Fankhauser

Agenda

- Overview
- Interop Setup
- Test Methodology
- Test Matrix
- Test Results
- Challenges / Issues
- Lessons Learned / Recommendations
- Summary

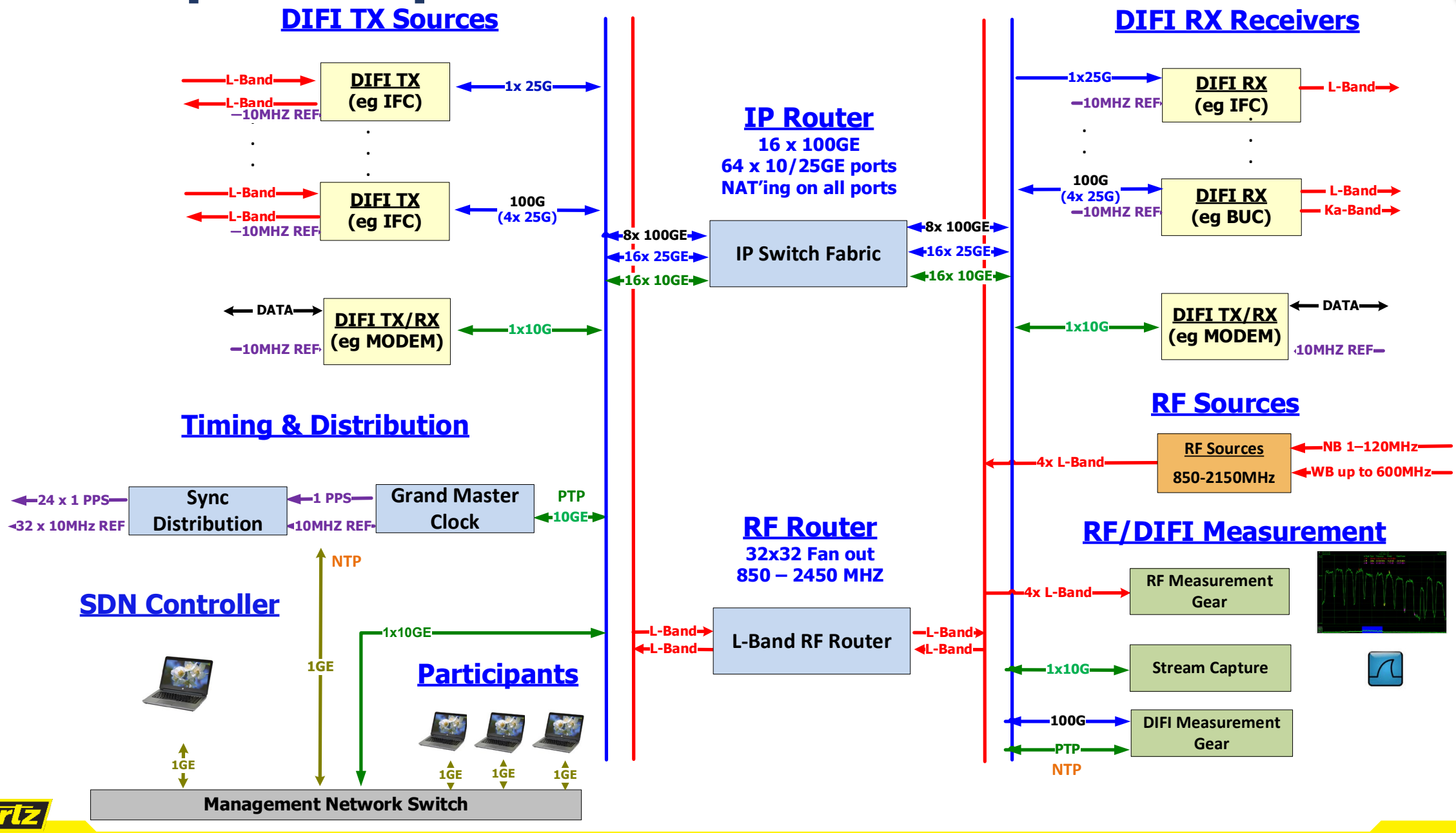
Overview

- DIFI interop held Sept 25–29, 2023 at Kratos Space and Defense in Co Springs, Co.
- 7 participating companies (~18 people)
  - Calian
  - Evertz
  - Keysight
  - Kratos
  - ST Engineering iDirect
  - Wavestream
  - Welkin Sciences
- Purpose:
  - Interop/Plugfest (not a certification event) to test V1.1 interoperability
  - DIFI implementations were in various states from prototype to pre/production product
- Goals:
  - Verify implementations & interoperability of V1.1 across scope of the standard
  - Not testing performance of RF/devices/system

Overview

- Equipment being tested
  - BUC
  - Combiner/Divider
  - DIFI Stream Generators/Testers
  - IFCs (ADC/DAC)
  - Modems
  - Modulator (DIFI out)

Interop Setup



Interop Setup

Test Methodology

- Survey of participants to determine level of V1.1 supported in equipment being tested (Frequency Range, Bit Depth, Sample Rates, PHY, Reference)
- Selected profiles to accomplish 3 objectives
  - Span the range of bit depth and BW/SR in V1.1
  - Accommodate the widest participation
  - Could be tested in the timeframe
- Test Profiles:
  - Low BW/Sample Rate: 10 MHz BW, 12.5 MSps @ 16 bits
  - Mid BW/Sample Rates: 120 MHz BW, 150 MSps @ 16 bits
    200 MHz, 250 MSps @ 6 bits
  - High BW/Sample Rates: 400 MHz, 500 MSps @ 8 bits
    600 MHz, 750 MSps @ 6 & 8 Bits
- Sources: NB RF 1–120MHz, WB RF to 600MHz, 1500MHz center, QPSK, ¾
- Criteria for successful interop:
  - DIFI RX able to lock to TX and happy with signal
  - Analog spectrum from input to output was recreated

Test Matrix

12.5 MS/s @ 16 bit			Calian, Adv. Tech	Evertz	Keysight	Kratos	ST iDirect	Wavestream	Welkin Sciences
Company	***Product***		**RX**	**RX**	**RX**	**RX**	**RX**	**RX**	**RX**
Calian, Adv. Tech	XYZ	TX	NA	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA
Evertz	XYZ	TX	Y/N/NA	NA	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA
Keysight	XYZ	TX	Y/N/NA	Y/N/NA	NA	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA
Kratos	XYZ	TX	Y/N/NA	Y/N/NA	Y/N/NA	NA	Y/N/NA	Y/N/NA	Y/N/NA
ST iDirect	XYZ	TX	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA	NA	Y/N/NA	Y/N/NA
Wavestream	XYZ	TX	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA	NA	Y/N/NA
Welkin Sciences	XYZ	TX	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA	Y/N/NA	NA

Notes

Test Results

Profile		Products Tested	Interop Success	Notes	Success Excl. Stream Gen
LOW	12.5 MSps @ 16b	7	85.7%	Issue with one DIFI TX no RX could receive	100%
MED	150 MSps @ 16b	7	95.8%	One RX unable to receive a specific source	
	250 MSps @ 6b	8	83.7%	Issue with one DIFI TX no RX could receive	98.0%
HIGH	500 MSps @ 8b	7	100%		
	750 MSps @ 6b	5	50%	Two RXs unable to receive any sources	
	750 MSps @ 8b	2	100%		

Note: Total of 12 products tested over the various profiles

Challenges / Issues

- Underestimated of wiring, setup and config time (est. 1 - 1.5 days)
  - Infrastructure wiring, network config and equip setup took 2.5 days, testing 1 day, teardown 0.5 – 1 day.
  - Misunderstanding of IP schema provided - required reconfig
  - Late arrival of participants
- Device related vs DIFI related issues slowed testing
  - Many participants running development code - many issues encountered were not DIFI but device related
  - Signal sources with excessive output power levels
  - Hard coded parameter that required other participants to do workarounds to accommodate
- Bursty Senders
  - Some receivers unable to receive bursty senders (>500 packets of burst/void).
- Insufficient signal capture resources
  - Limited test equipment slowed down interop confirmation during profile testing
- Did not get a chance to do some augmented testing
  - Adding network impairments (packet jitter, dropped packets, etc.)

Lessons learned / Recommendations

- Interop setup
  - Need 2 days (min) for wiring and setup
  - Clearer communication on things like IP schema and setup times
- Default profiles that all participants support
  - Reference P-Caps or an algorithm to generate them – Test before hand
  - Include occupied BW definitions with the sample rates
- Recommended Practice or Appendix around packet playout and buffer profiles
- Vague information in VITA-49
  - Clarify IQ order in DIFI spec
- Test Cases
  - V1.1 is relatively simple so simple TX >> RX was sufficient
  - Specific test cases may be required for V1.2, 1.3 etc. as complexity increases

Summary

- DIFI Plugfest/Interop was a resounding success!!!
- Issues seen that could be quickly resolved in Plugfest environment
- Confirmed interoperability across a range of profiles in the V1.1 standard
- Identified potential enhancements to the V1.1 standard that can improve implementations and interoperability

Thank You

Eric Fankhauser
ericf@evertz.com