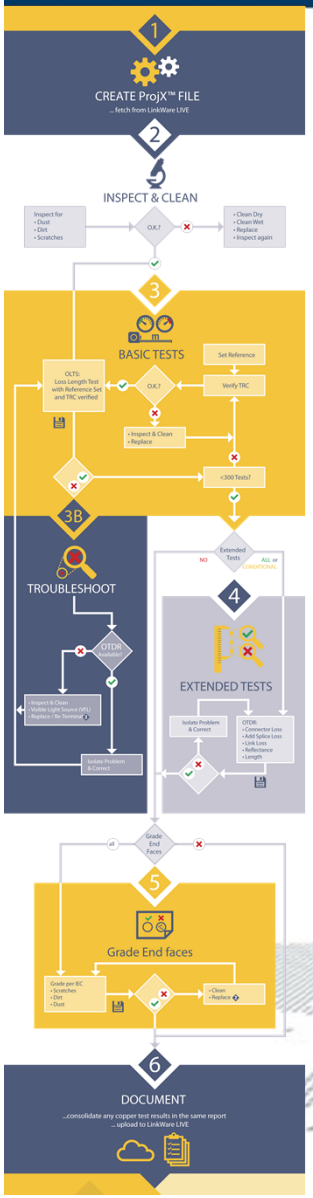


Optimized test regimes and workflows for the certification and troubleshooting of an cabling infrastructure found in today's data centres

Maximize …
Optimize …
Protect …

Christian Schillab
EMEA Marketing Engineer / FlukeNetworks
Christian.Schillab@FlukeNetworks.com

Agenda

- What makes testing in the data centre **different** from testing cabling in the commercial building ?
- Adapted **fiber** test regimes for the data centre
- Adapter **copper** test regimes for the data centre

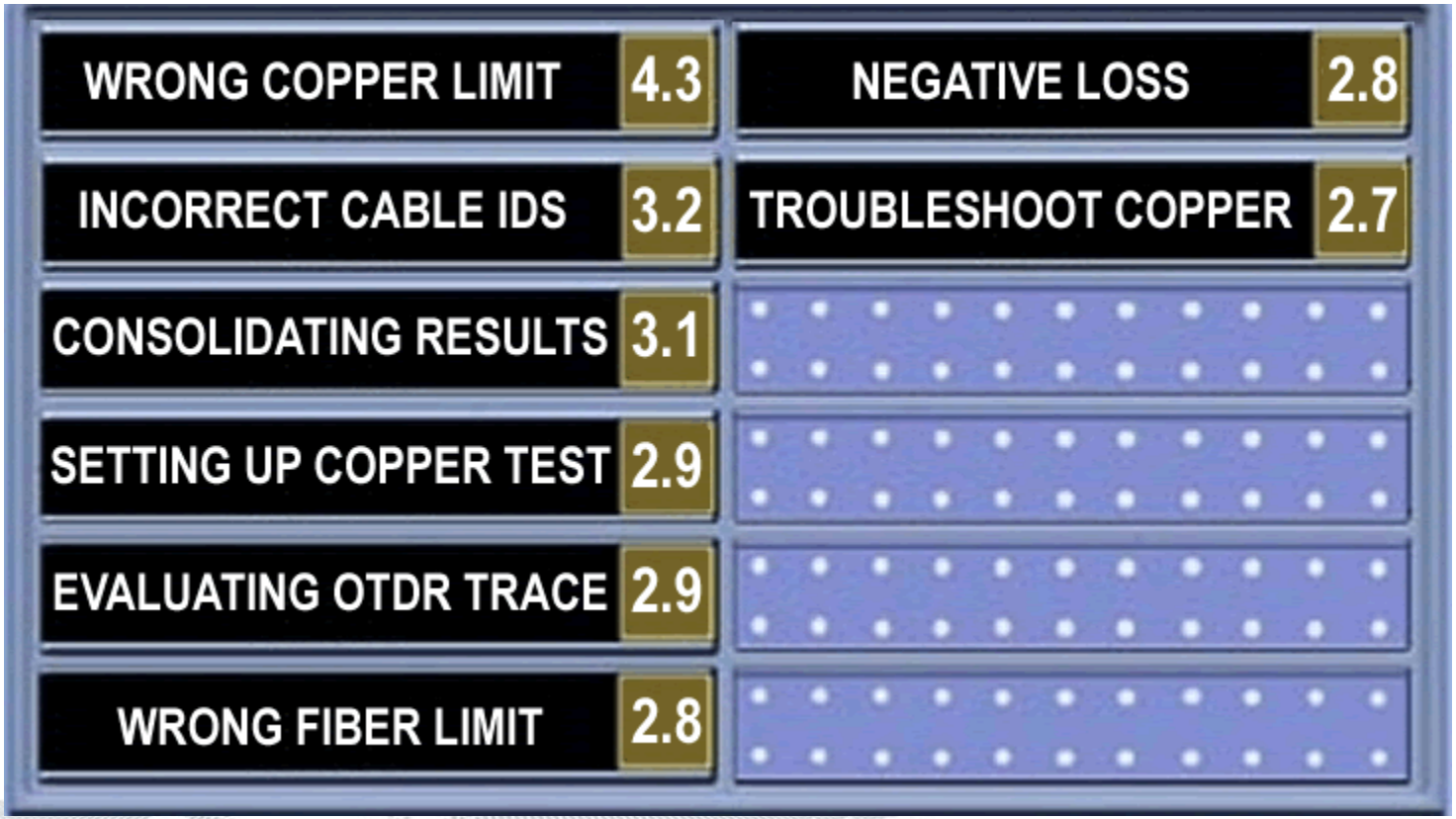
Data Centre vs. Commercial Building Cabling Infrastructure Differences Affect Test Regimes

Larger number of links

- **Testing time**
- **Consolidation**
- **Labeling / ID Mgmt.**

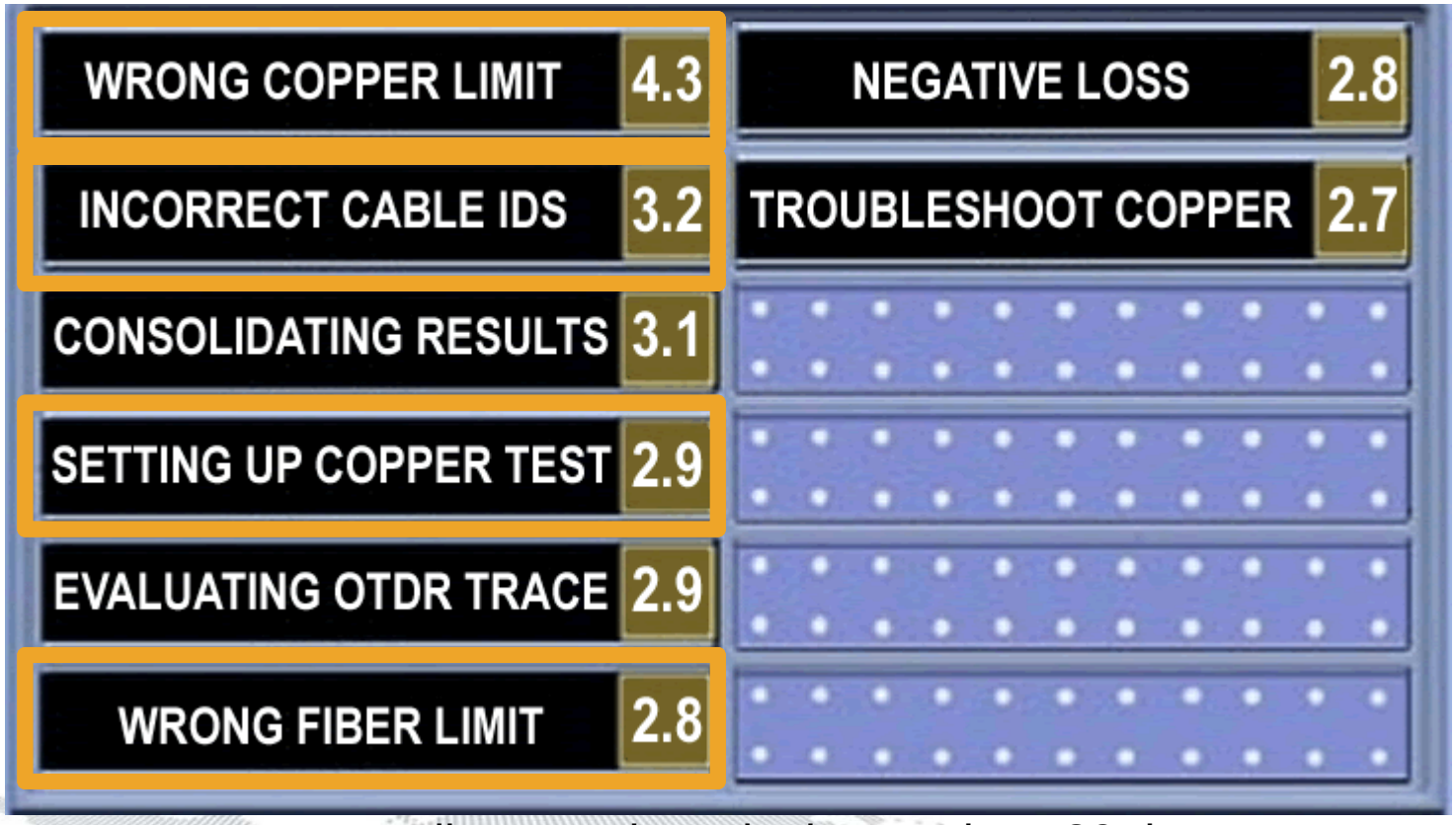
800+ Installers VOCs:
Top eight problems (hours wasted)

Create ProjX ™



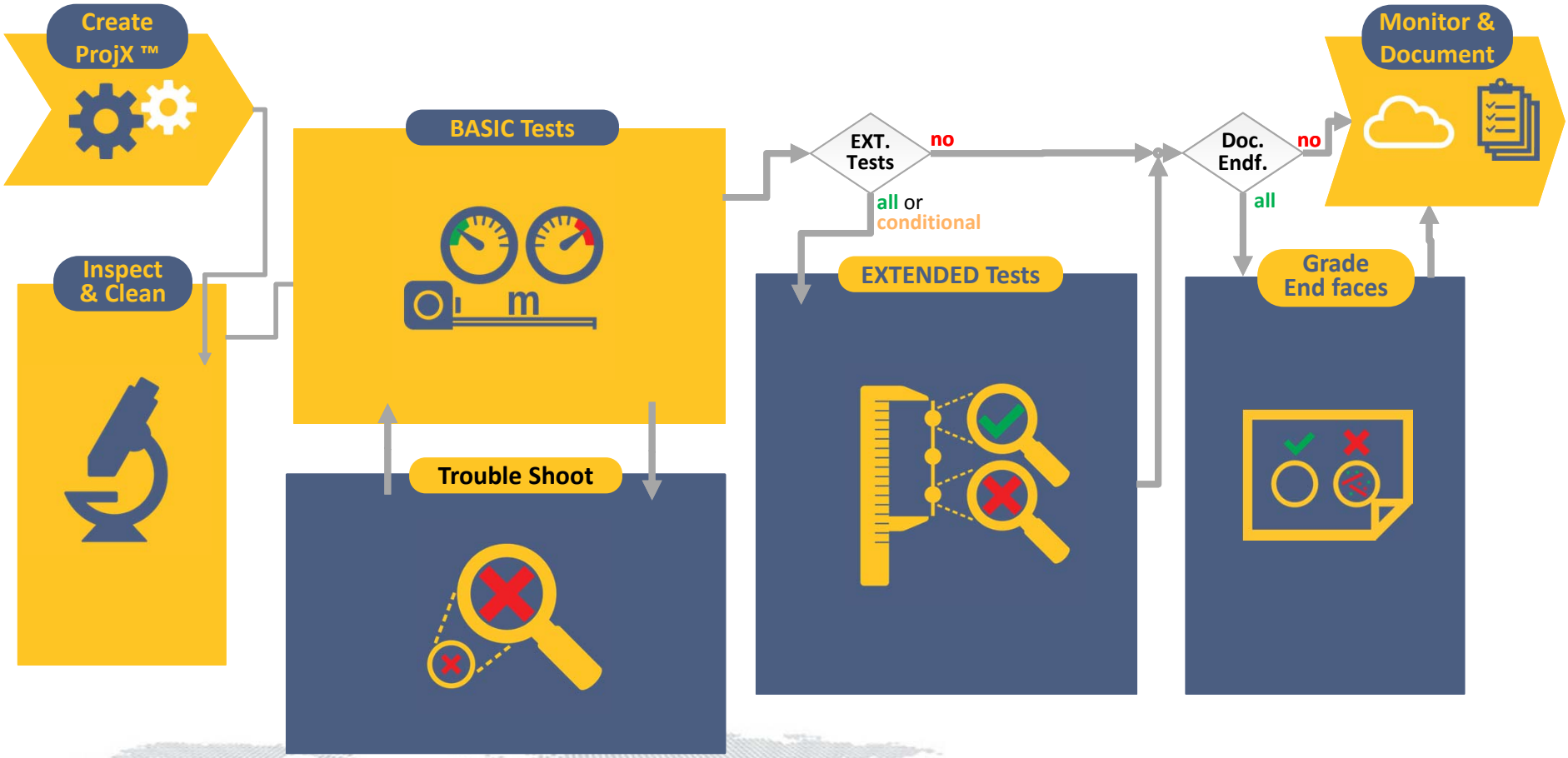
Average amongst all respondents in the previous 30 days

Top eight problems:
Wrong Configuration (Limit, IDs, Standard, …..)



Average amongst all respondents in the previous 30 days

Step 1: Project Definition



Project Definition

Create ProjX ™

- Limits, Cable Types, Cable ID are best known by the planner/project-manager
- New relaxed ISO limits do not reflect what is possible and/or needed to be future ready → **Custom Limits**

ID Lists …. Sources

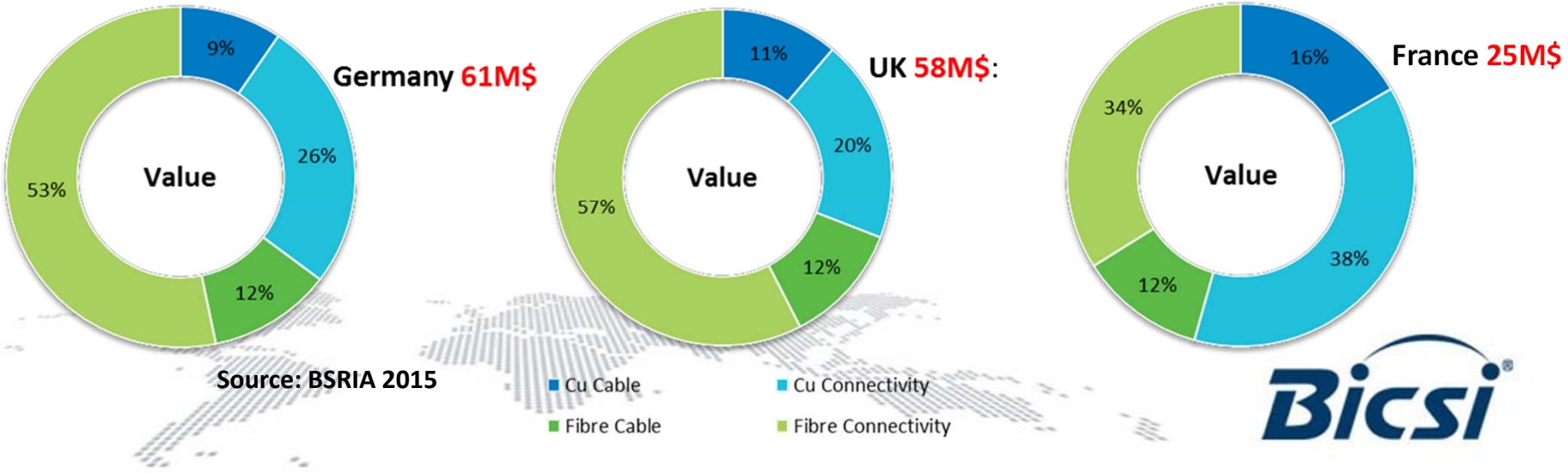
Create ProjX ™

Data Centre vs. Commercial Building Cabling Infrastructure
Differences affecting test regimes

Larger number of links

- Testing time
- Consolidation
- Labeling / ID Mgmt.

Larger share of fiber vs. copper



Data Centre vs. Commercial Building Cabling Infrastructure
Differences affecting test regimes

Larger number of links

- Testing time
- Consolidation
- Labeling / ID Mgmt.

Larger share of fiber vs. copper

"Zoned" Data Centers

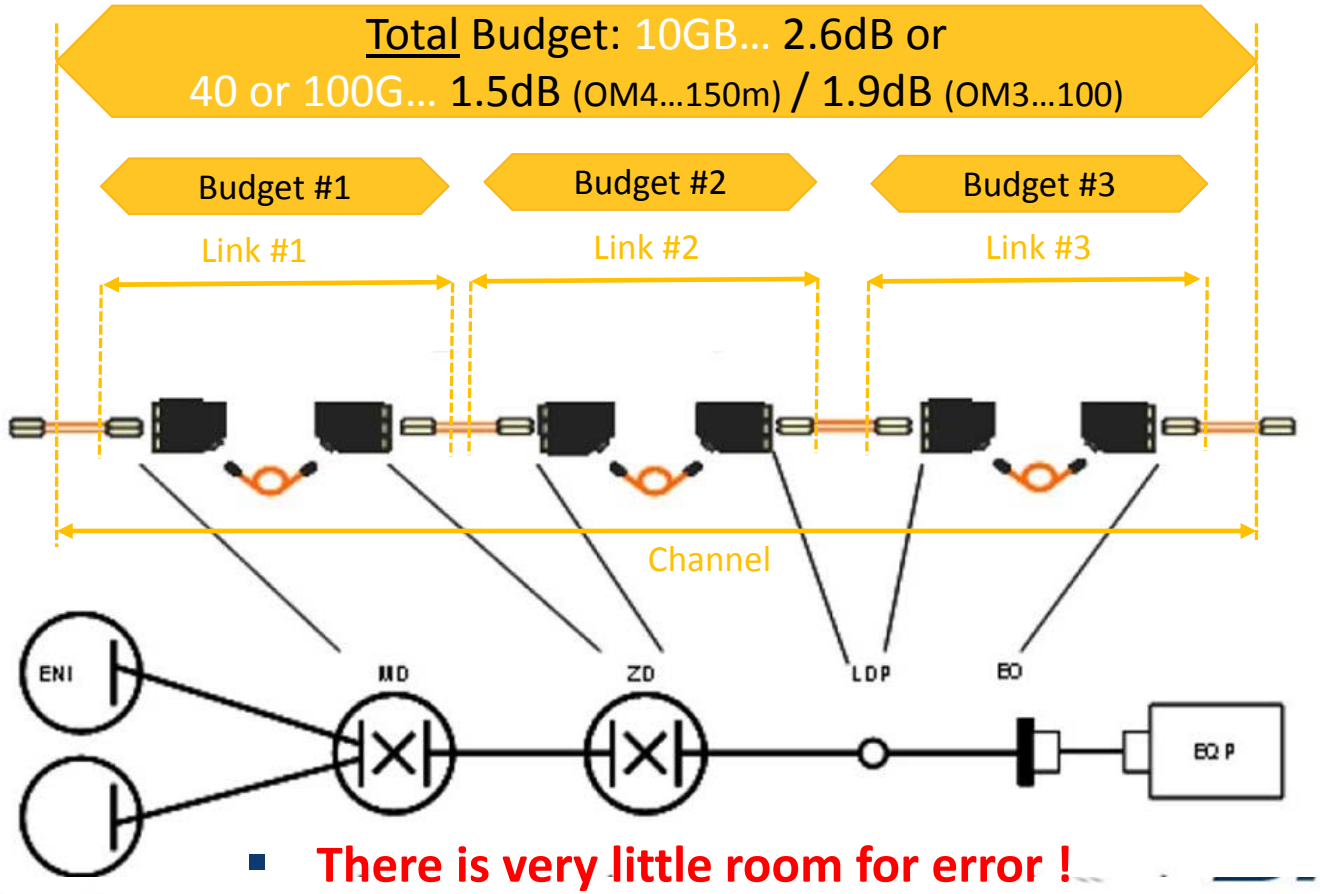
Low channel loss budgets

Low loss connectors

- Little room for measurement error

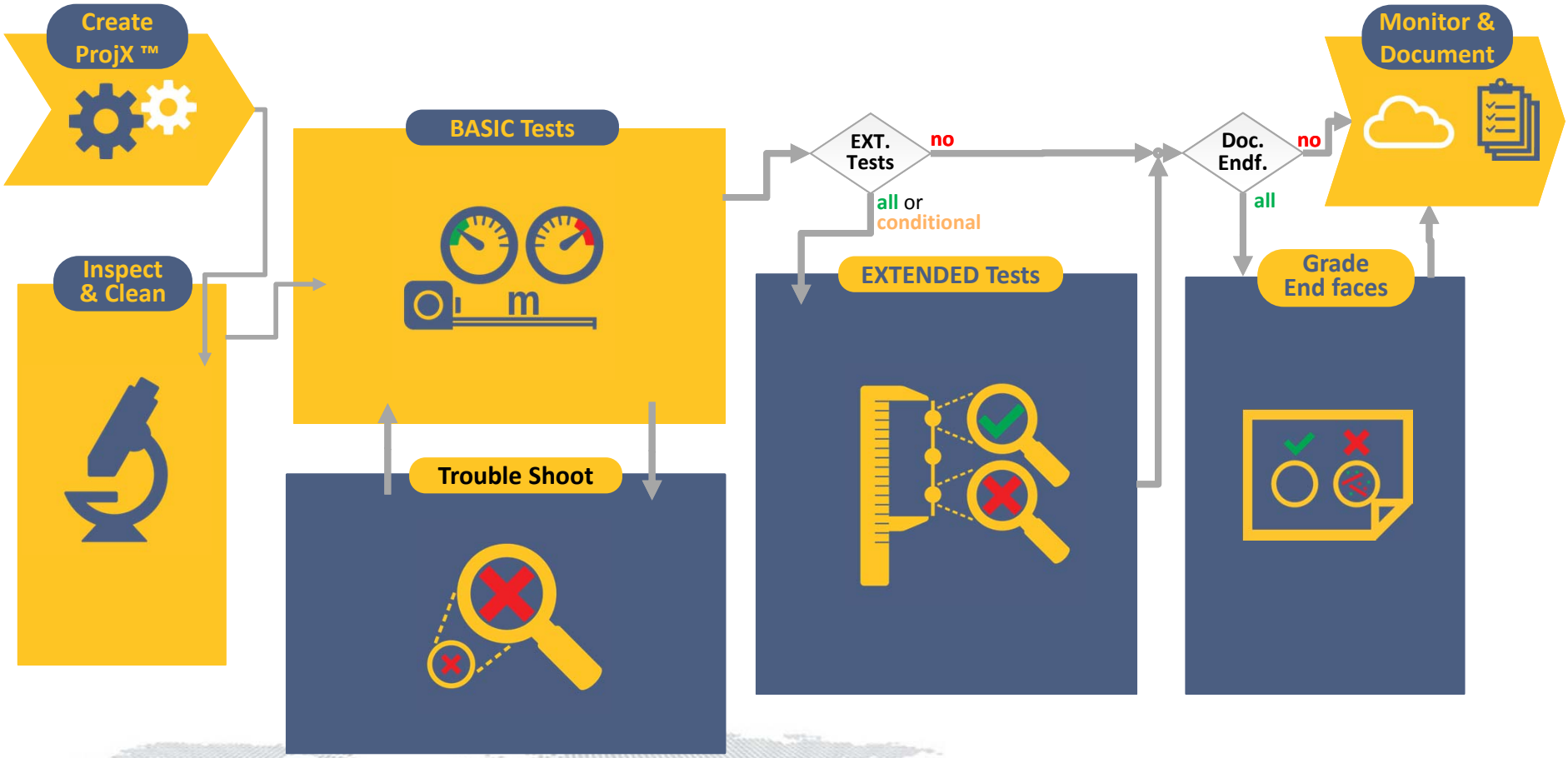
Testing – "Zoned" Data Centers

- After the installation only the links can be tested
- The "Patched Channel" is configured by the network user during the operational phase

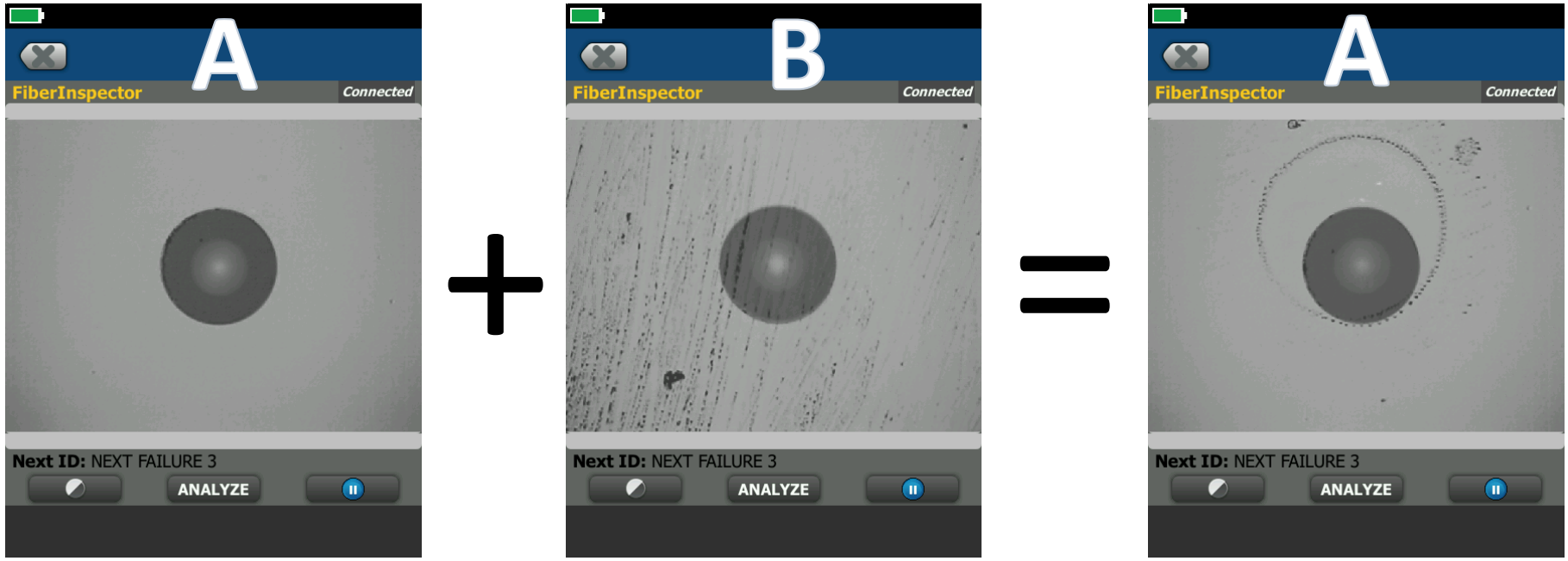


- **There is very little room for error !**

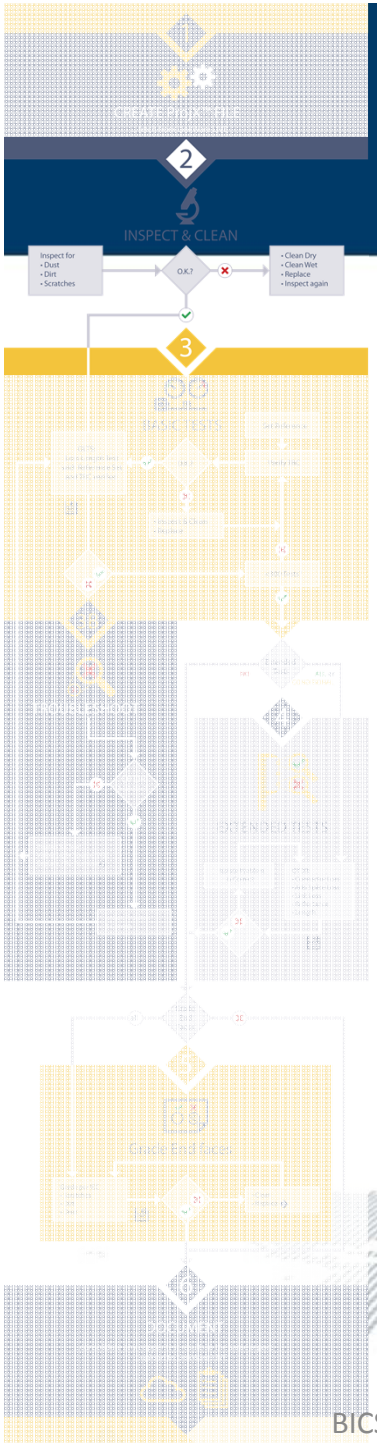
Step 2: Inspect & Clean Fibers



Dirt will transfer



Conclusion: Clean measurement cord after every mating

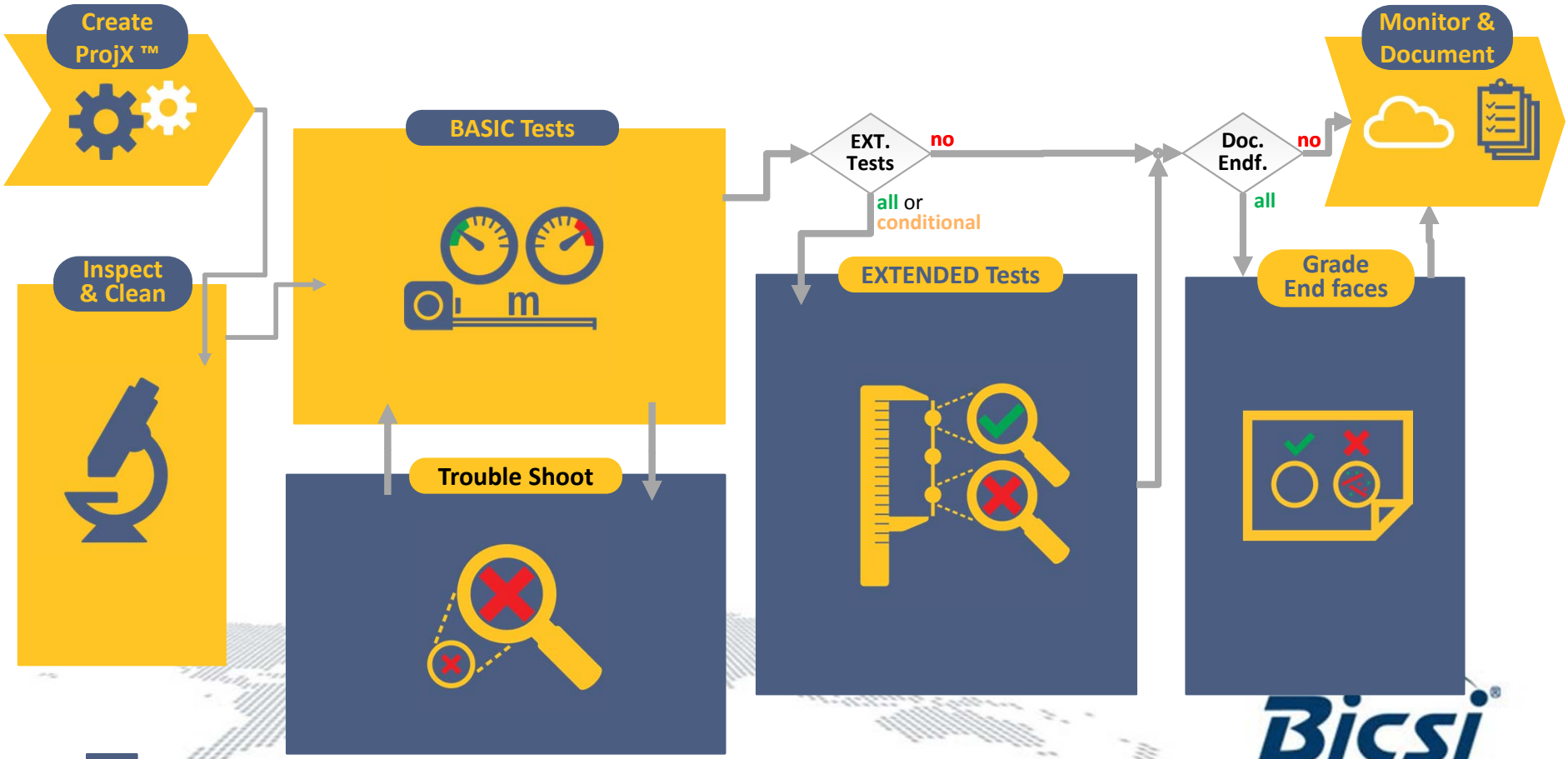


Step 2: Inspect & Clean

- Prevent dirt from causing poor/incorrect Test Results
- Prevent dirt from spreading
- Prevent abrasive dust on test cords damaging ports
- Prevent abrasive dust on ports from damaging valuable test cords

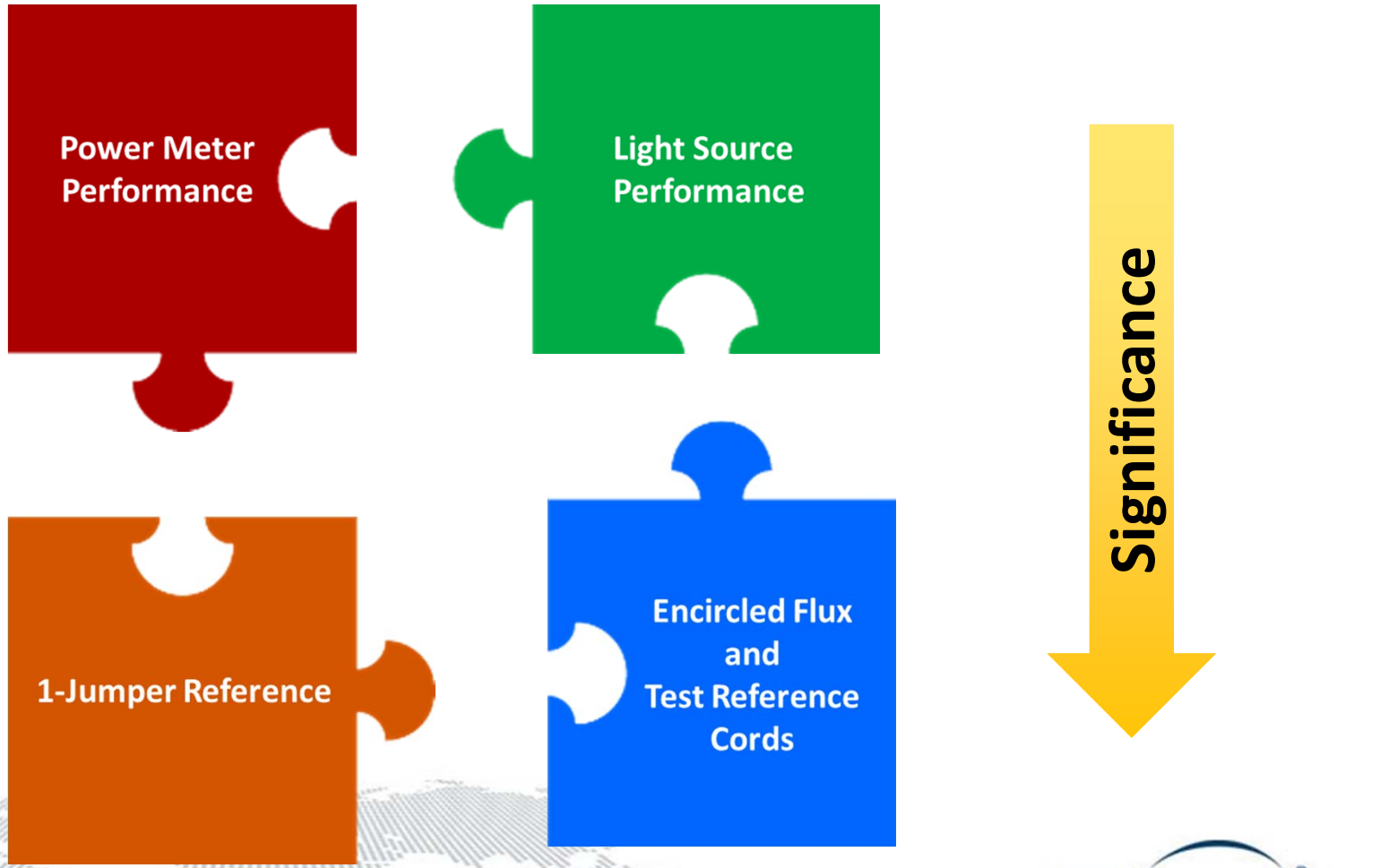
Step 3: BASIC Tests

	Tier 1	Tier 2
	BASIC	EXTENDED



…Optional / Conditional Testing

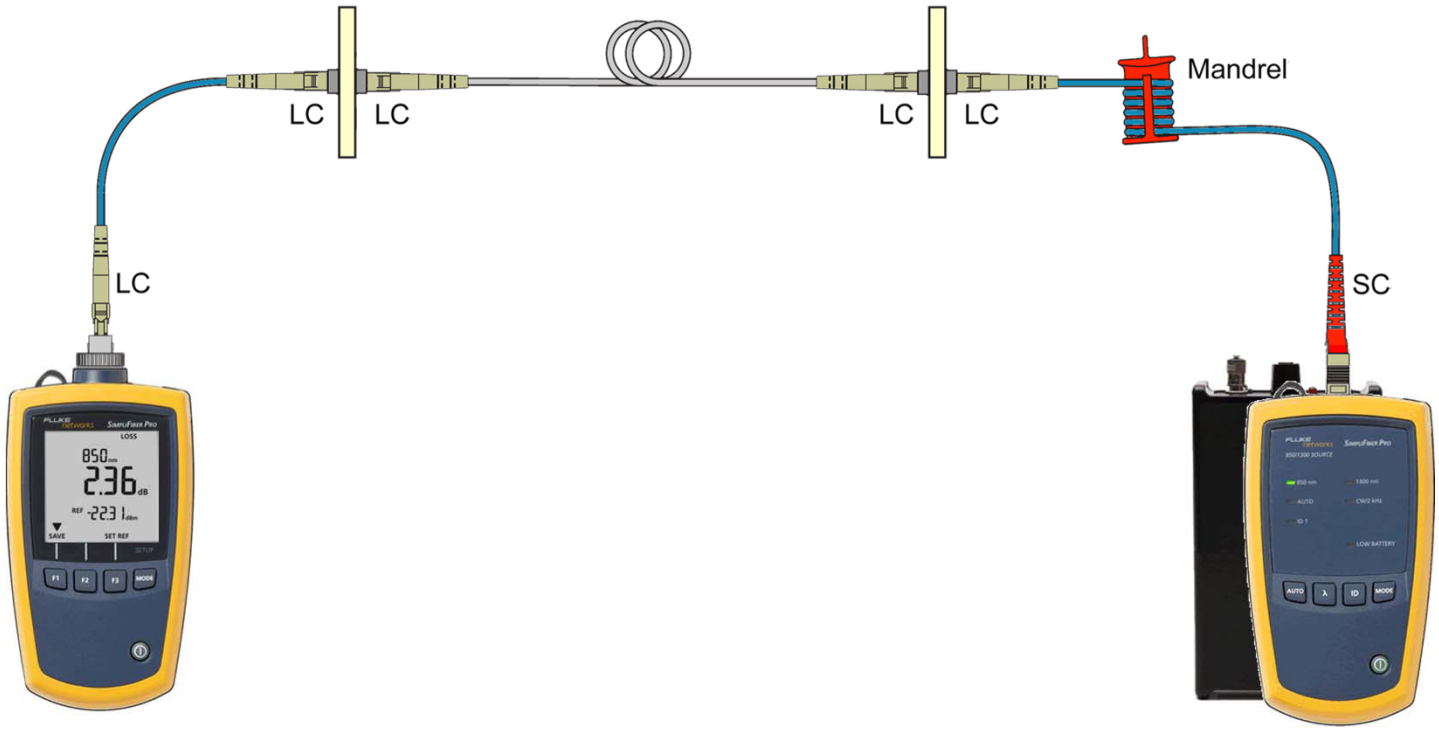
Being certain of loss uncertainty

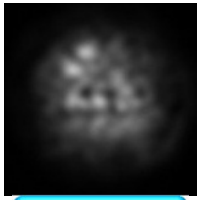


Set Reference & TRC verification

- A wizard guides through the correct process
- TRC verification stored as part of project
- A TRC verification test should be run with regular intervals

Why was the EF STANDARD NEEDED ?



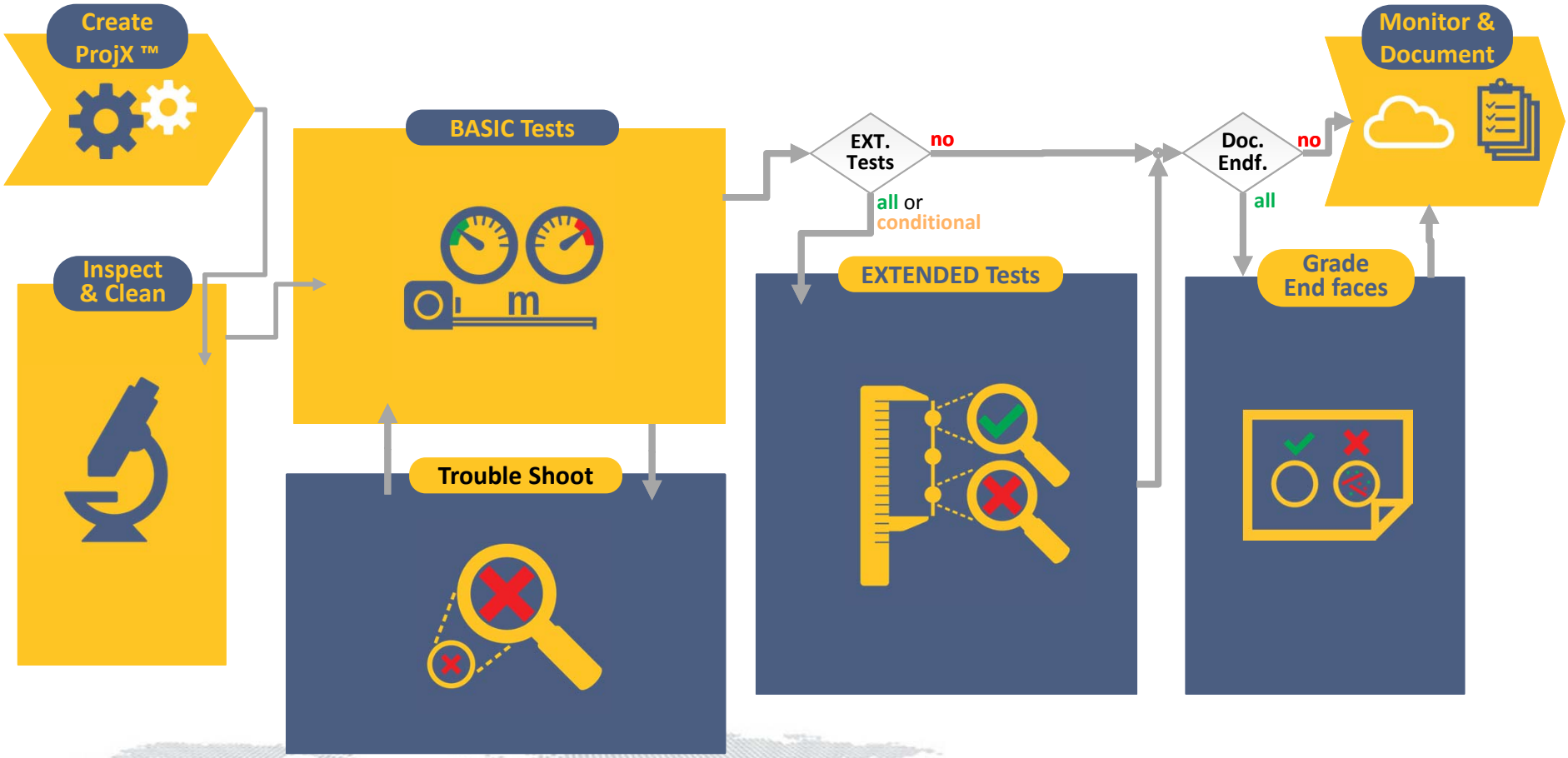


- Different light sources may have different launch conditions
- A EF compliant source reduces the error from 50% to 10%

Encircled Flux

Why ?	How ?
Normative Requirement • ANSI/TIA-526-14-B • ISO 1180 → ISO/IEC 14763-3 Ed.1 62 • EN 50173 → IEC IEC 61280-4-2	

If BASIC Tests FAIL …
Step 3B: Trouble Shoot



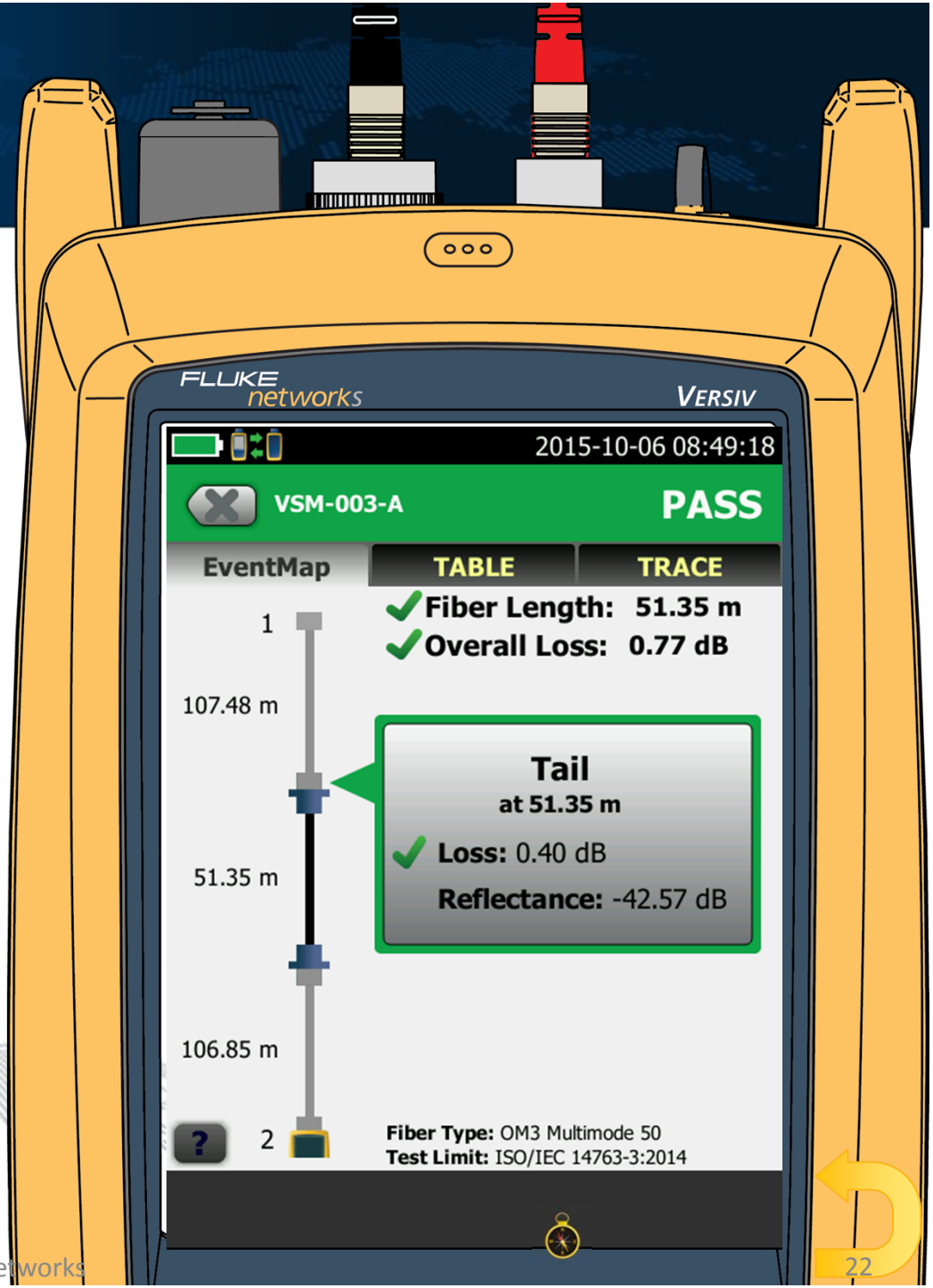
…Optional / Conditional Testing

800+ Installers VOCs:
Top eight problems (hours wasted)

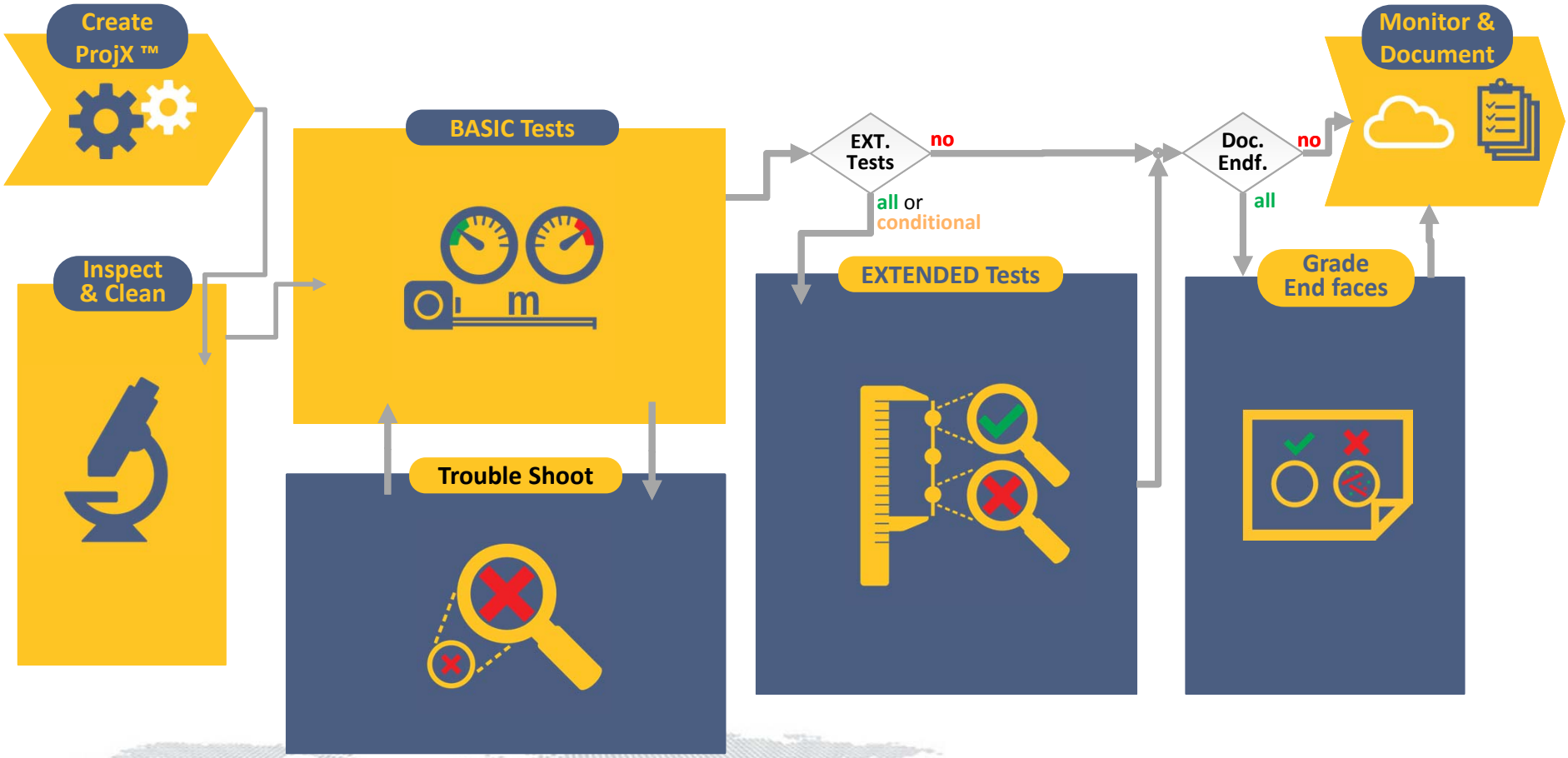
WRONG COPPER LIMIT	4.3	NEGATIVE LOSS	2.8
INCORRECT CABLE IDS	3.2	TROUBLESHOOT COPPER	2.7
CONSOLIDATING RESULTS	3.1		
SETTING UP COPPER TEST	2.9		
EVALUATING OTDR TRACE	2.9		
WRONG FIBER LIMIT	2.8		

OTDRs are not only for "Gurus"

- Event Maps simplify the presentation
- Overall (Link) limits complement component limits
- Launch & Tail fibers are automatically excluded



Step 4: Extended Test

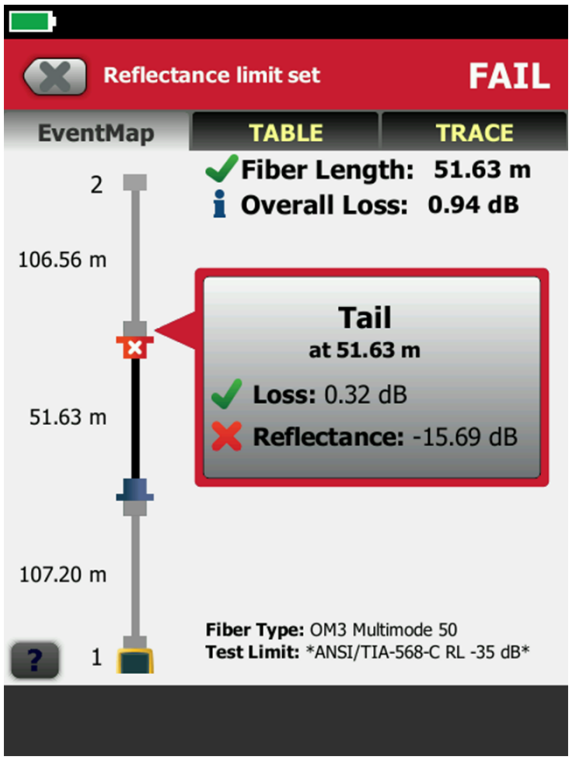


…Optional / Conditional Testing

Why EXTENDED Testing ?

- Identify, locate and eliminate <u>unnecessary</u> bottlenecks in otherwise compliant links
  - Further increase performance margin
- Identify connectors with excessive reflectance
- Document the state of the installation

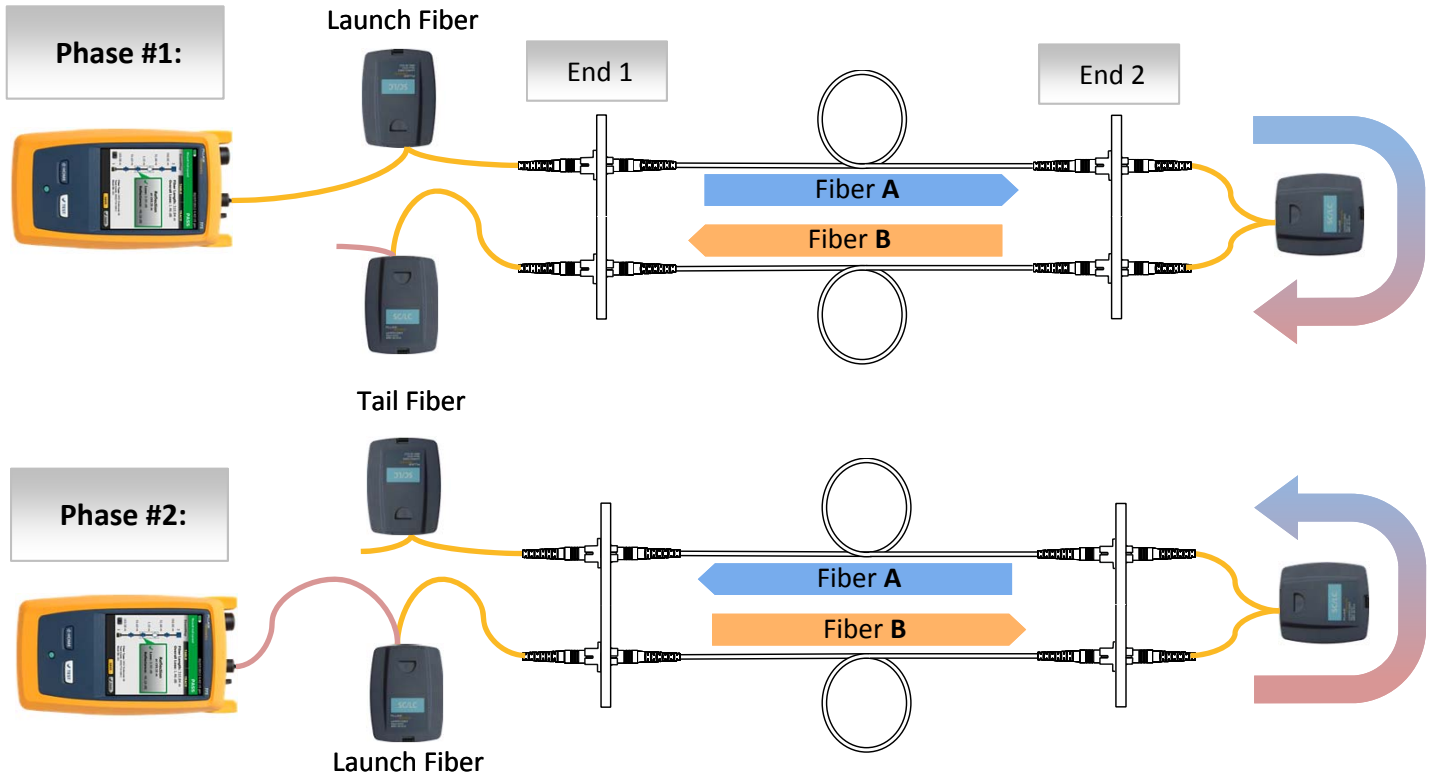
- Bi-Directional testing and averaging is <u>essential</u>



Testing with a SMART Loop

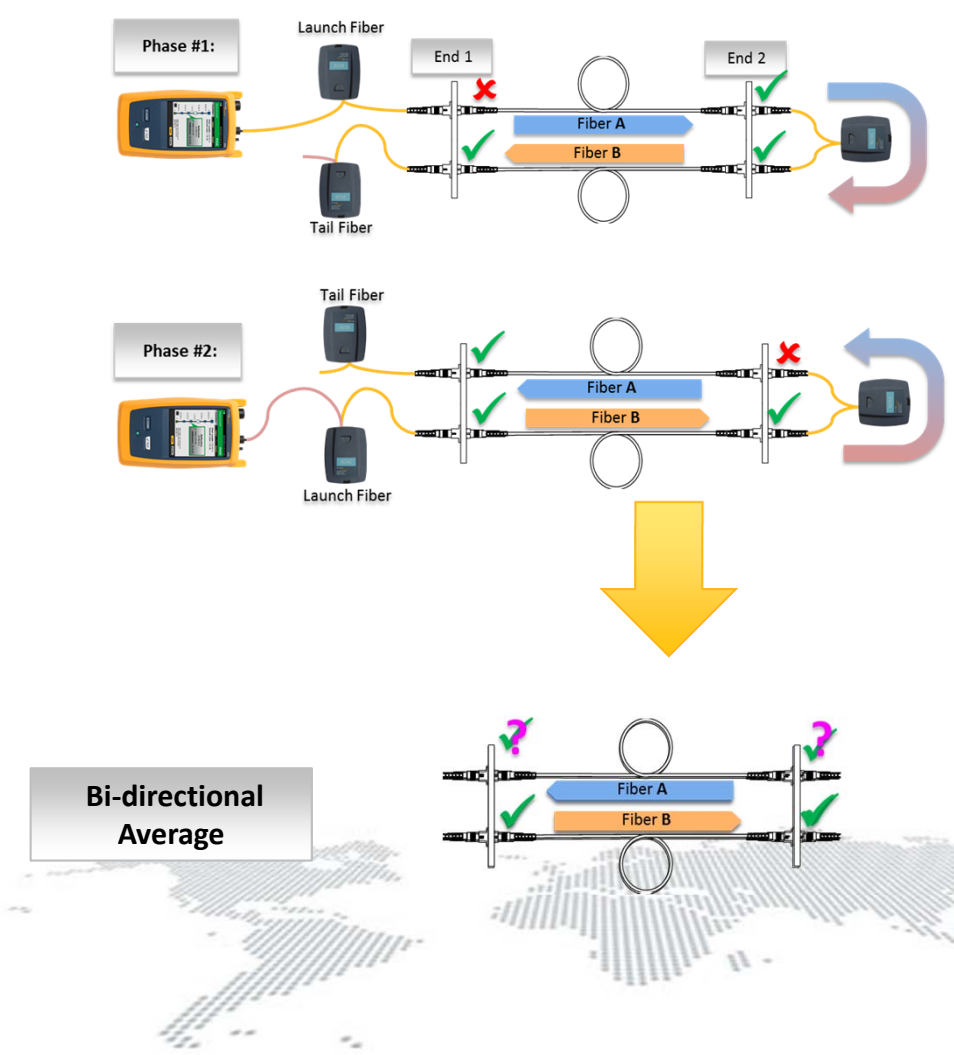
- > 9 out of 10 OTDR tests are performed incorrectly. The list of reasons is long
  - No Bi-Directional test and/or averaging
  - No tail fiber
  - Incorrect handling of launch and tail fiber
  - Adaption with hybrid cords
  - etc.
- A SMART Loop concepts forces the user to perform the test correctly
- Multiple remote loops support operation by 1 technician

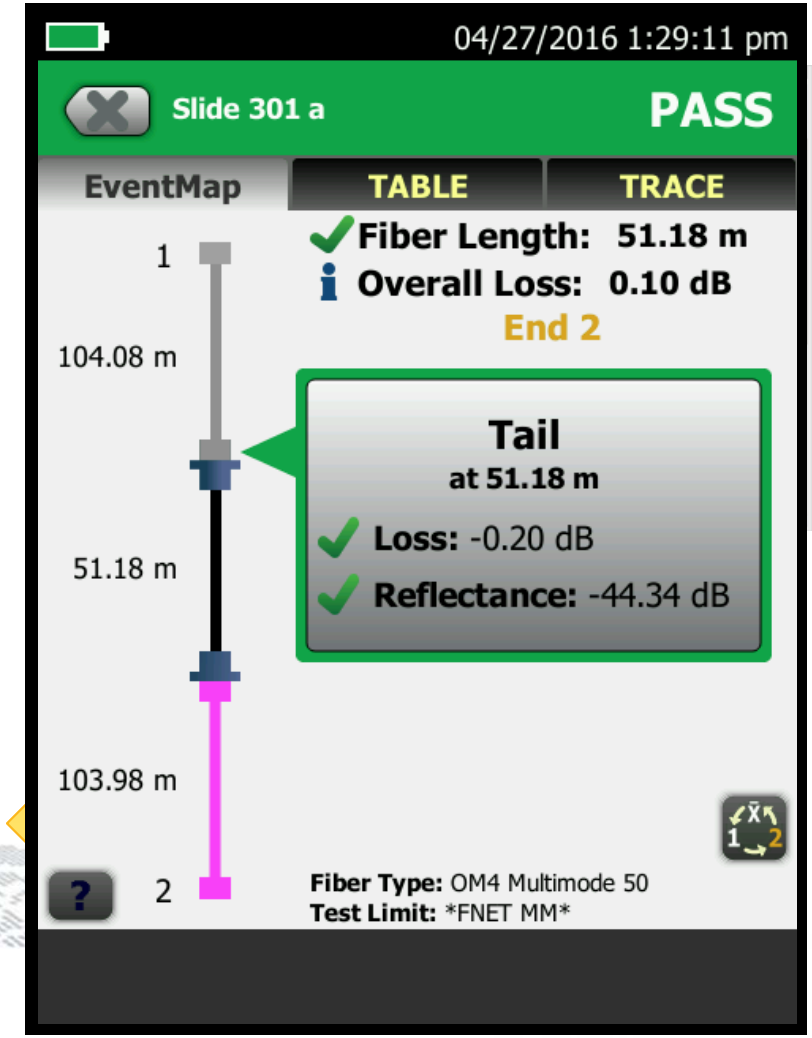
ACCELERATED EXTENDED Testing with a SMART Loop



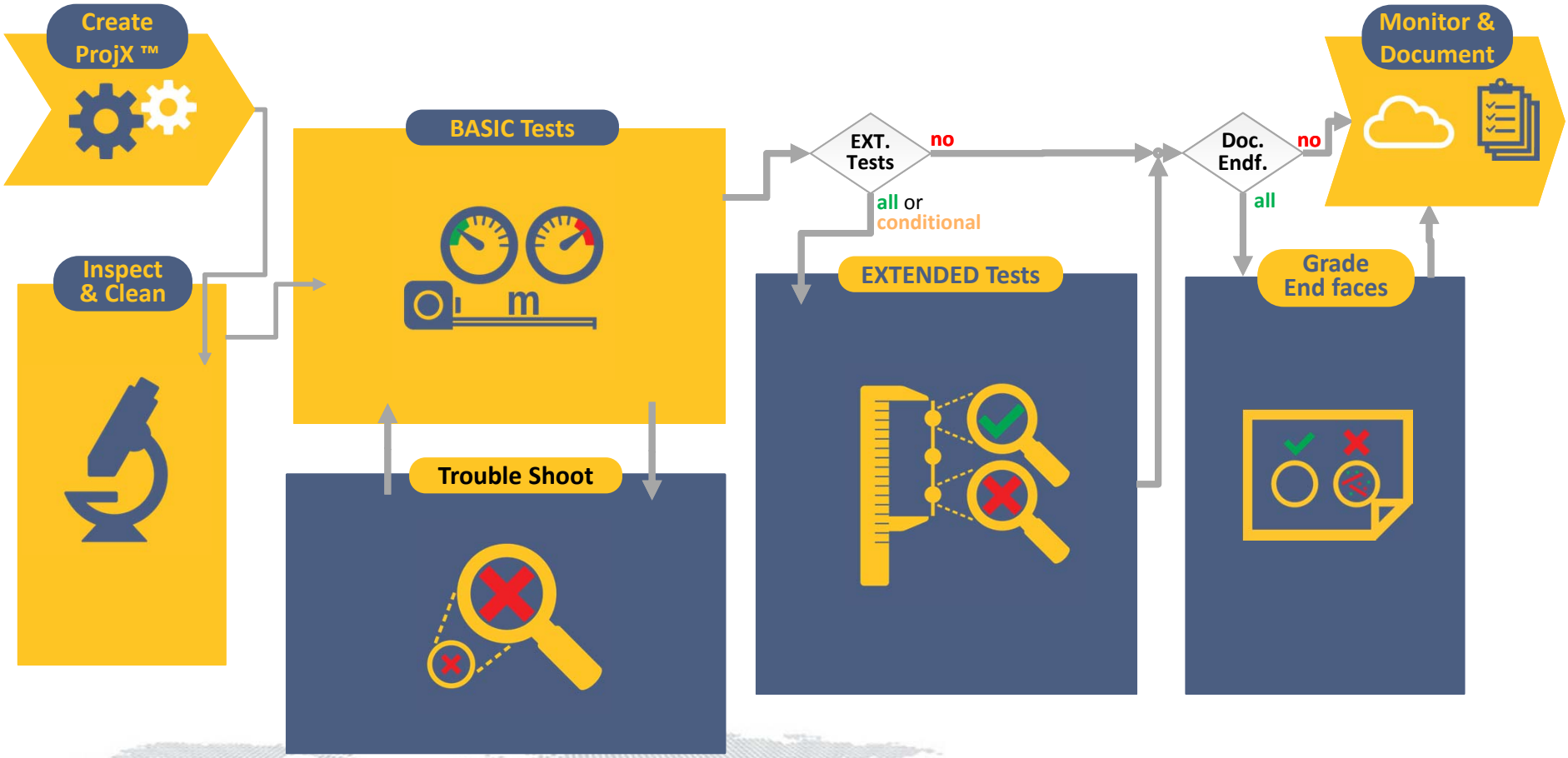
- A built in experts verifies the integrity of the test setup
- The testing time reduced by > 50%

Internal Bi-Directional Averaging



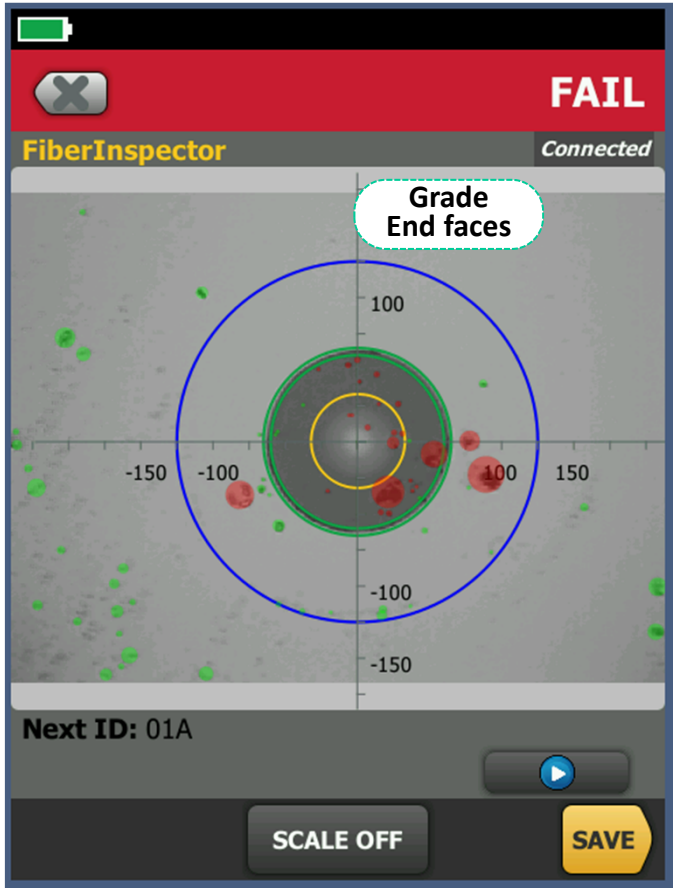


Step 5: Fiber End Face Grading & Documentation

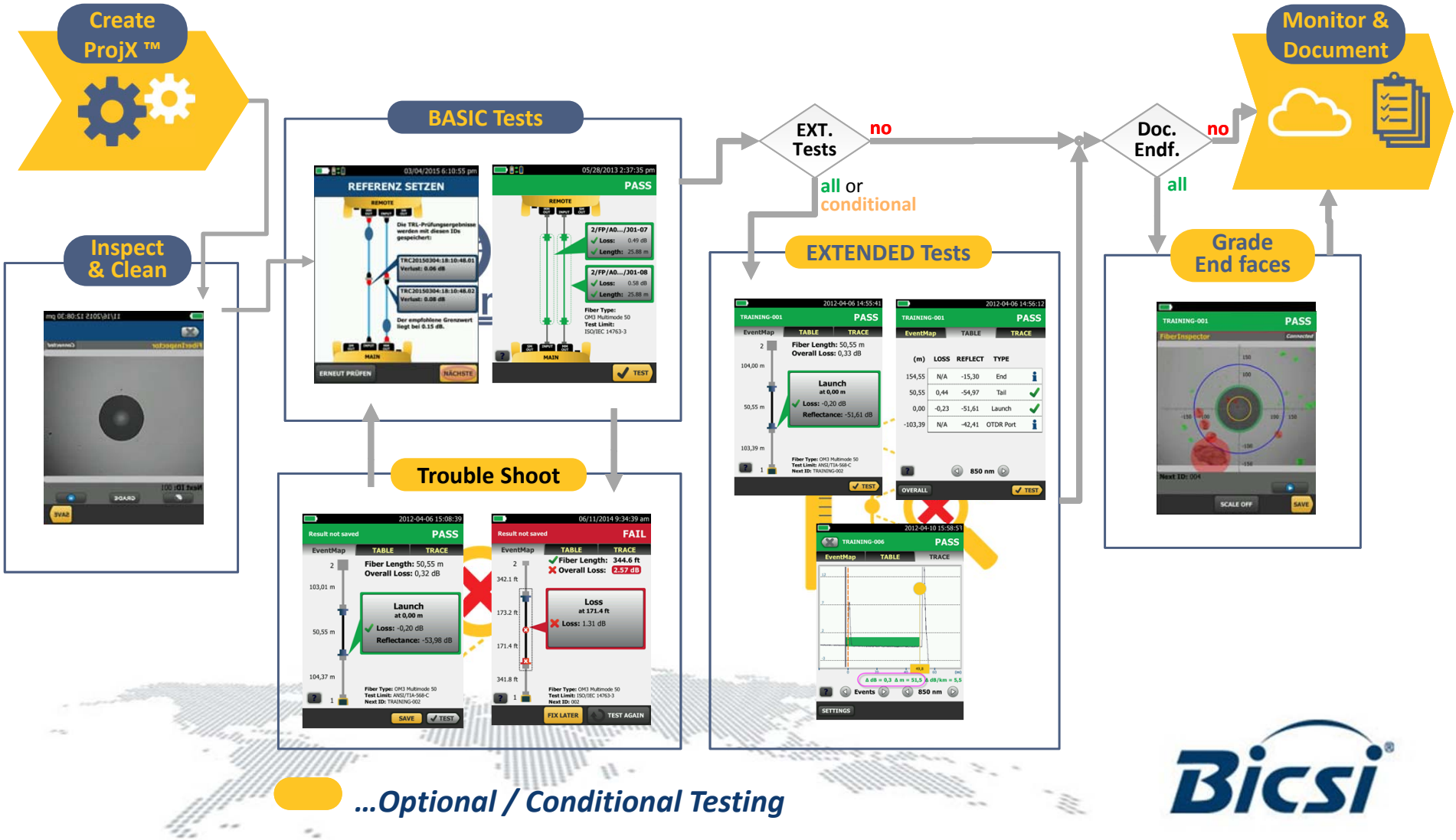


Grade & Document

- Without inspection equipment, you will never know if the connector is clean or not
- Even with inspection equipment, there are arguments as to what is acceptable for a fiber connector
- IEC 61300-3-35 defines levels of acceptable scratches and debris on the end faces of fiber connectors
- Automated field inspection is something to consider
- Images can be stored and made part of the documentation



Fiber Testing Best Practices



Data Centre vs. Commercial Building Cabling Infrastructure
Differences affecting test regimes

Larger number of links

- Testing time
- Consolidation
- Labeling

Larger share of fiber vs. copper

"Zoned" Data Centers
Low channel loss budgets
Low loss connectors

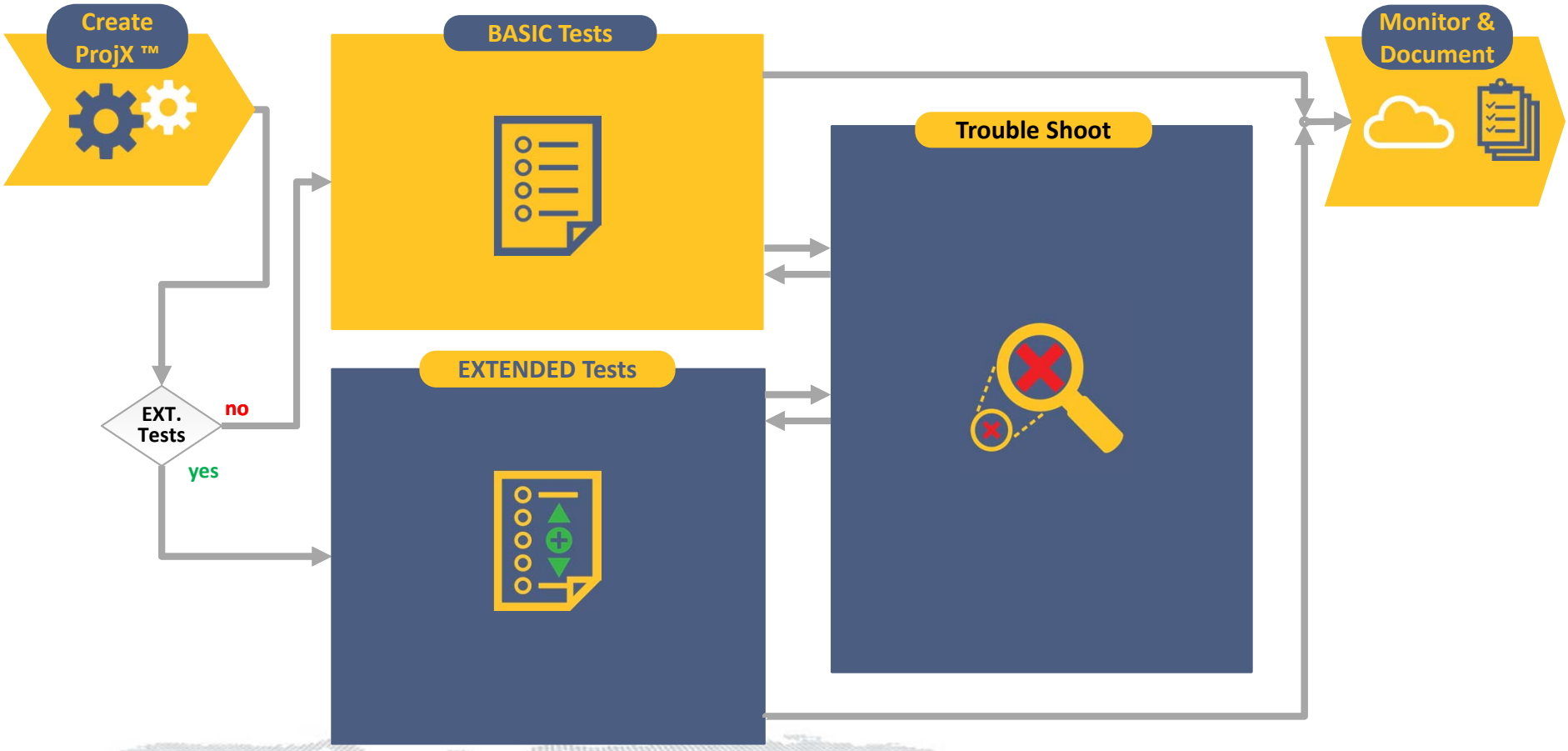
- Little room for measurement error

Copper testing in the Data Centre

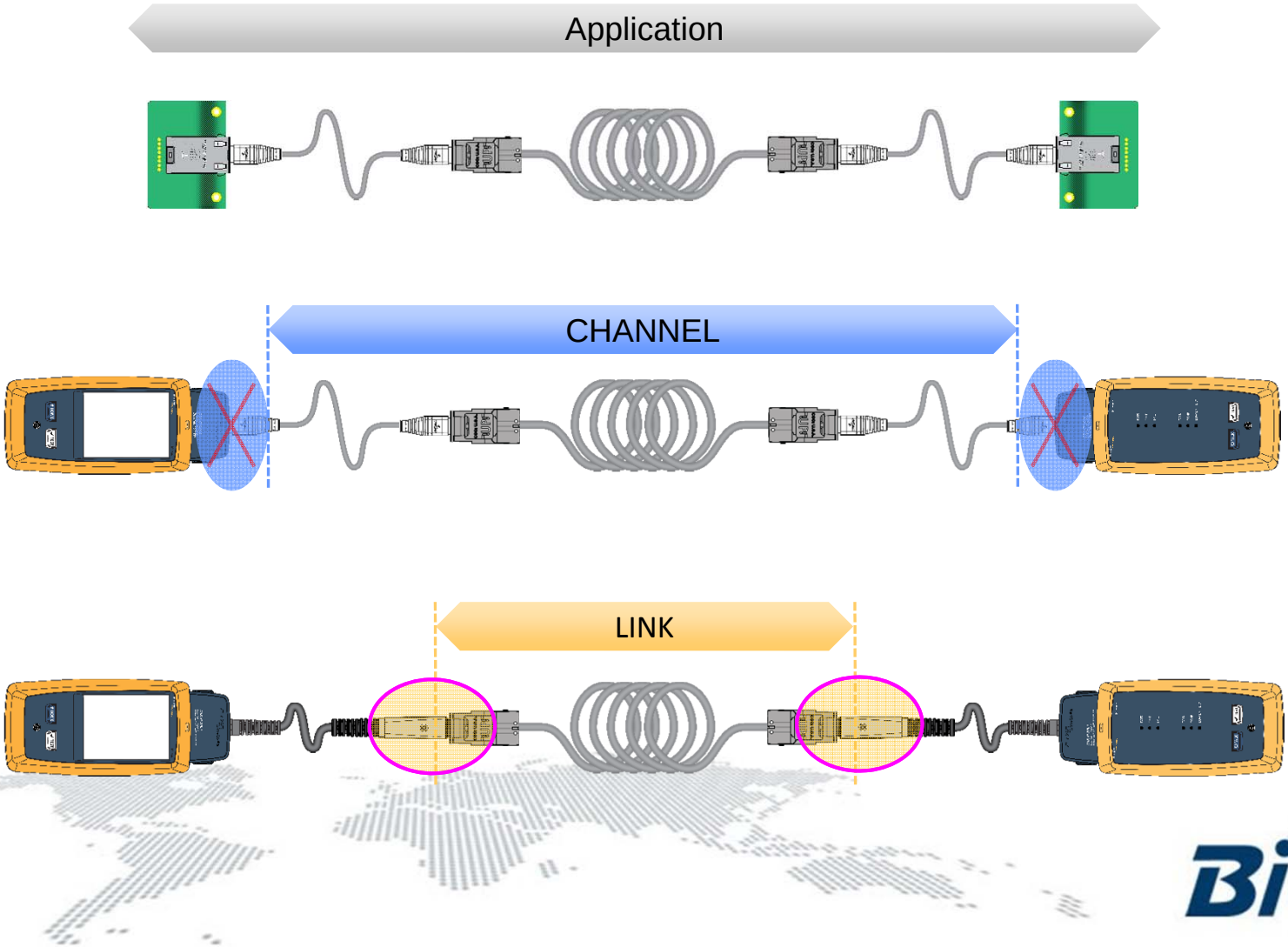
10GBASE-T / Cat.6_A dominant
Shielded systems
Future Cat.8 systems

- An Extended Test Regime is beneficial

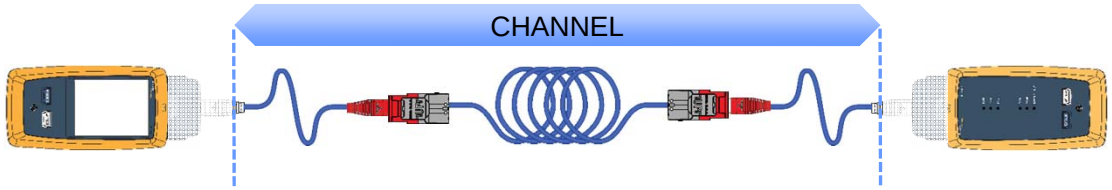
Step 1A: Basic (Minimum) Test Regime



Test Interfaces & Reference Planes

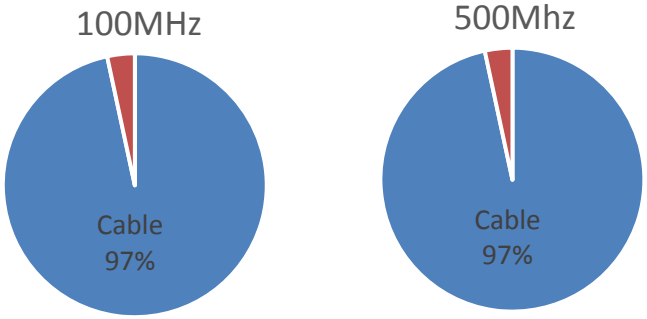


What Limits The Bandwidth more … Connectors or Cable ?

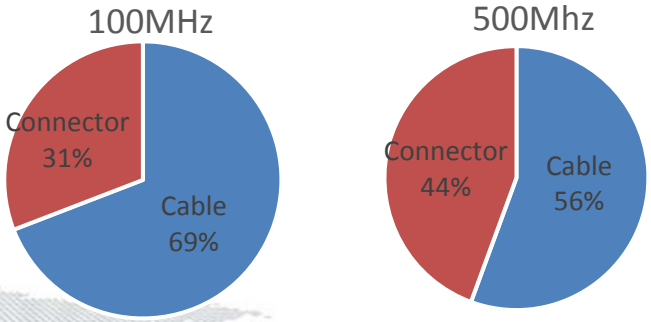


Example: 30m Link

- Insertion Loss (IL)



- Near End Cross Talk (NEXT)



…An inch at either end affects results noticeable

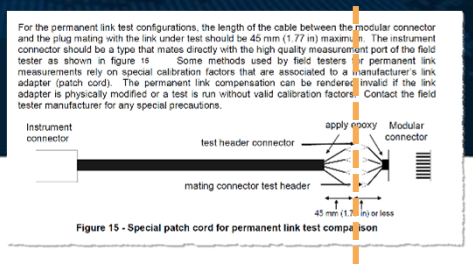
What makes a Cat.5e, -.6, -.6A, .-8.1 Connector work

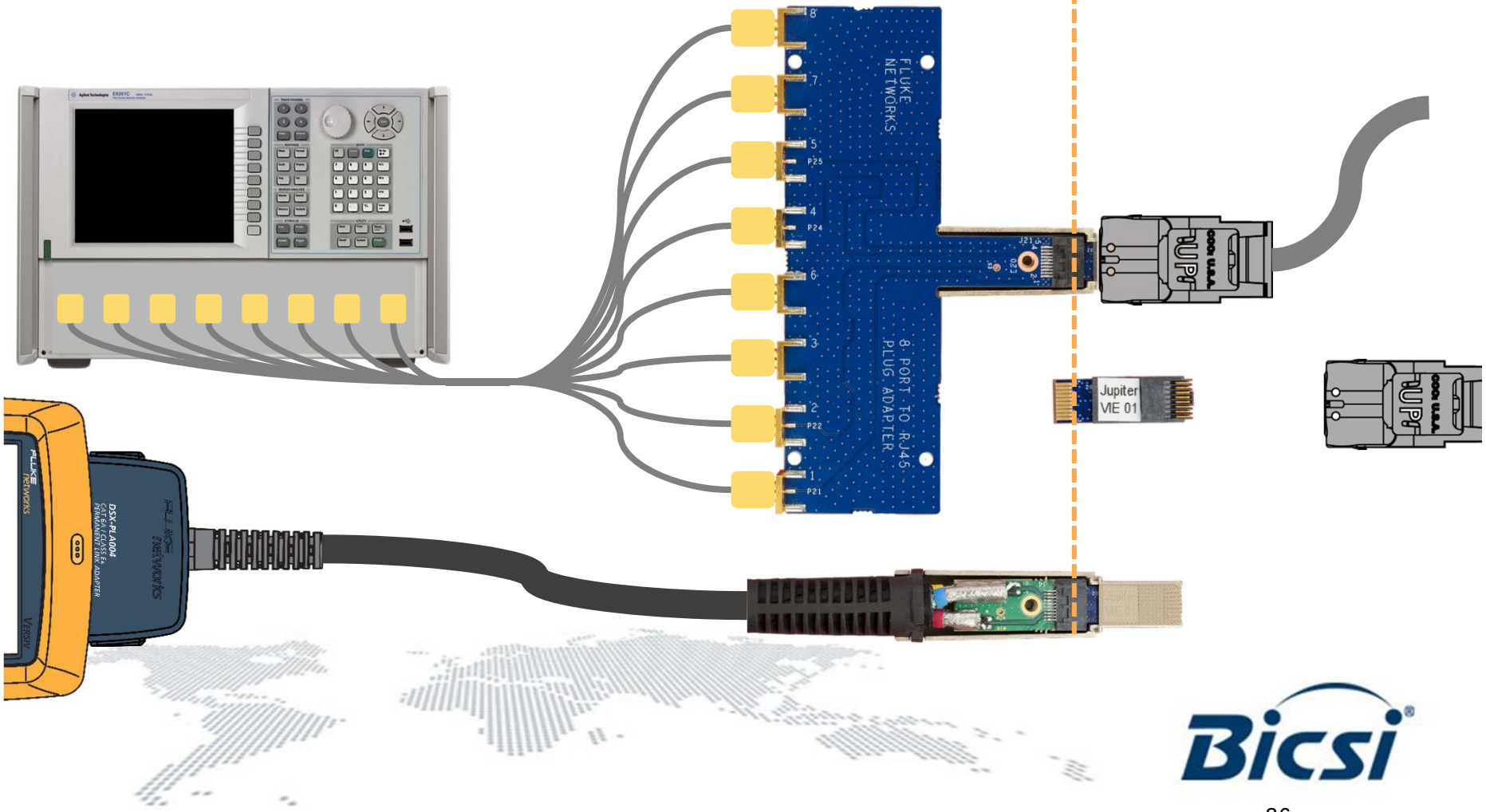
NEXT: 37dB …14mV

Cat.6, Cat.6A, Cat.8.1 …"Mated NEXT"
> 54dB … < 1.9mV

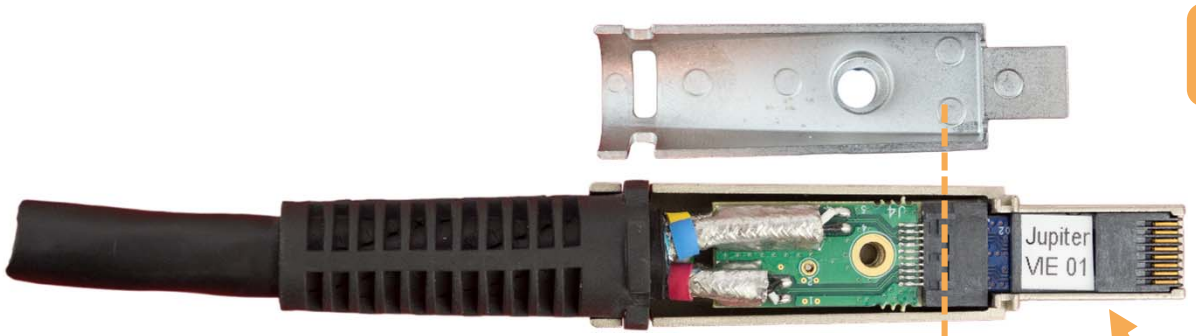
Note: Above is shown for the most critical pair 3,6/4,5 at 100MHz

Comparing PERMANENT LINK Results





Permanent Link Adapter with a "CENTERED" Test Plug for the „Heavy Duty Field Use"



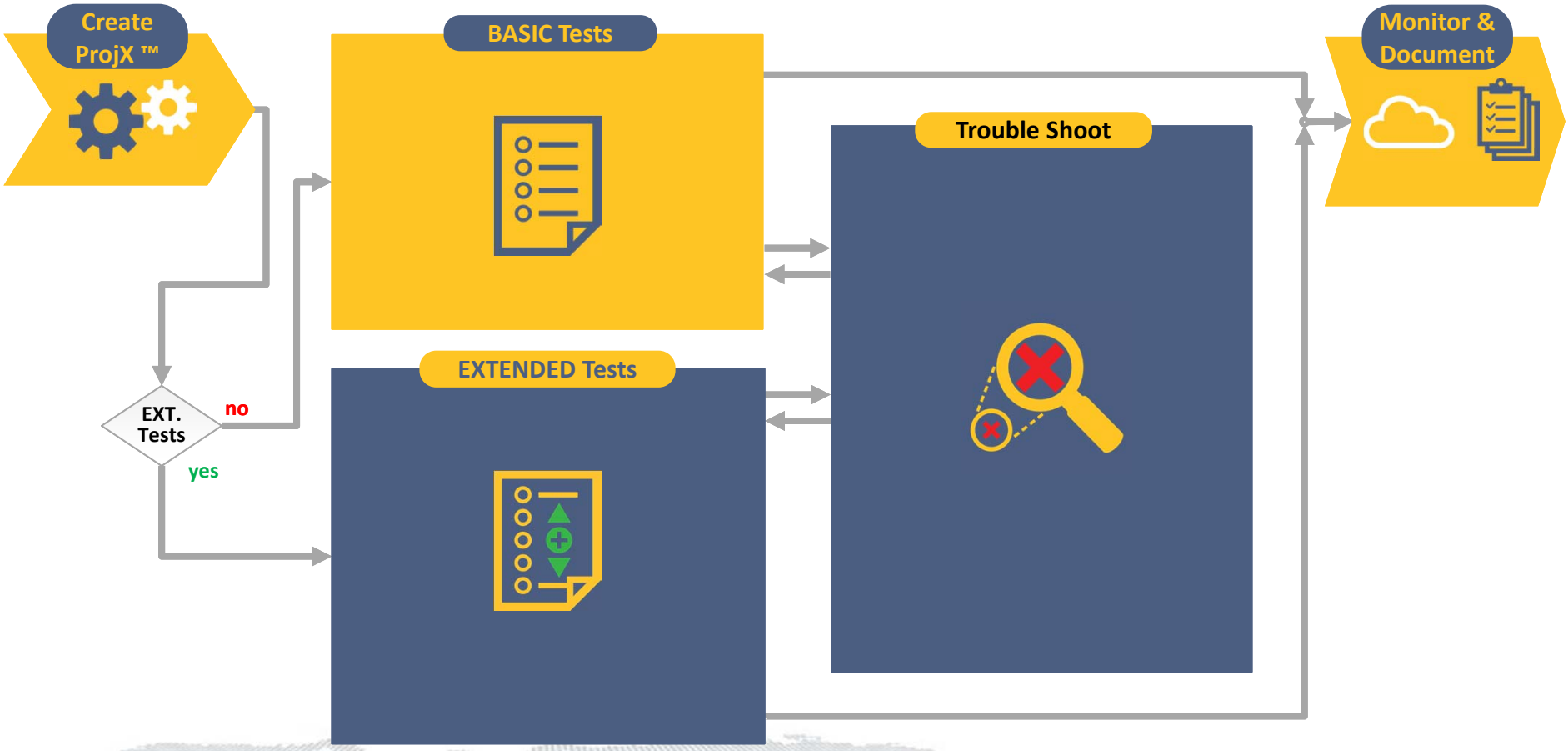
Consumable

Test Plug Adapter

Test Plug Interface (proprietary)

Test Plug "Centered Plug"

Step 1B: Extended Test Regime



Why EXTENDED Testing ?

	Copper Certification to ISO/IEC 11801	
	Reference Conformance Testing	Installation Conformance Testing
Wire Map	✓	✓
Length	✓	
Propagation Delay	✓	✓
Delay Skew	✓	✓
DC Loop Resistance	✓	✓
DC Resistance Unbalance	✓	
Insertion Loss	✓	✓
NEXT, PS NEXT	✓	✓
Return Loss	✓	✓
ACR-N, PS ACR-N	✓	✓
ACR-F, PS ACR-F	✓	✓
TCL, ELTCTL	✓	
PS ANEXT, PS AACR-F [1)]	✓	✓

1) Class E_A only

Why EXTENDED Testing ?

ADVANCING GLOBAL COMMUNICATIONS

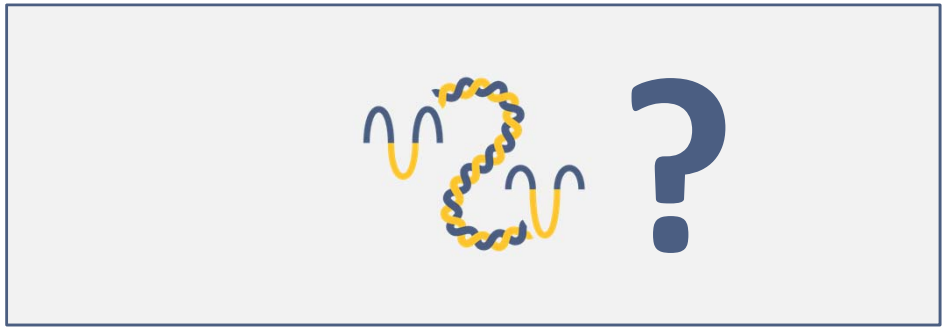
	Copper Certification	
	ANSI/TIA-568-C.2 (Cabling System)	ANSI/TIA-1152 (Minimum Field Test)
Wire Map	✓	✓
Length	✓	✓
Propagation Delay	✓	✓
Delay Skew	✓	✓
DC Loop Resistance	✓	
DC Resistance Unbalance	✓	
Insertion Loss	✓	✓
NEXT, PS NEXT	✓	✓
Return Loss	✓	✓
ACR-F, PS ACR-F	✓	✓
TCL, ELTCTL	✓	
PS ANEXT, PS AACR-F [1)]	✓	✓

1) Category 6A only

BICSI

WHAT IF …

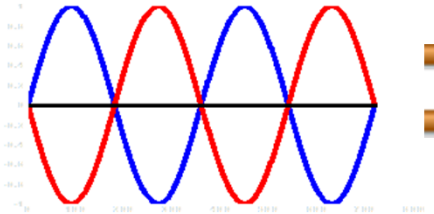
TCL / ELTCTL is not compliant



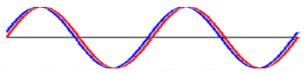
TCL (Transverse Conversion Loss)

- **T**ransverse **C**onversion **L**oss is the ratio (in dB) of a common-mode voltage measured on a wire pair relative to a differential-mode voltage applied to the same end of the pair. The TCL value shows you how well the impedances of the pair's conductors are balanced.

Differential Signal Applied



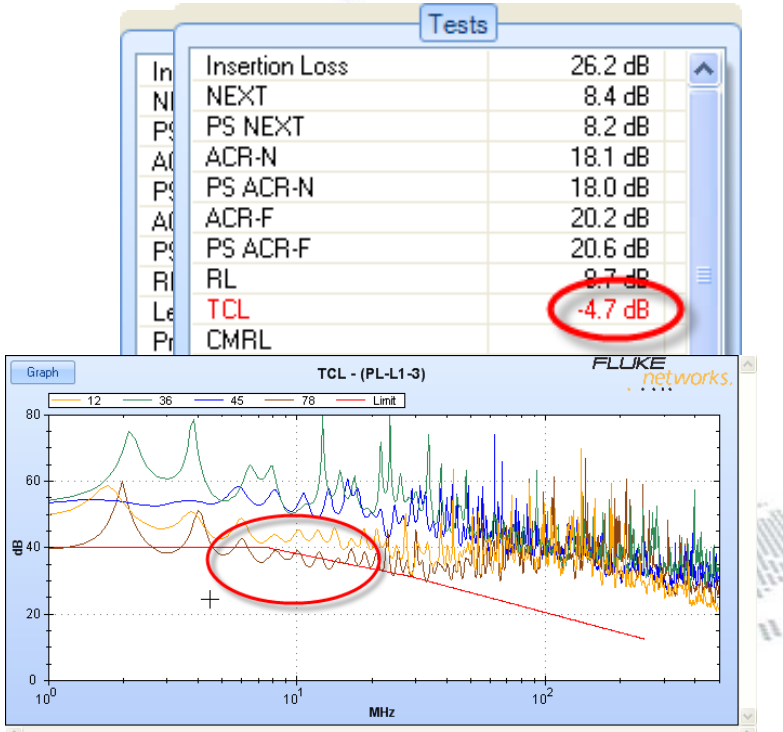
Common Mode Voltage Measured



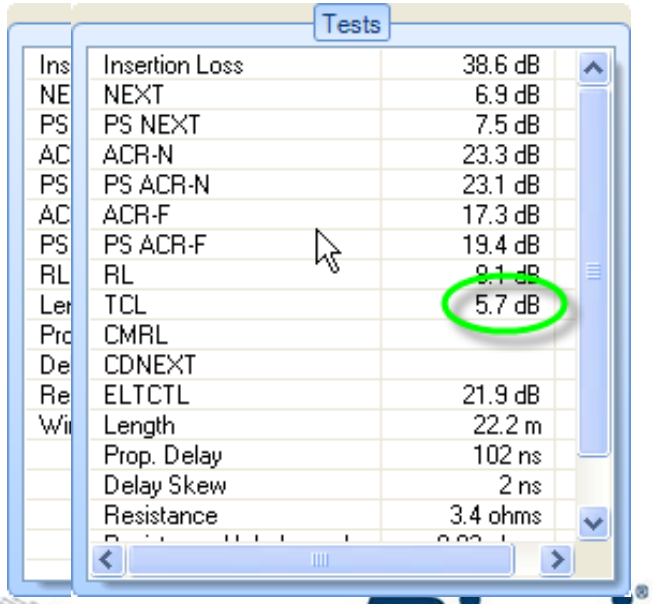
Mode Conversion – Real World Example
GOOD vs BAD Drum of Cable

- 18km cable of identical type was installed
- 30% of the links don't carry 1000BASE-T

Drum #1



Drum #2

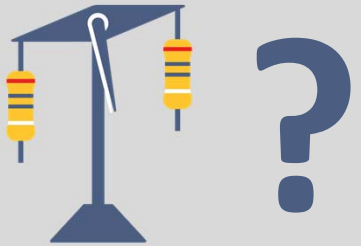


WHAT IF …

TCL / ELTCTL is not compliant

Even a legacy application like 1000Base-T may not work on an otherwise compliant Cat.6/6A system !

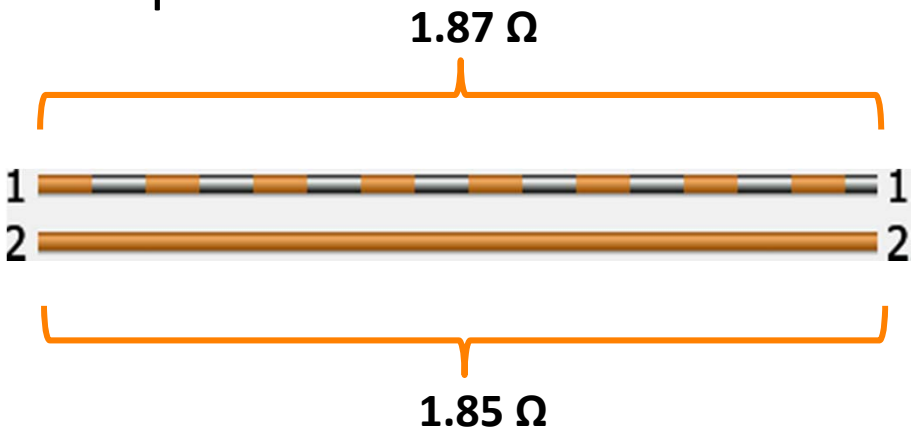
Resistive Unbalance is not compliant



Shield Integrity is not given

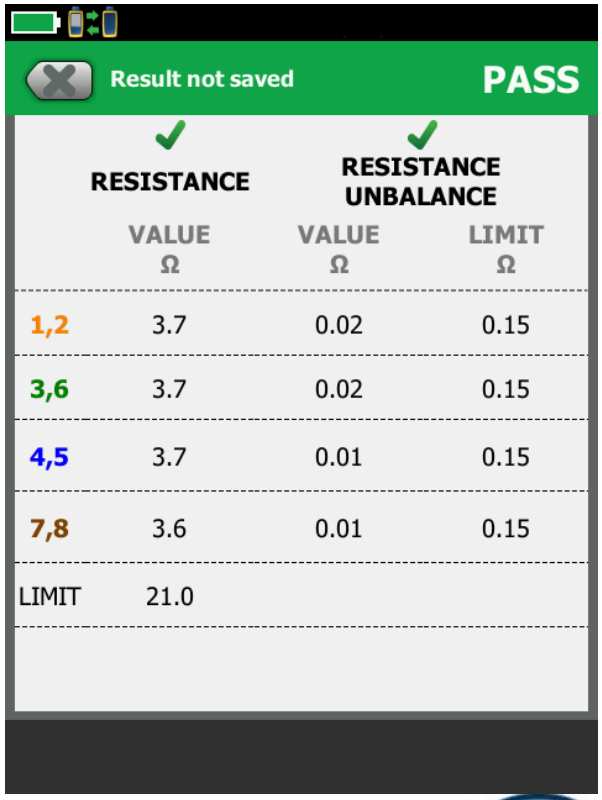
Resistance Unbalance

- Difference in Resistance between wires in the pair
- Example:

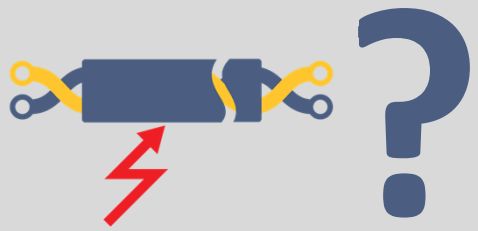


Resistance= 3.7 Ω

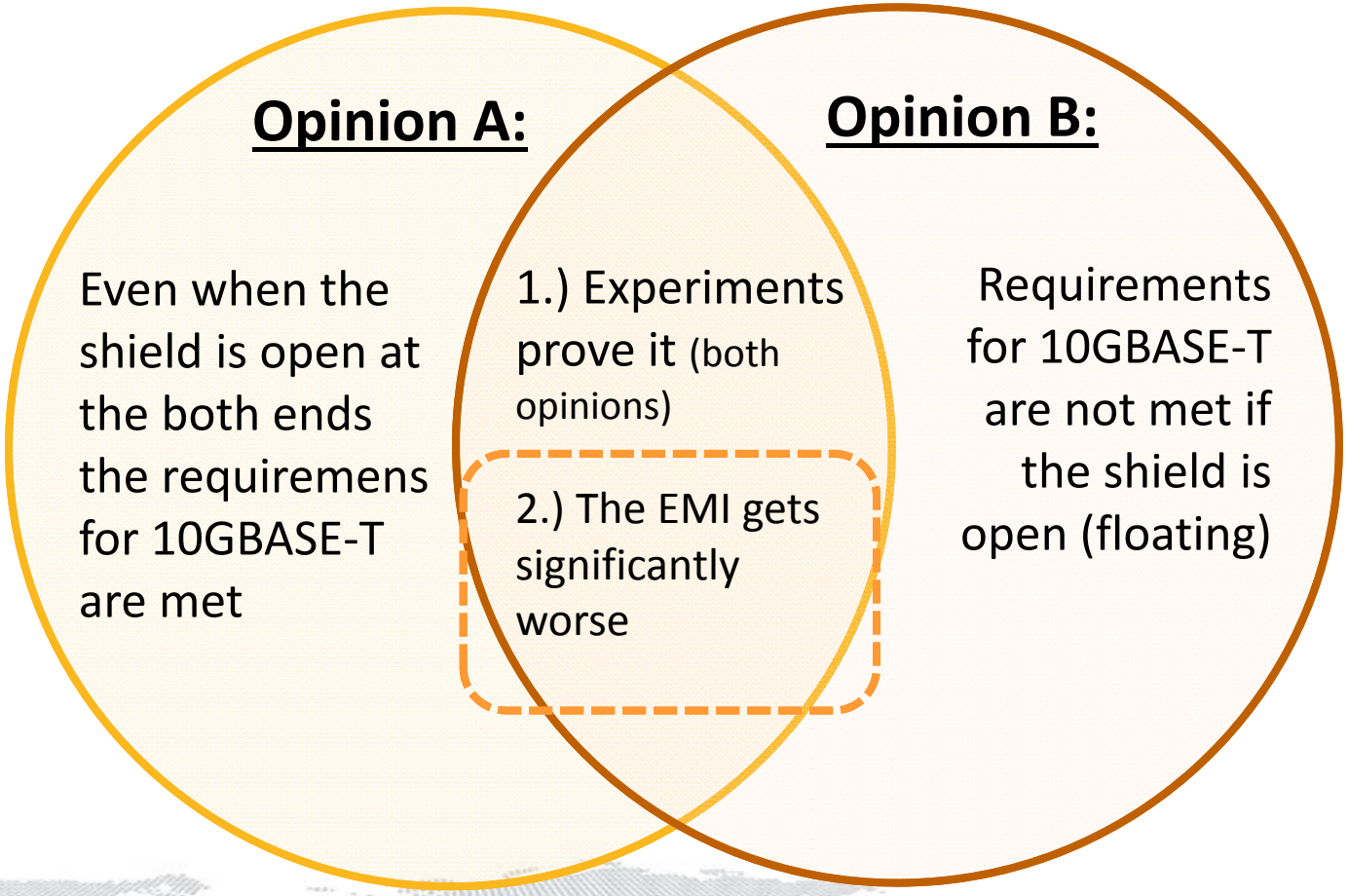
Resistance Unbalance = 0.02 Ω



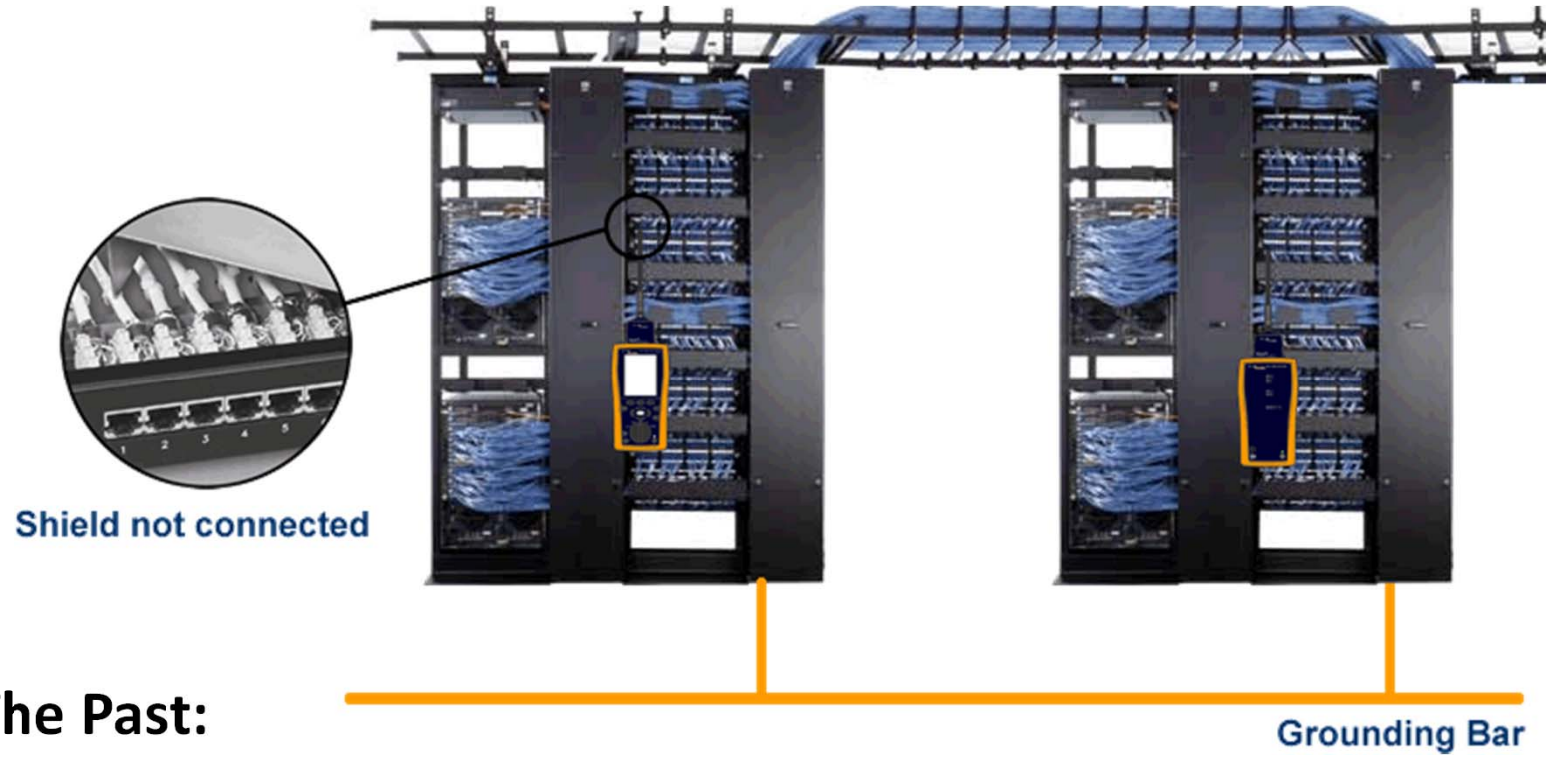
WHAT IF …

TCL / ELTCTL is not compliant	**Even a legacy application like 1000Base-T may not work on an otherwise compliant Cat.6/6A system !**
Resistive Unbalance is not compliant	**POE operation is at risk during maximum load** **Poor contacts may further degrade over time**
Shield Integrity is not given	

Shield Integrity … Opinions



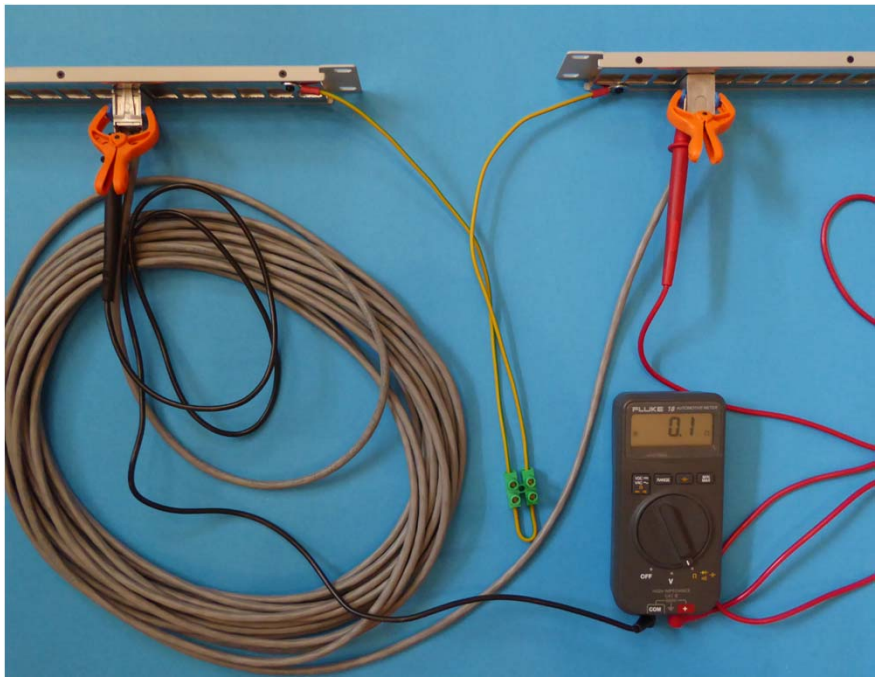
Shield Integrity

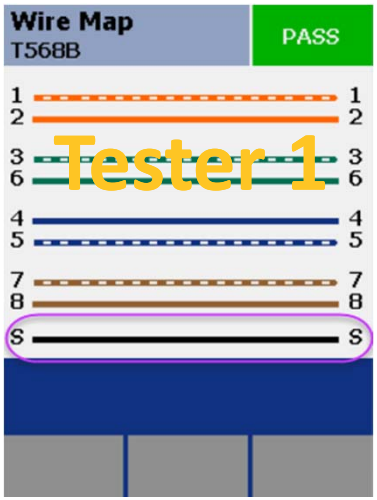


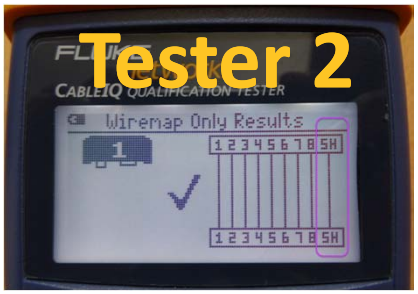
In The Past:

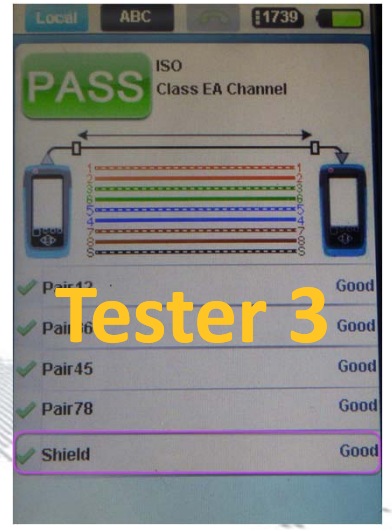
- Field testers could only verify that there is DC Continuity
- DC Continuity is given by grounding and earth
- Any open shields/ends could not be detected

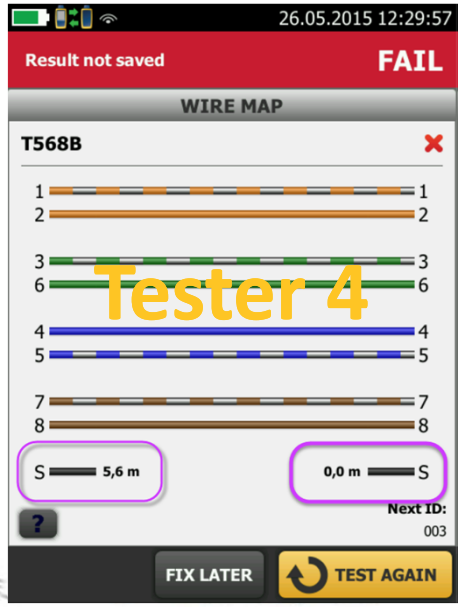
Let's test a UTP cable between shielded patch panels…







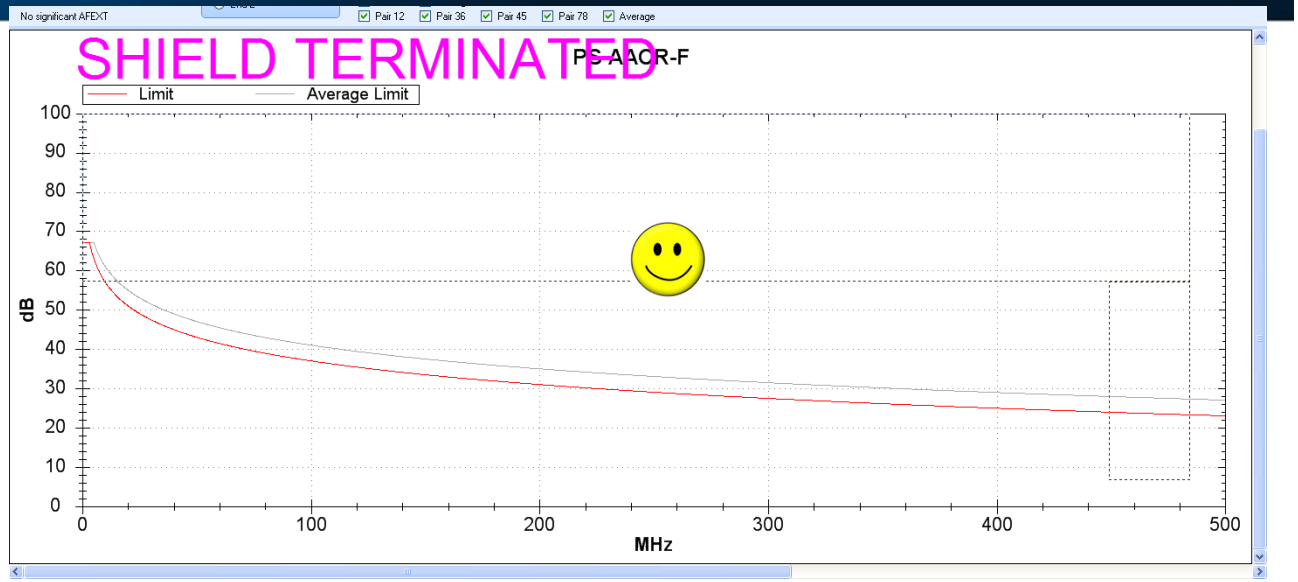




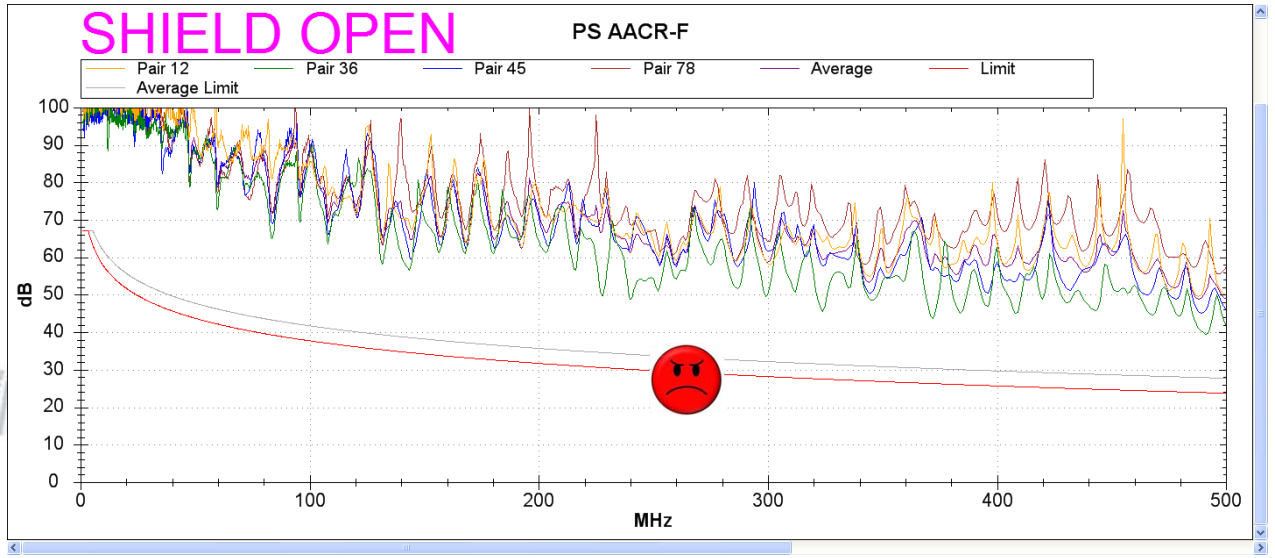
- Only 1 tester will detect the lack of a shield
- NOTE: In special applications it may be essential to verify that the shield is open on a defined end

Example Alien Crosstalk: Shield Open / Connected

- For this high end cable the Alien Crosstalk is below the testers significance level



- The same cable show a > 20dB worse Alien Crosstalk
- A major portion of the EMI (Electromagnetic Immunity) was lost

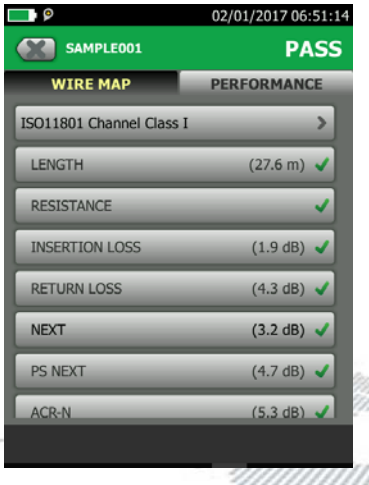


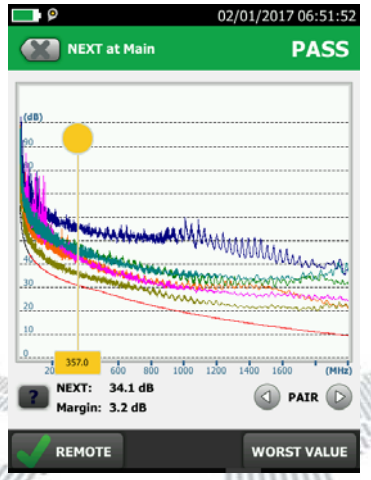
WHAT IF …

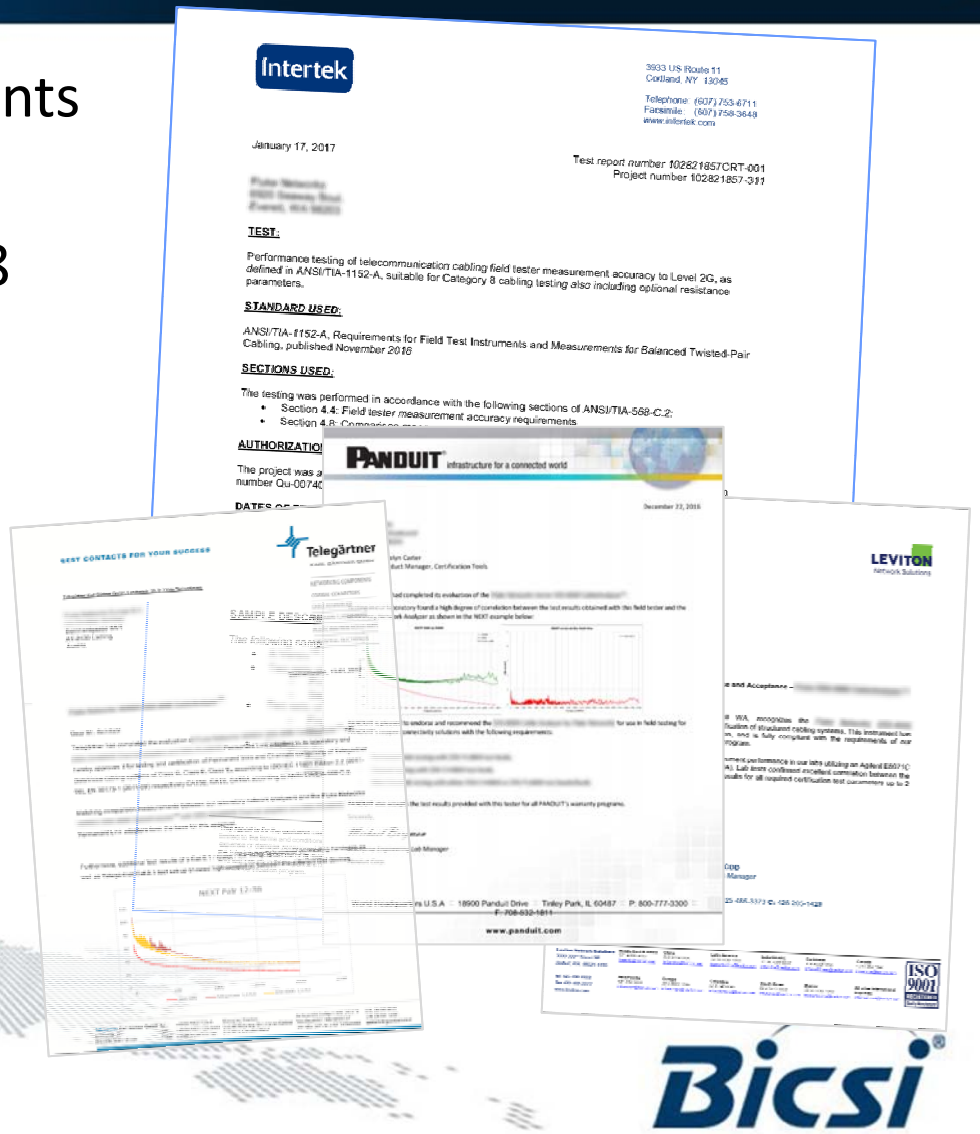
TCL / ELTCTL is not compliant	**Even a legacy application like 1000Base-T may not work on an otherwise compliant Cat.6/6A system !**
Resistive Unbalance is not compliant	**POE operation is at risk during maximum load** **Poor contacts may further degrade over time**
Shield Integrity is not given	**10 or 20 dB of electromagnetic immunity (EMI) is lost.** **Alien Crosstalk may become non-compliant**

Standards Compliant Cat.8 Field Testing…

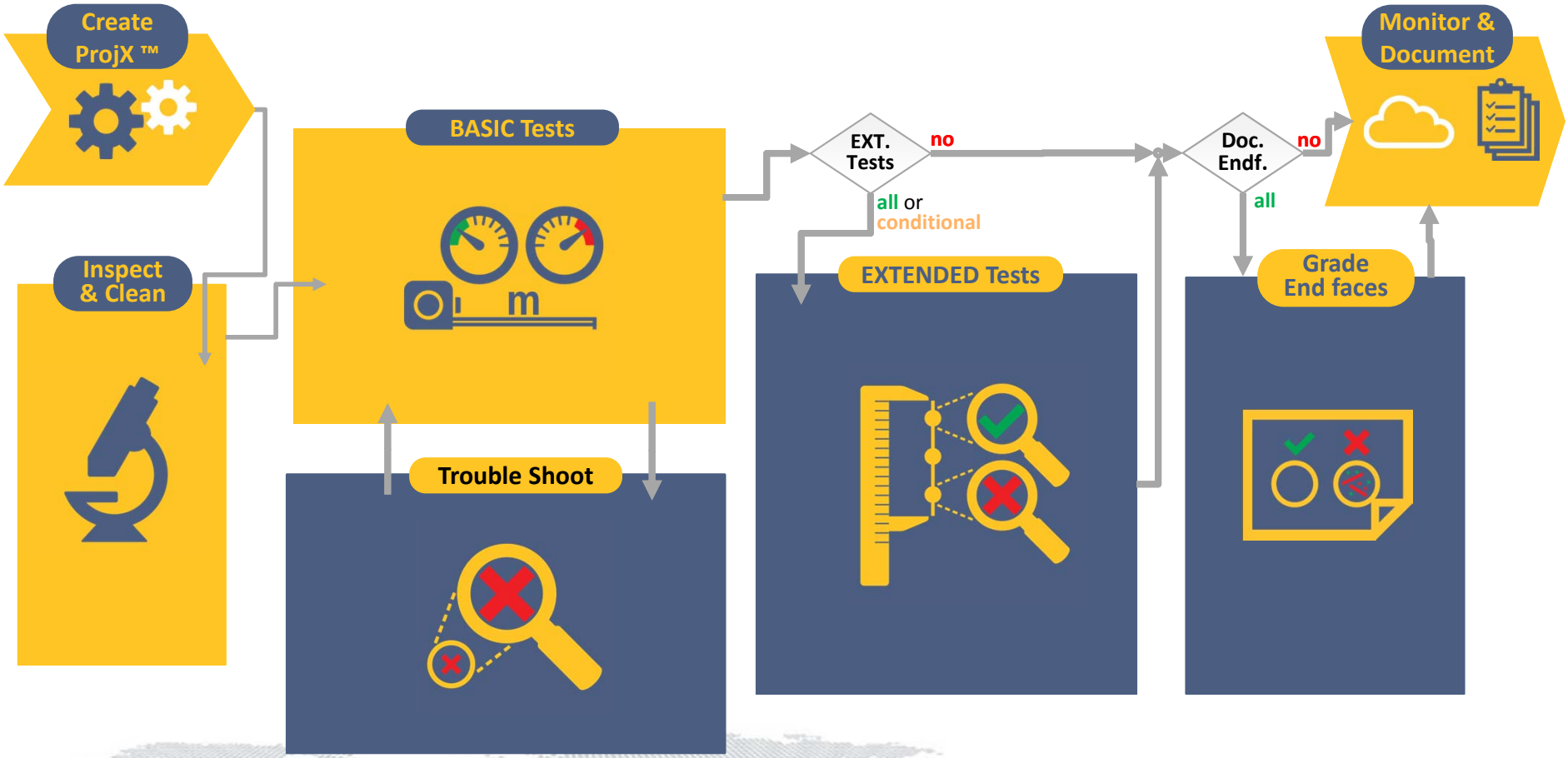
- Standards defined requirements for field testers
- Manufacturer endorsed Cat.8 Field Testers
- Testing Cat.8 links is no more complex the Cat.6_A





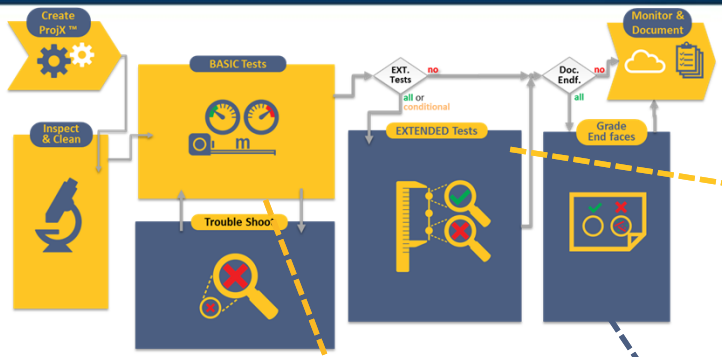


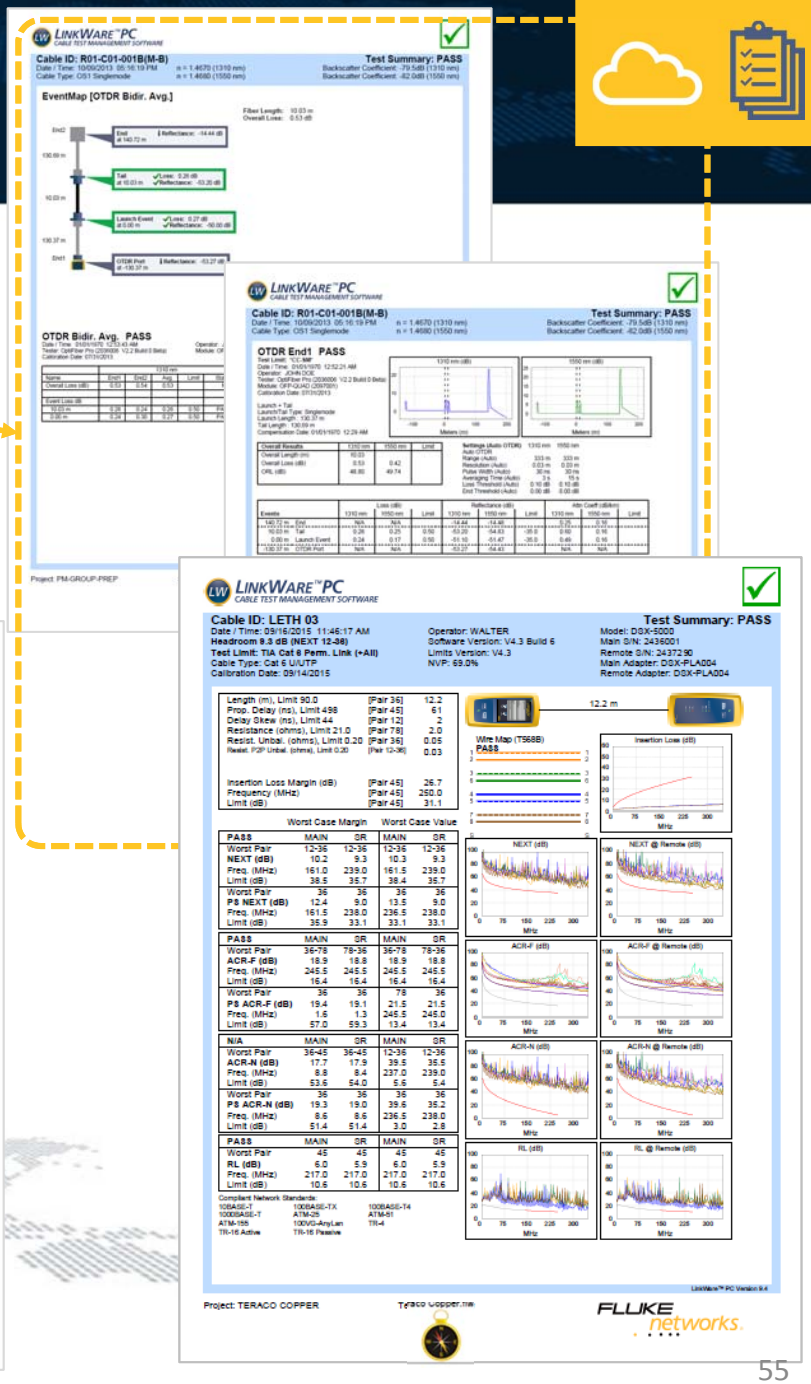
Step 6: Project Monitoring & Documentation



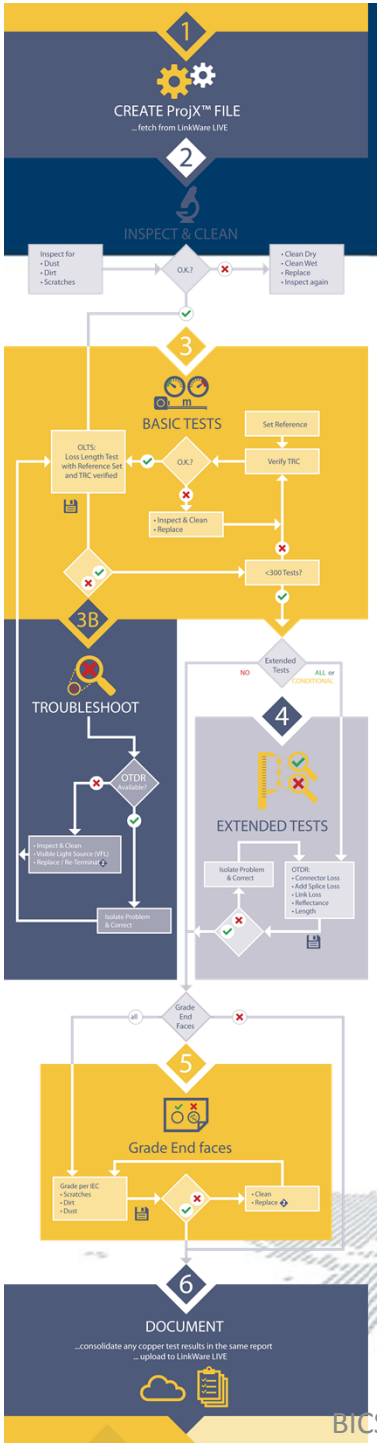
Monitoring & Documenation

Documentation





Conclusio



Qualified instruments and personnel paired with an efficient work flow ensures …

- “Next Generation Readiness” by maximizing performance margins
- ensures a profitable certification of fiber optic or copper cabling systems

THANK YOU
FOR YOUR ATTENTION !

Questions?

Christian.Schillab@FlukeNetworks.com