

# 10G Network Qualifying

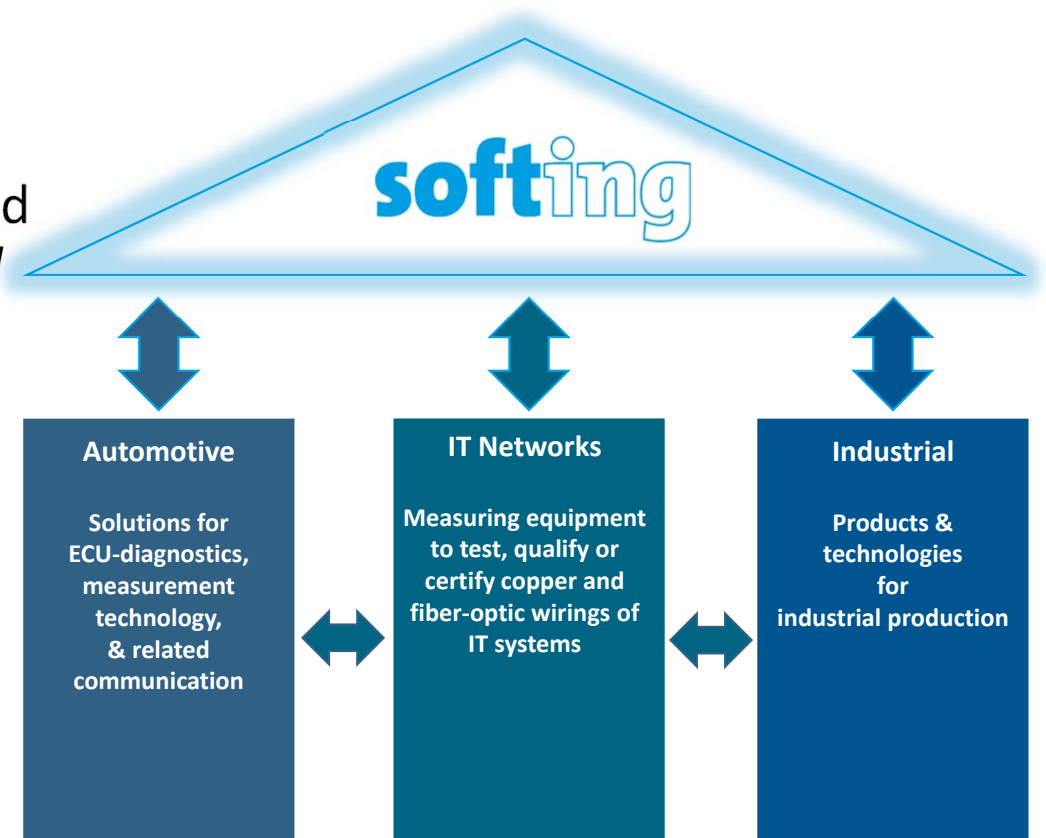
How to Test the True Speed Limit of Your Existing LAN

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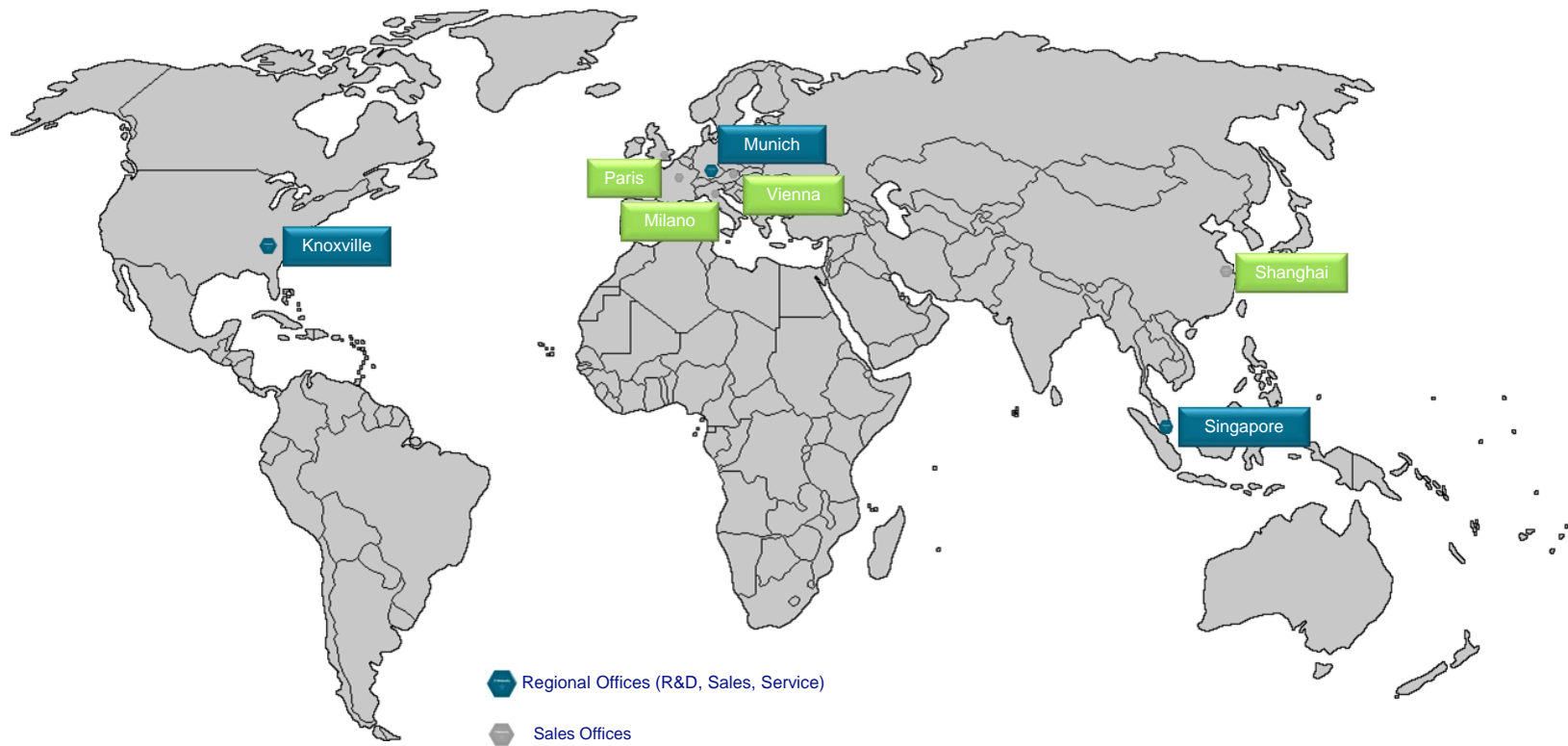


# Who we are

- Management holding run in accordance with the principles and values of a German *medium-sized* enterprise
- Headquartered in Haar near Munich, Germany
- Founded 1979
- Sales ~€80 million
- ~400 employees (annual average)



# Where we are

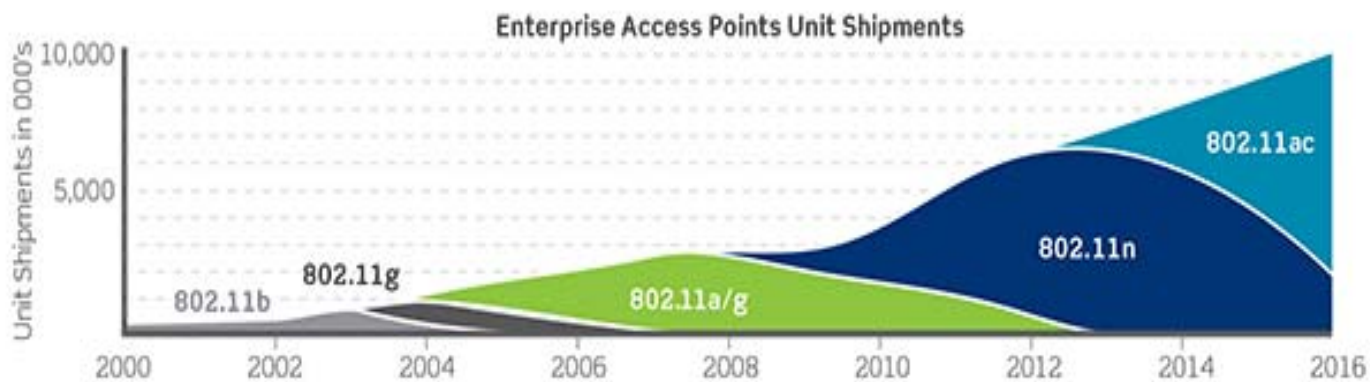


# The Demand in Speed

Everything needs to be faster and faster

# The Demand in Speed

- More and more mobile devices require more and more bandwidth
- Wireless accesspoints are following this evolution so everything is fine?



802.11ac up to 6,9GBit/s

802.11n up to 600MBit/s

802.11a/g up to 54MBit/s

Source: Dell'Oro Group

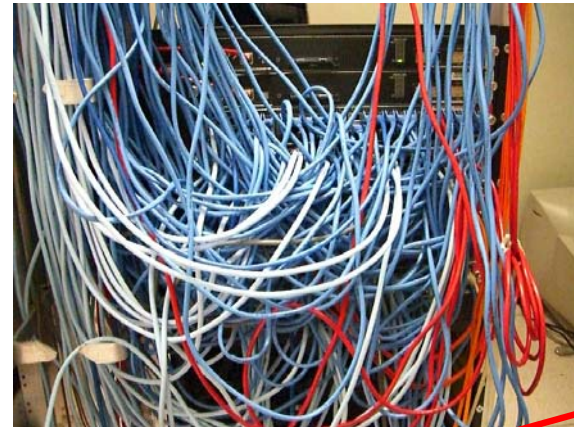
# The Bottleneck

There are two players in the game using technology from the late 90's.



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Easy to replace

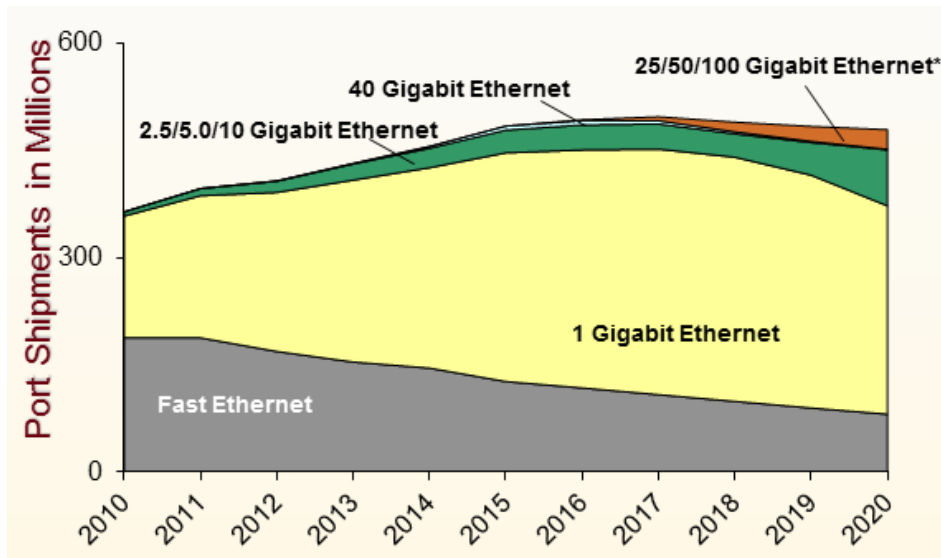


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Not so easy to replace

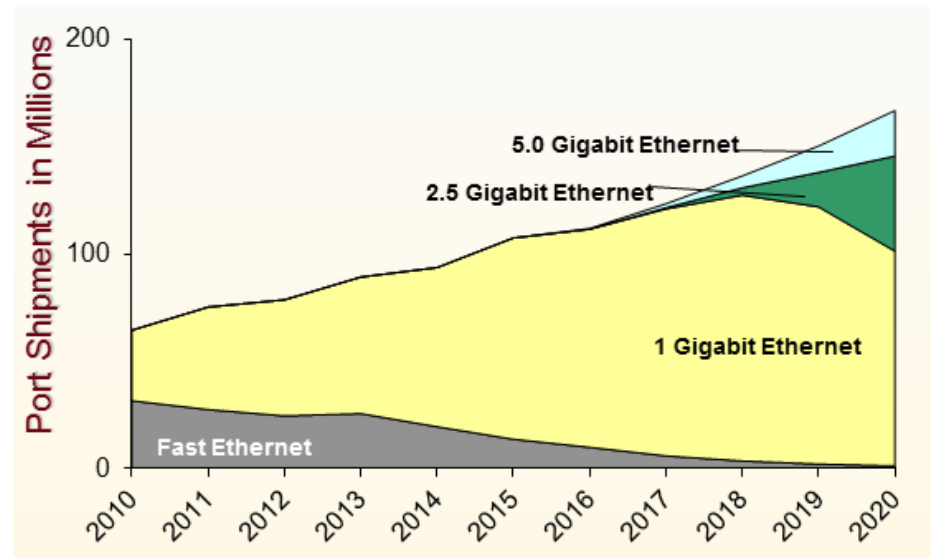
# Market Share of Switches Up to 10G

Switches total



Source: Dell'Oro Group 2016

PoE switches only

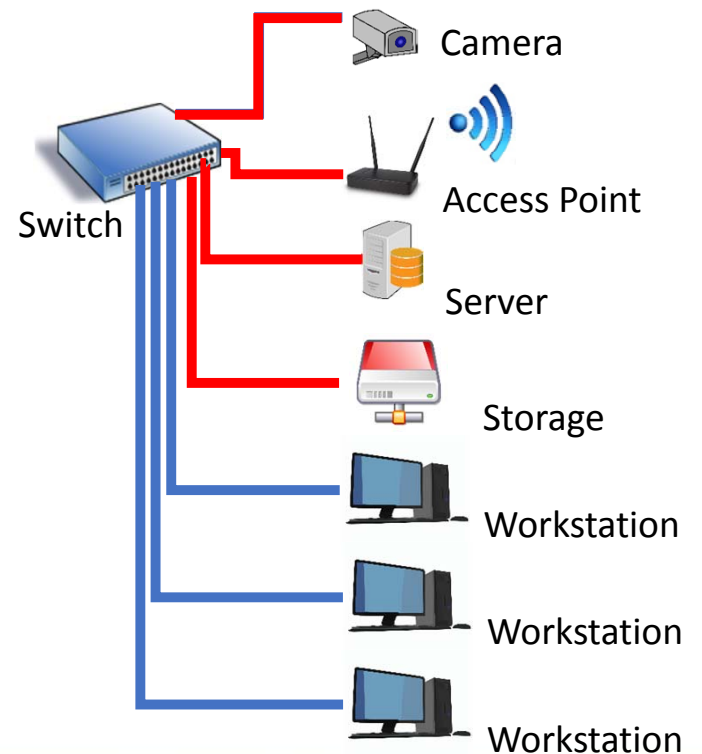


Source: Dell'Oro Group 2016



# Only Selected Links Will Need Higher Data Rates

- In real life, only selected devices in existing installations will be upgraded and will require higher link speeds
- Most of the connected clients will continue with 1Gbit/s for the next years





# What about cabling for N-BaseT?

- In 2016, IEEE approved IEEE 802.3bz  
Use CAT5e cablings up to 2.5GBit/s and CAT6 up to 5GBit/s
- So your old installation runs 2.5GBit/s without any problem you only need to replace your old switches

**Are you sure?**

Does N-BaseT really work on the installation  
someone did more than X years ago?



What about aging?

What about wear?

Was the cabling properly installed

In the first place?

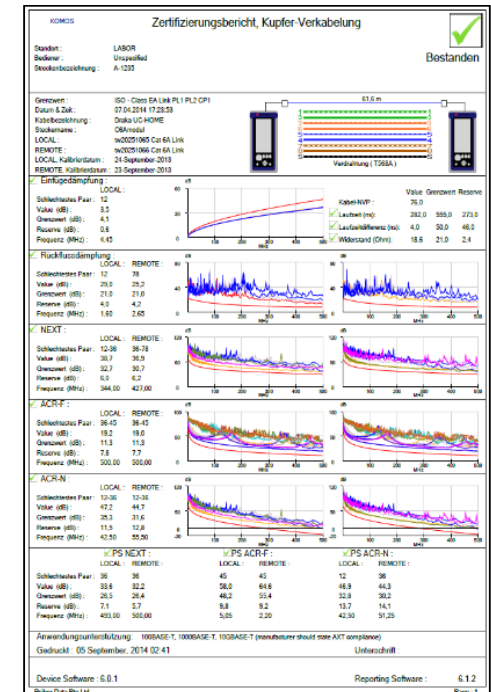
CAT5e or just CAT5?

# How to be sure?

## Recertify your installation

- You need a modern cable certifier
- You only test if cabling meets TIA/ISO standards
- Testing against TIA TSB-5012 or ISO11801-9904
- Regular AUTOTEST is simple and only takes a few seconds,

But.... In unshielded cabling, there is a high risk for Alien Crosstalk at speeds beyond 1Gbit/s !

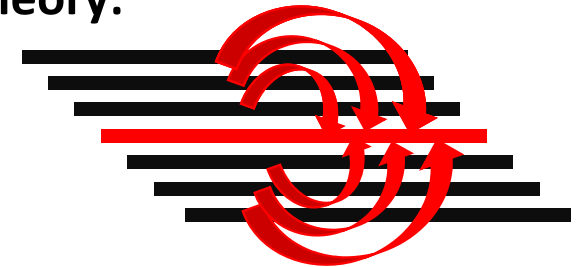


# How to be sure?

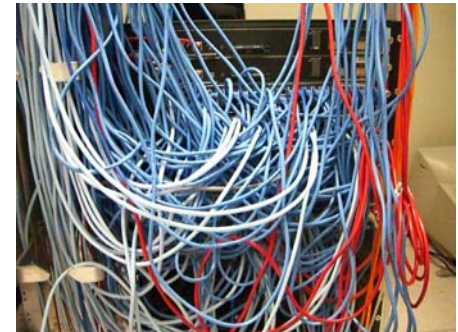
## Recertify your installation

- Alien Crosstalk (AXT) and Alien Signal to Noise Ratio (ALSNR) has to be measured on UTP cabling
- To measure AXT and ALSNR, the whole system must be shut down to generate a defined situation
- AXT and ALSNR testing takes several minutes per link
- Selection of disturbers is difficult:  
Adjacent ports on panels plus links running in the same bundle
- Only sample testing possible!

Theory:



Reality:



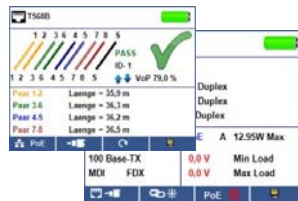
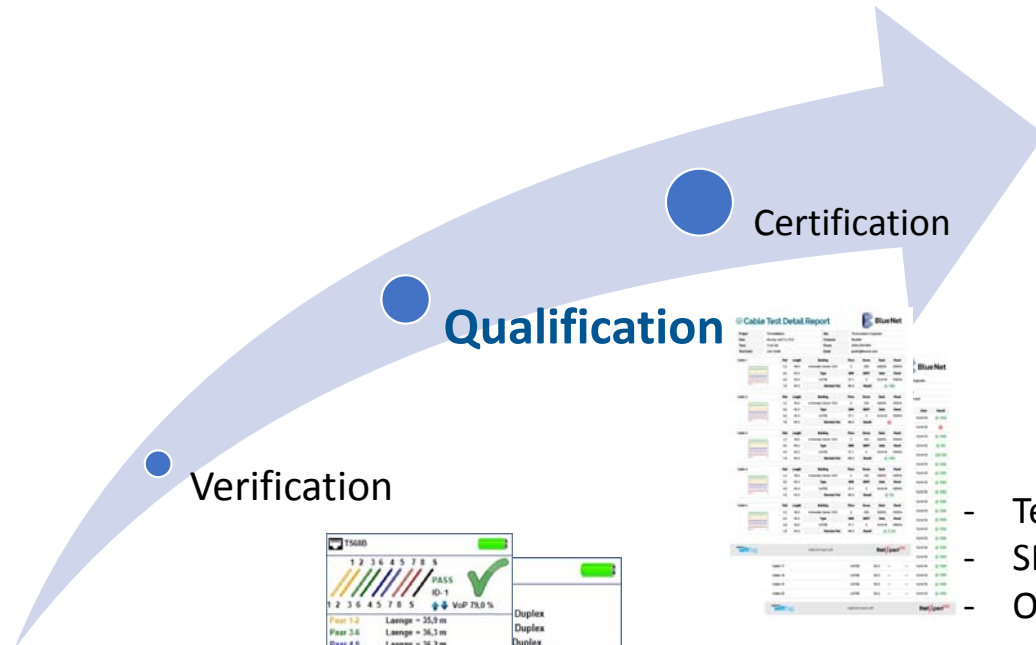
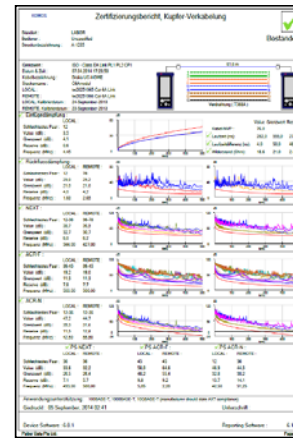
# How to be sure?

## Use a qualifier

- Simply test if the link can handle higher speeds
- Run tests while all the other links in your system are still active so you work with a real world noise situation
- Additional benefit:  
No second tester for active network tests and troubleshooting needed as these functions are implemented



# Qualification – What's That?

- RF&LF tests against TIA cabling standards

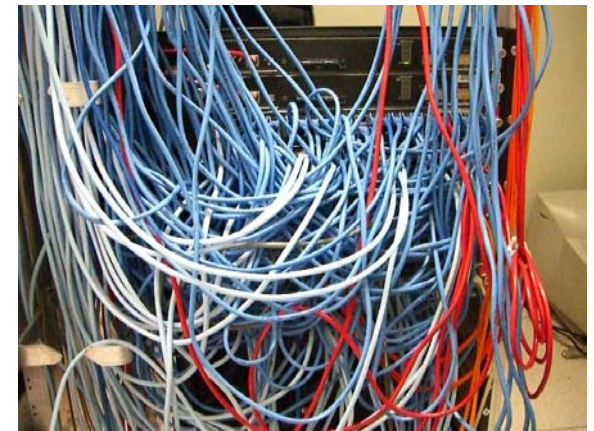
- Test against IEEE Bit Error Rate
- SNR and other tests
- Optional „IP Tests“

- Simple Wiremap
- Optional length and „IP-Tests“

# Qualifier – Ethernet Speed Certification Next Generation

A modern Qualifier needs to support two main operating modes or use cases

- Qualification of passive communication links
  - perform Wiremap testing for proper termination and troubleshooting of cabling problems
  - locate related ports
  - **determine the Ethernet Performance of a passive link (up to 10 Gb/s)**
- Troubleshooting Ethernet issues
  - See further slides



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# “All good things come in threes!”

## SNR Signal to Noise Ratio

- The ratio of signal power to the noise power
- When signal power gets too low and noise power too high, data can not be detected by a receiver

## BERT Bit Error Rate Test

- 100% load generation up to 10Gbit/s
- Testing if transmission errors occur

## Delay Skew

- Difference of signal runtime between pairs
- When delay skew is too high data packets can not be reassembled by a receiver

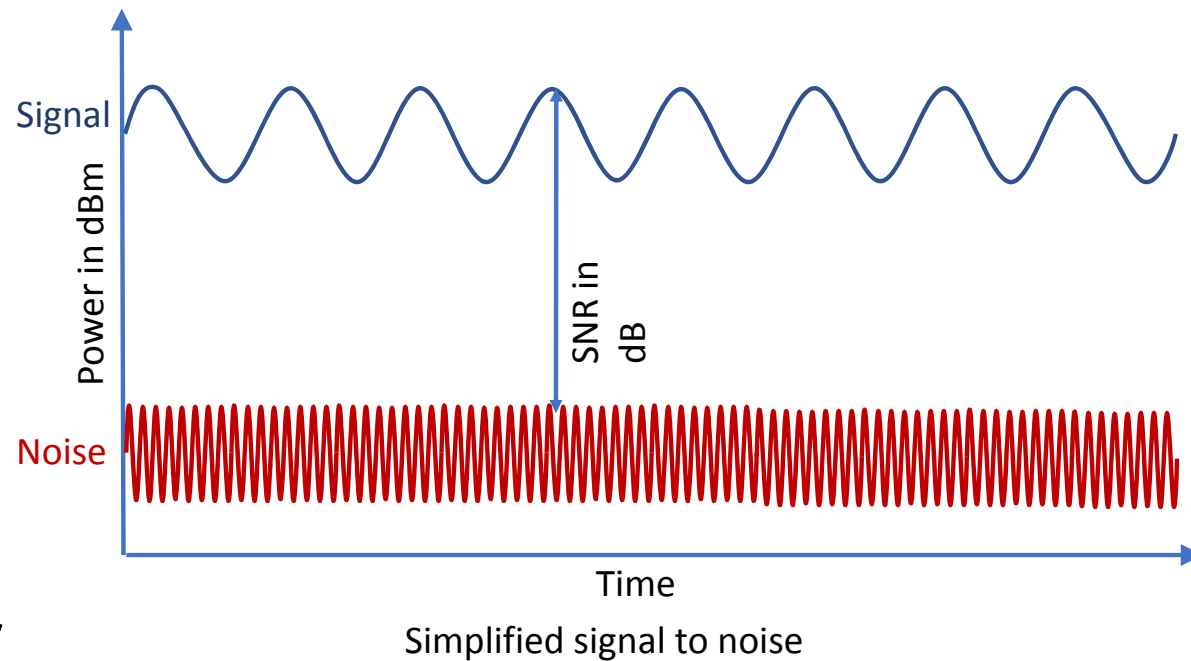




# What's SNR

## Signal to Noise Ratio

Distance between electrical signal and surrounding noise inducted into cable  
"Noise" can be inducted by other cables or by other sources like power cables, motors or any other electrical device

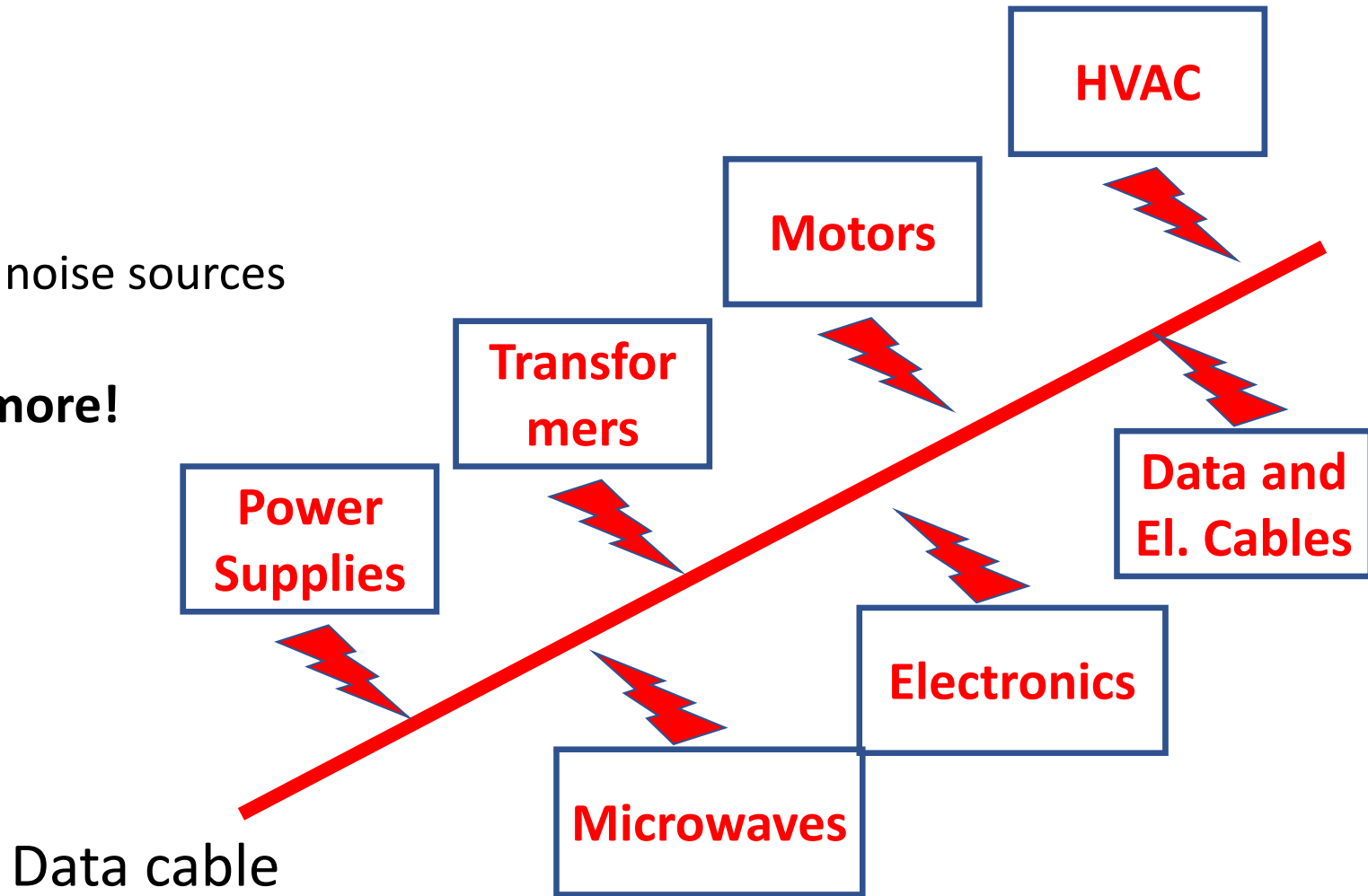


AXT and ALSNR is only a subset of the complete „noise“. The real noise is EMI: **Electromagnetic Interference**

# EMI

Some examples for noise sources

There are many more!



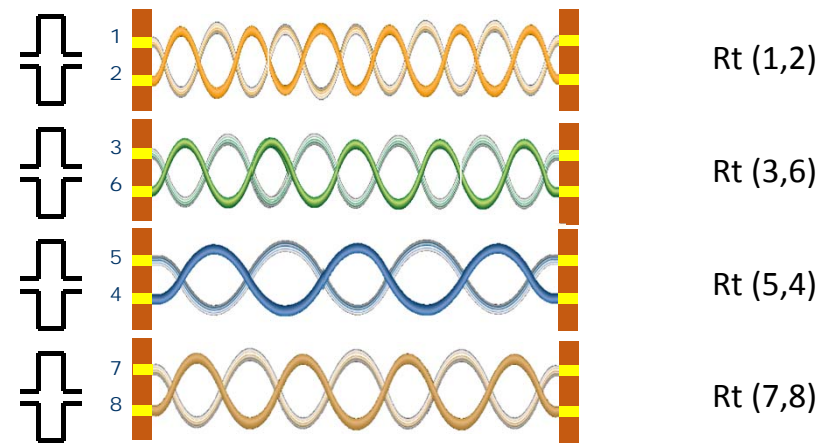
# What's delay skew?

Delay Skew is the difference in propagation delay between the fastest and slowest set of wire pairs

Why is it important?

All Ethernet speeds with 1Gbit/s or higher require simultaneous transmission on all 4 pairs

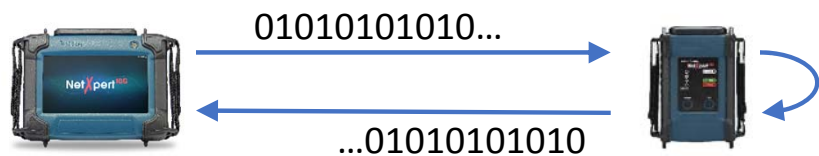
If signals do not arrive on all pairs within a certain time window, the receiver will not anymore understand the information



# What's BERT?

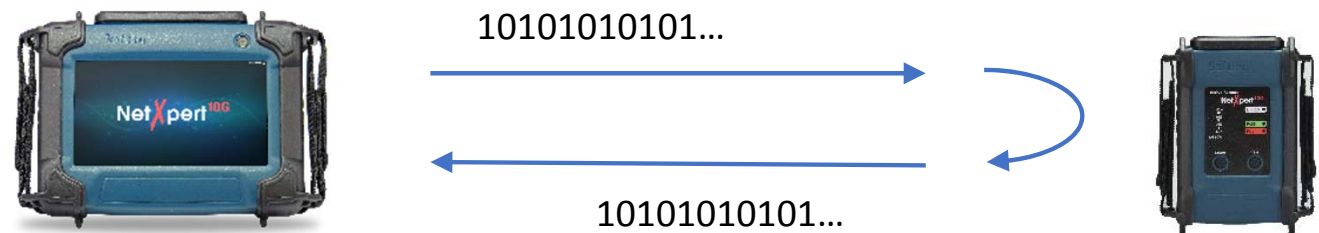
Bit Error Rate Test is a testing method for digital communication circuits that uses predetermined stress patterns consisting of a sequence of logical ones and zeros generated by a test pattern generator.

Wikipedia



# Link Qualification using BERT

- Use bit error rate defined by IEEE 802.3bz as pass/fail criteria:  $10^{-12}$
- Run 100% load test for 10 seconds ensures above criteria
- Real life test with real Ethernet pattern



# Qualifier – Ethernet Speed Certification next Generation

- Comprehensive Ethernet-Troubleshooting
  - check Ethernet link capability & status & do network discovery
  - test PoE/PoE+/PoE++
  - work on VLANs
  - perform Ping and Traceroute tests
  - identify switch ports
  - work as DHCP Client
  - decode CDP and LLDP protocols



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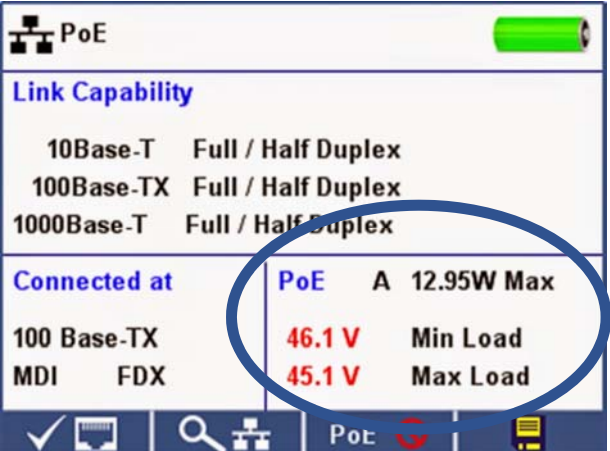


# Does PoE supply work?

PoE load test proves if PoE voltage stays stable when consumer load is connected.

A minimum load and a maximum load should be connected and voltage measured

-> Important test since many access points are powered by PoE



PoE	
<b>Link Capability</b>	
10Base-T	Full / Half Duplex
100Base-TX	Full / Half Duplex
1000Base-T	Full / Half Duplex
<b>Connected at</b>	
PoE	A 12.95W Max
100 Base-TX	46.1 V Min Load
MDI FDX	45.1 V Max Load



# Conclusion

- Testing legacy CAT5e/CAT6 cabling prior to buying / installing new NBase-T equipment is important
- 2 ways of testing NBase-T compliance
  - Certification against TSB-5012 or ISO 11801-9904
    - Advantage: Testing against cabling standards
    - Disadvantages: Expensive, time consuming, very cumbersome, **not reflecting real life circumstances, 100% test of all links is impossible**
  - Qualification against IEEE 802.3bz
    - Advantages: Real life test using real Ethernet takes into account real EMI, not just AXT&ALSNR
    - Additional troubleshooting for PoE and Ethernet issues possible



# Questions?

Thanks for your attention!

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