

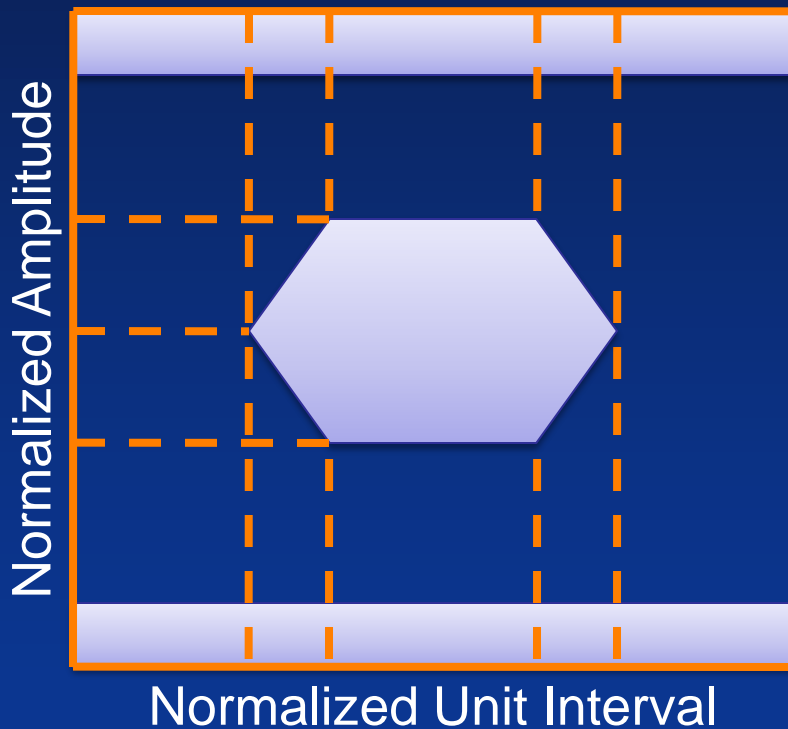
All-Silicon Frequency Sources for Ethernet

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Overview

- Timing considerations for Ethernet
- Timing requirements and references for Ethernet
- All-silicon frequency sources for Ethernet
- Summary

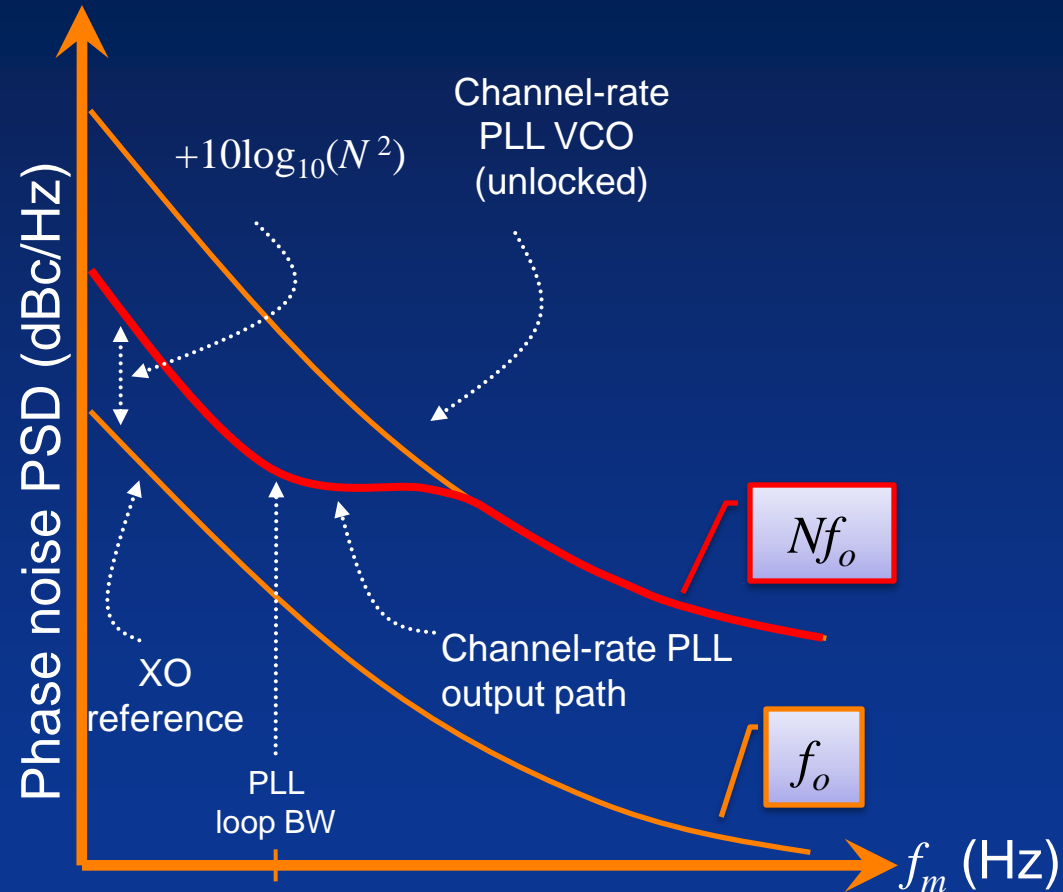
Timing is critical in Ethernet



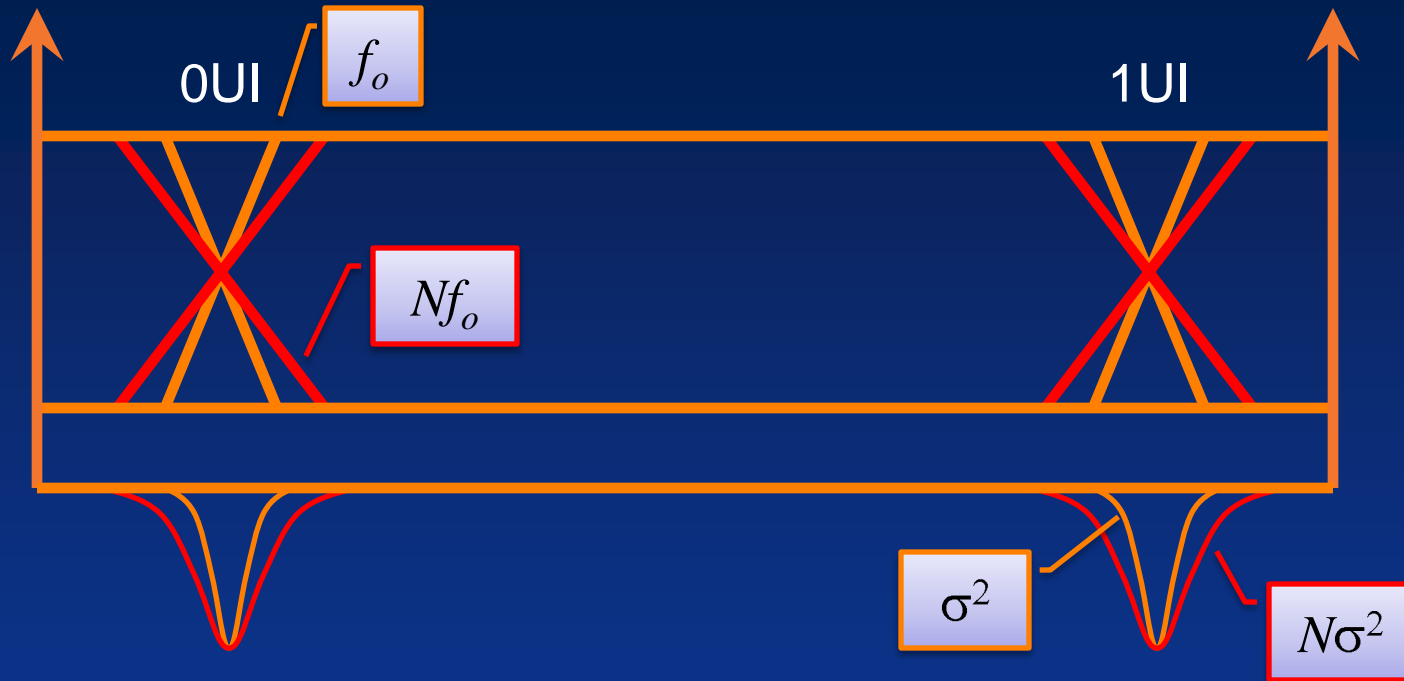
- Eye-opening template for a 1Gb Ethernet TX
- Eye-closure originates from several sources, but timing quality is the one of the main determinants of link performance

Frequency multiplication & eye-closure

- Fundamental-mode BAW XTAL reference oscillators exhibit low phase noise, but support frequencies up to only ~50MHz
- The channel-rate PLL multiplies frequency by N and noise by N^2
- Outside the PLL loop BW, the VCO is tracked



Frequency multiplication & eye-closure

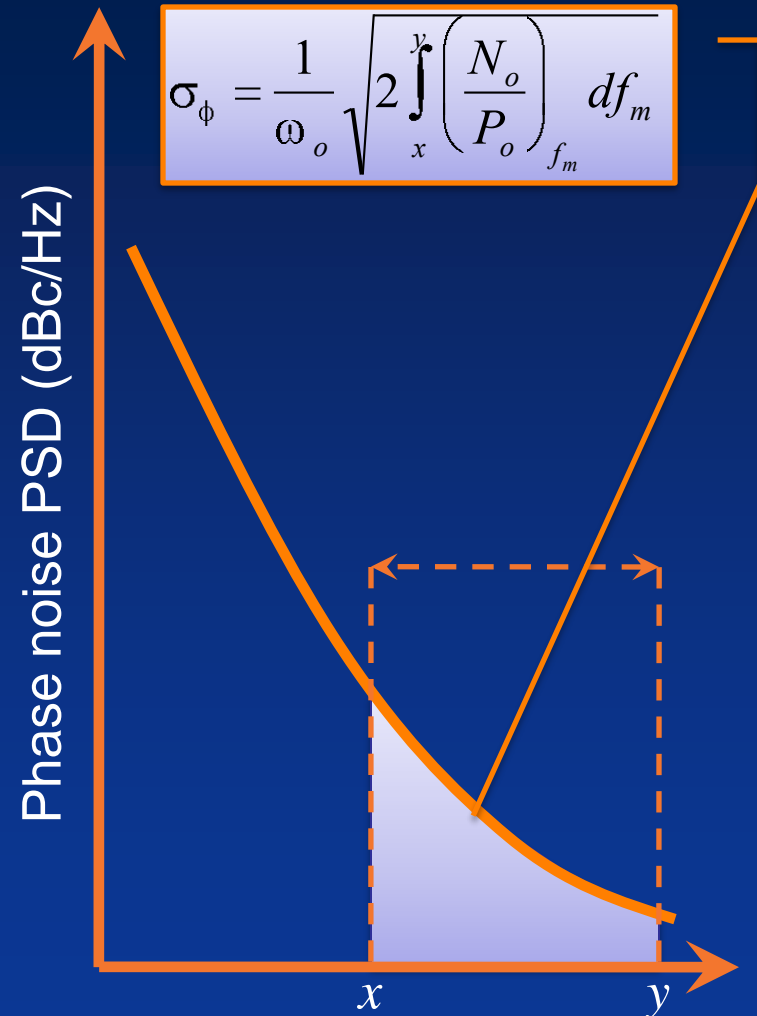


- Low loop multiplication, N , is desired to reduce accumulated noise and prevent eye-closure
- To maintain low N , each new generation of Ethernet requires a reference at a higher frequency

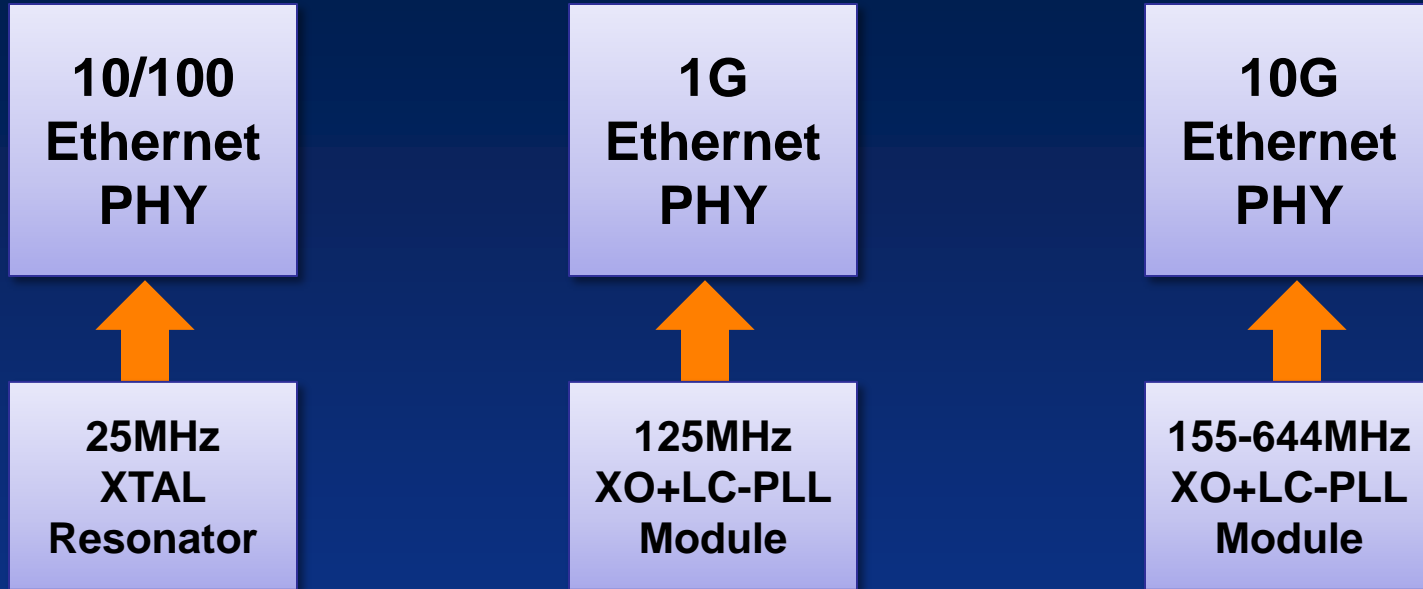
Key Ethernet timing requirements

Ethernet Rate	Accuracy (ppm)
10/100M	100
1G	100
10G	50

- Eye diagram assumes the presence of only high-frequency jitter components that are not tracked by the clock recovery circuit
- Integrated phase jitter is typically measured from 637kHz to 20M



Timing references for Ethernet



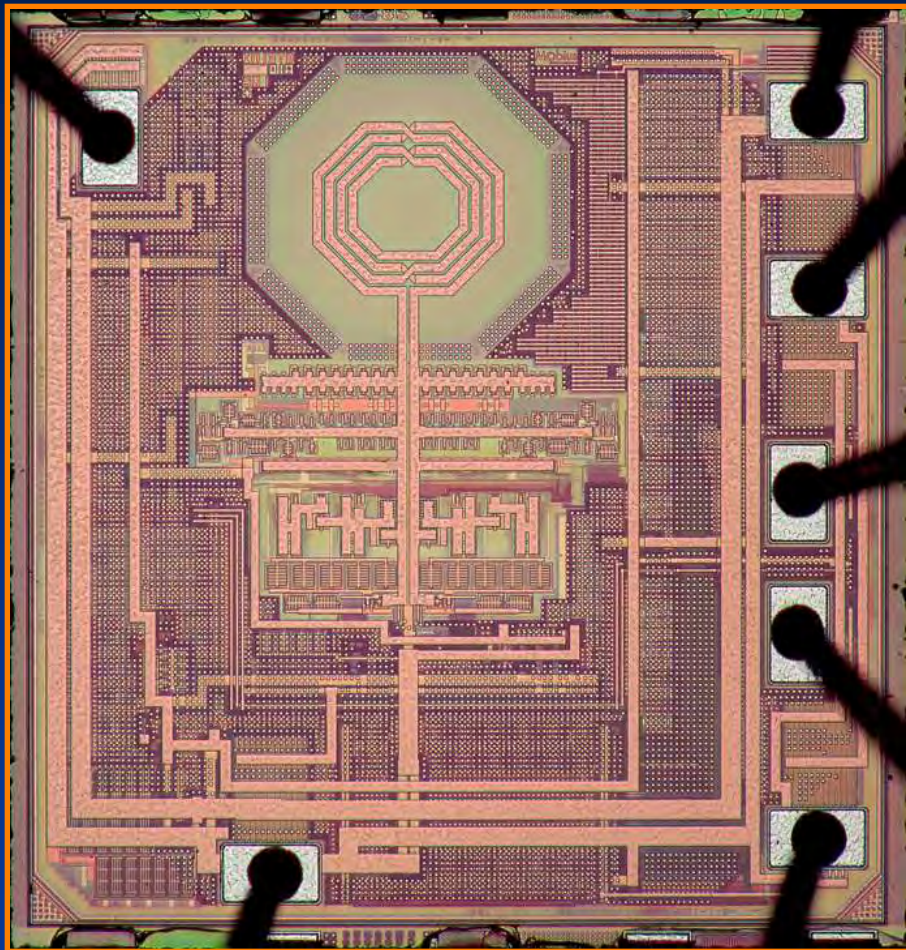
XTAL Resonator



XO+LC-PLL Module

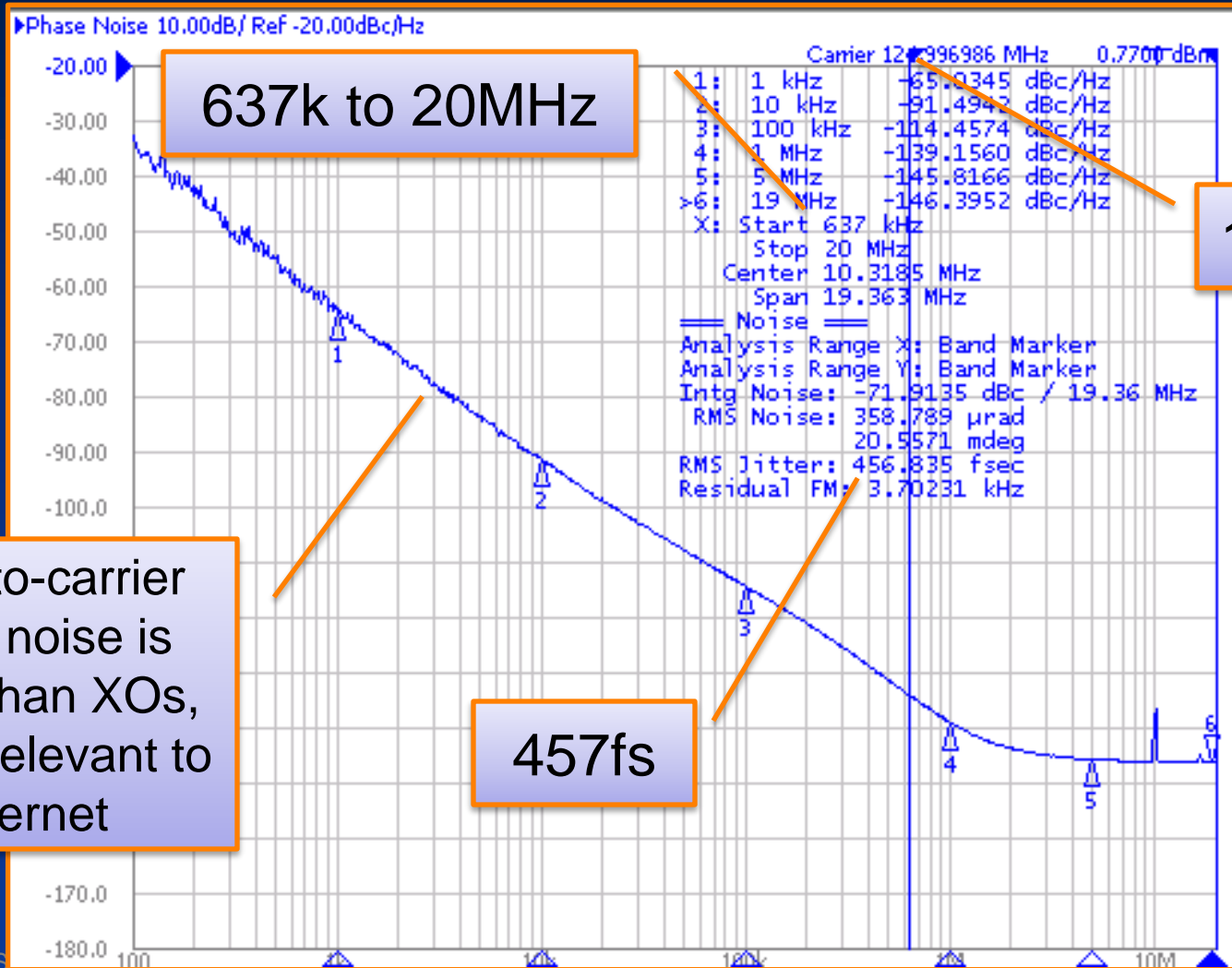


All-silicon frequency sources for Ethernet



- A frequency-trimmed and temperature-compensated, 3GHz self-referenced LCO
- <2mA unloaded active power
- Programmable output frequency from 4–150MHz
- Programmable drivers: CMOS, LVPECL, LVDS, HCSL
- Currently meets specification for HS- and SS-USB, S-ATA, PCIe (qualified at ± 250 ppm)

All-silicon frequency sources for Ethernet



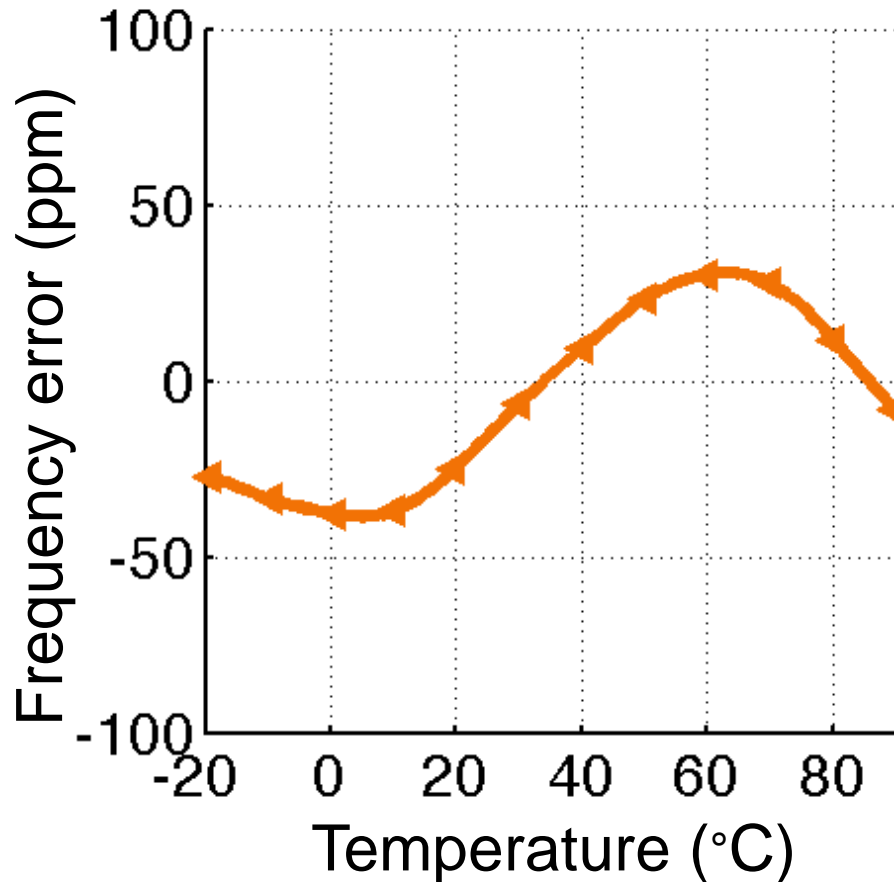
637k to 20MHz

125MHz

Close-to-carrier phase noise is higher than XOs, but not relevant to Ethernet

457fs

All-silicon frequency sources for Ethernet



- ± 50 ppm frequency error has been demonstrated and can be sampled
- Current production is qualified at ± 250 ppm
- ± 100 ppm devices available Q3'10
- ± 50 ppm devices available Q4'10

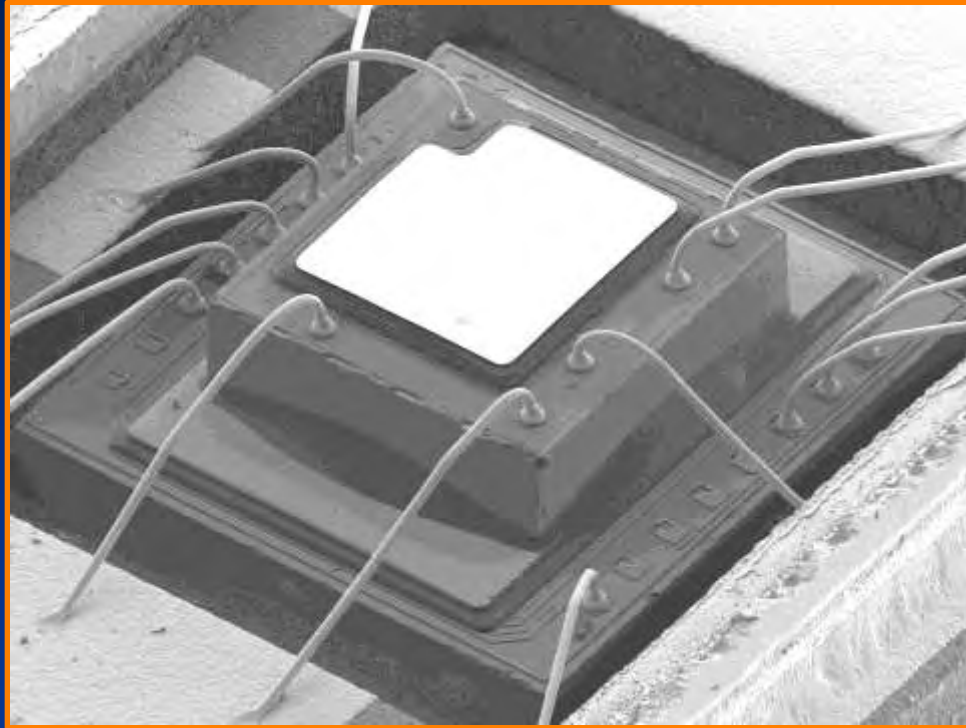
All-silicon component frequency source

Note: Mobius was acquired by IDT so these packages will be inked IDT soon!



- Silicon oscillators can replace XOs and XO+LC-PLL modules in Ethernet applications
- The device provides a low-power, programmable, high-frequency source w/o a PLL
- Packages are pin-compatible with standard XOs and XO-PLL modules

All-silicon die frequency source



- Die can be integrated into MCP or MCM or can be assembled as CoB
- Post-processed prevents frequency shift from packaging and environmental effects
- Die can be used in place of resonators or XOs
- $<2\text{mA}$ unloaded power dissipation
- Higher frequencies to be supported in future devices

Summary

- Timing is critical to Ethernet link performance
- Each new generation of Ethernet requires a higher frequency reference, but fundamental-mode BAW XTALS are limited to ~50MHz
- Silicon oscillators are low-power, programmable and high-frequency references that can meet the timing requirements for Ethernet
- Silicon oscillators can replace XO+LC-PLL modules as a component and can replace XTAL resonators as a die