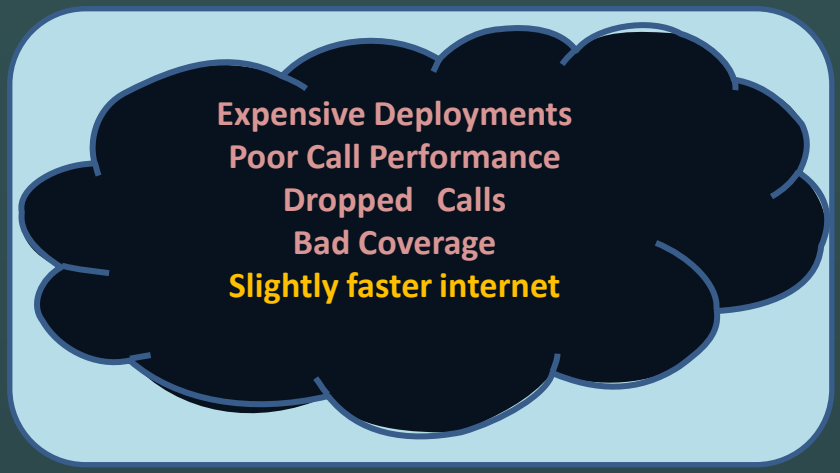
Optical Wireless

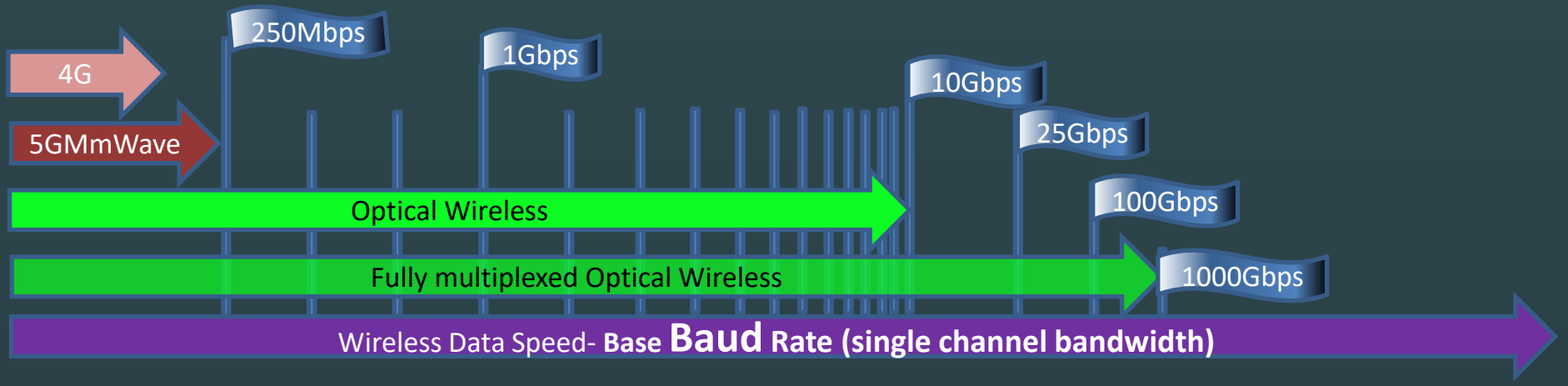
Photonic Technology to Connect, Educate, and Employ the Unconnected

Wireless Data Rates

When 4G went to 5G

- Deployment is costly and difficult
  - Many more building and pole locations are needed with high speed backhaul
  - 5Gmm Wave Radios have limited range and line of sight limited
  - Wind loading with radio's a problem



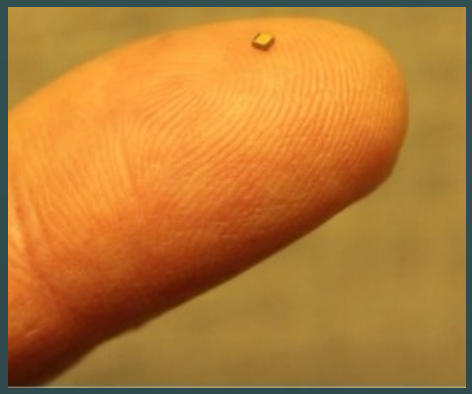


What Would Be an Ideal Optical Wireless Source?

- Inexpensive
- Invisible and Eye Safe
- Mutable Divergence Angle
- Higher Bandwidth than Fiber
- Have an Extremely Small Formfactor
- Use << Energy than Microwave Sources
- Radiation Hardened and Space Qualifiable
- Higher Powers Are Available and Inexpensive
- Beams Are Steerable Without Mechanical Apparatus
- Propagate Through the Atmosphere Farther Than a Laser

- High Security- Can Be Protected From EMP

OptiPulse's Optical Wireless Photonic Source



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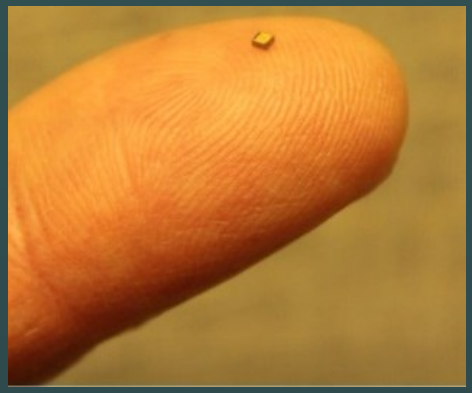
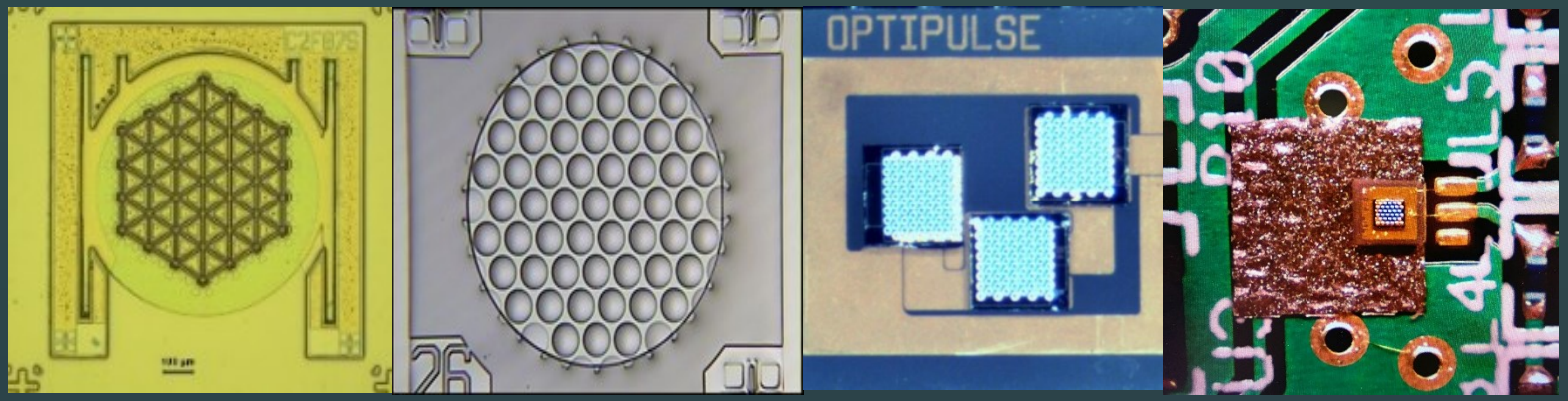
OptiPulse's Optical Wireless Photonic Source

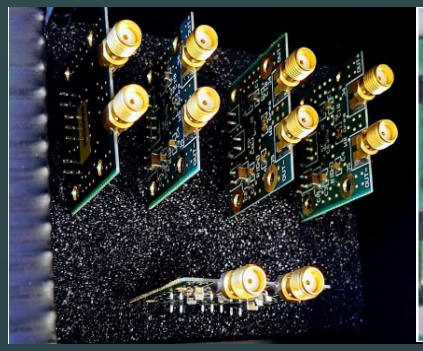
8 Issued Patents with CIPs
Multiple Foreign Filings
Chips Produced a Production Foundry

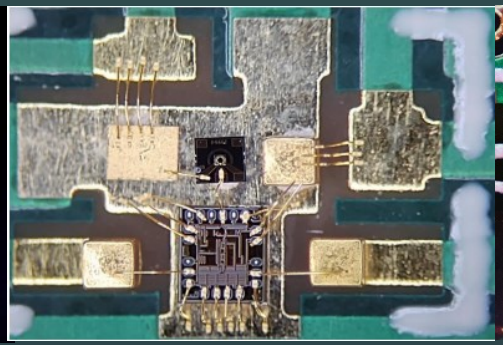


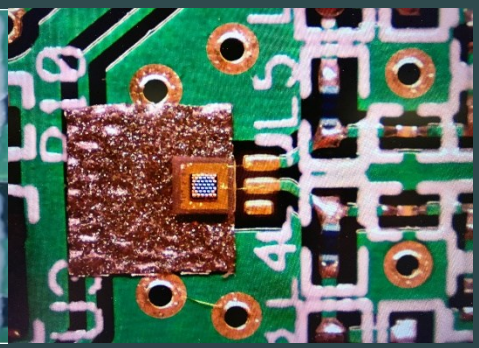


OptiPulse's Optical Wireless Photonic Source

Evaluation Boards Available Q4 2022



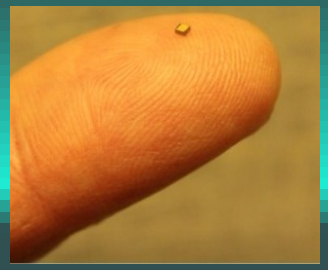


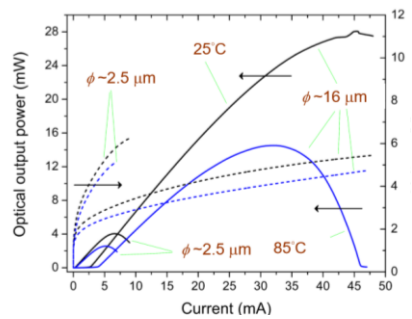


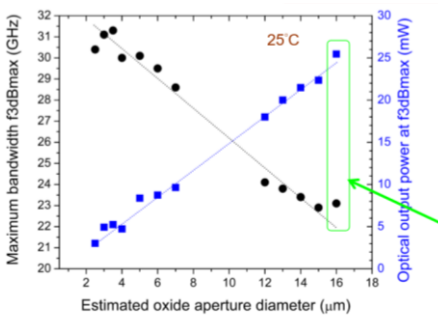
Testing of the Chips

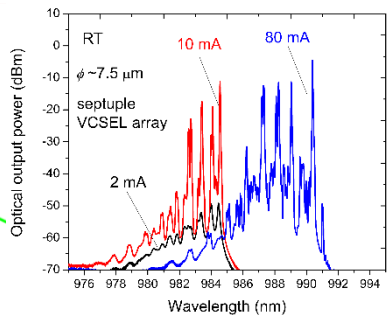
Chip Architectures prove fast and powerful

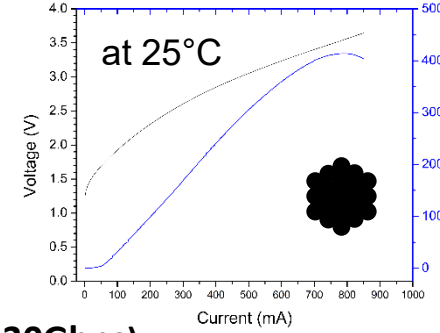
Dr. Lott's Epitaxial Designs are Significant Advancements in Photonics





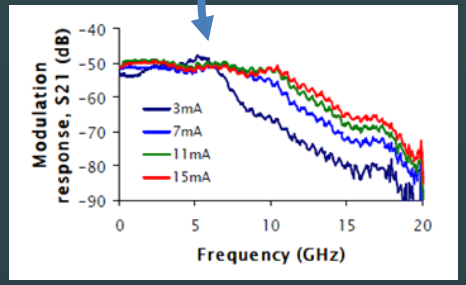


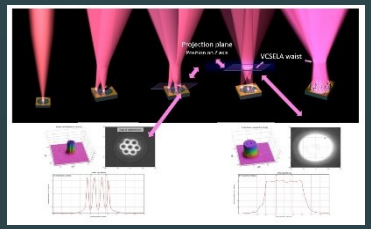




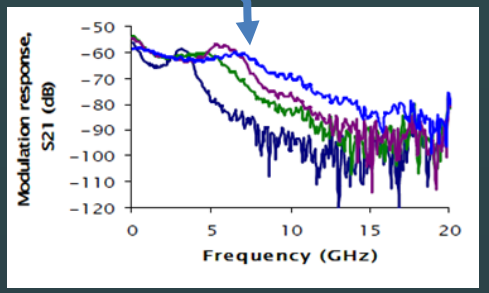
16um apertures ~25mW Avg Pwr (single element) and a freq mod above 20GHz (> 30Gbps)

3mA bias
Single VCSEL





3mA bias
105 VCSELs
~ 1.5 Watts at 10Gbps

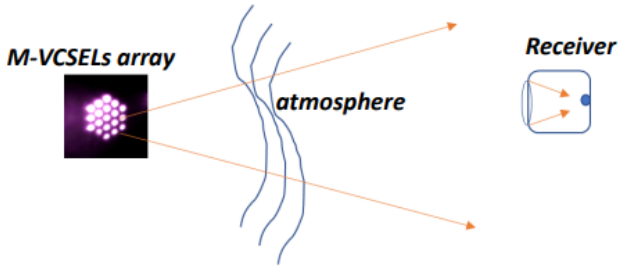


A1

Early CSU work shatters record for single chip power/speed combo

Atmospheric Scintillation Limits Coherent Propagation

Scintillation Mitigation by VCSELs Source Diversity



SNR for an array of M - VCSELs:

$$\langle SNR_M \rangle = \sqrt{M}\,\langle SNR_1 \rangle$$

$\langle SNR_1 \rangle$ = *single-VCSEL SNR*

Scintillation index for an array of M - VCSELs:

$$\sigma^2_{I,M} = \frac{1}{M}\sigma^2_{I,1}$$

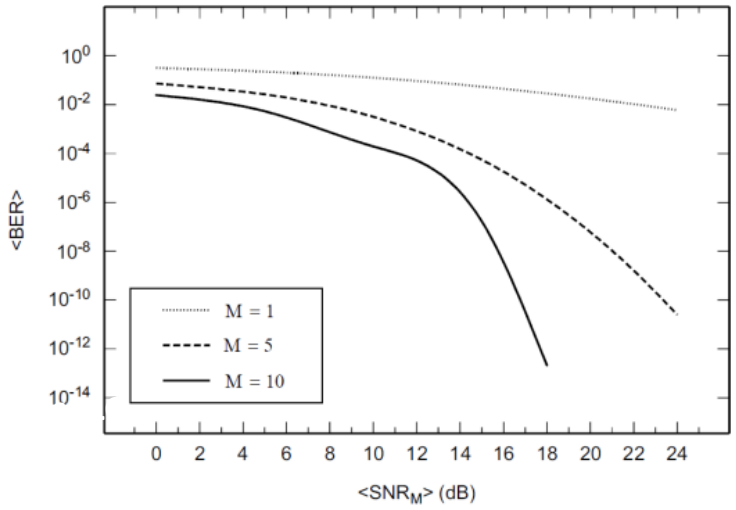
$\sigma^2_{I,1}$ = *single-VCSEL scintillation*

Bit Error Rate (BER) for an array of M - VCSELs:

$$\langle BER_M \rangle = \frac{1}{2}\int_0^\infty p_\gamma(u)\,erfc\left(\frac{\langle SNR_M \rangle u}{2\sqrt{2}}\right)du$$

$p_\gamma(u)$ = *gamma-gamma distribution*

BER for an array of M VCSELs as a function of mean SNR



Dr. Sami Shakir- Tau Technologies

OptiPulse Senior Engineering Team

John Joseph
CEO, Co Founder,

20+ issued patents photonics 30 yrs of VCSEL processing and product development, Optical Packaging, QA, applied systems manufacturing. Director of QA, Director of Manufacturing. Technology Transfer and Manufacturing

Dr. James Lott
CTO, Co-Founder

Record breaking epitaxial wafer designs for VCSELs. International leadership in semiconductors and photonics. Applied physics professor. Retired military science/engineering officer

Dr. Kevin Lear
Consulting -Chief Engineer

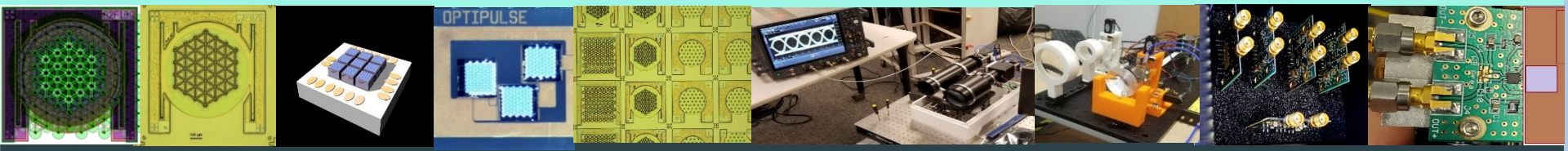
Leader in VCSEL development, 35+ years developing and managing semiconductors and optics, professor of electrical & computer engineering, inaugural director of biomedical engineering

Dr. Nasibeh *Haghighi*
Director of R&D

Sensor design and analysis, extensive experience in VCSEL epitaxial wafer design, cleanroom processing, and device testing. She leads OptiPulse's processing development and semiconductor device research and development

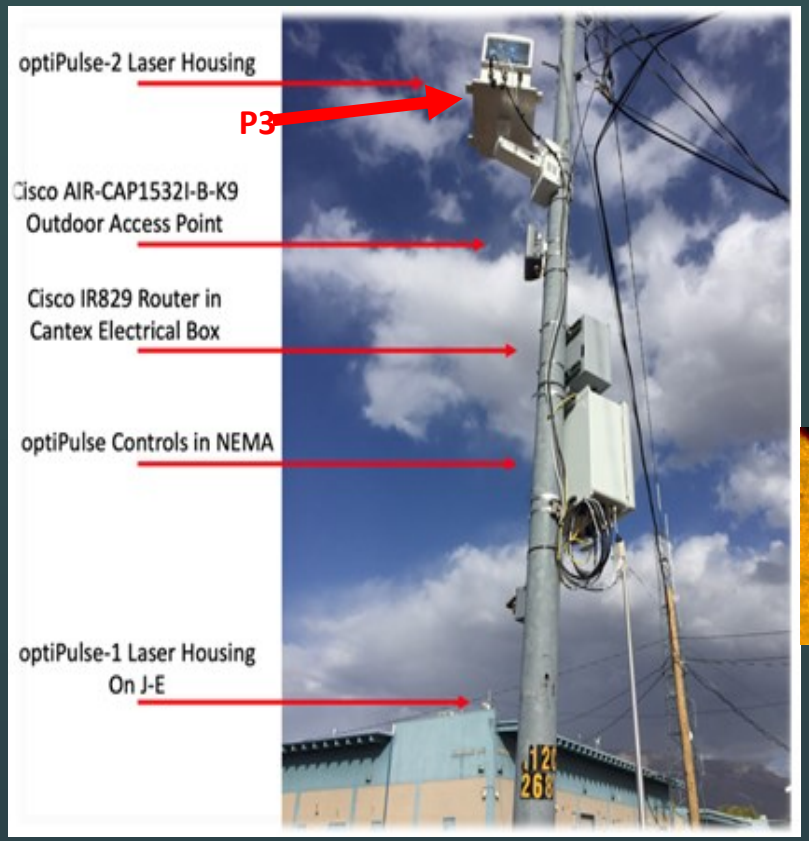
Dr. Payman Zarkesh-Ha
Consulting Director Circuit Design

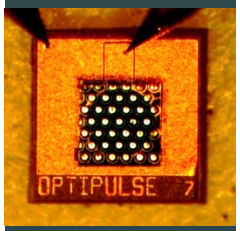
Expert in high-speed RF circuit design and detection circuits with over 30 years of experience. Associate director of the Center for High Technology Materials (CHTM) and professor of electrical & computer engineering at UNM

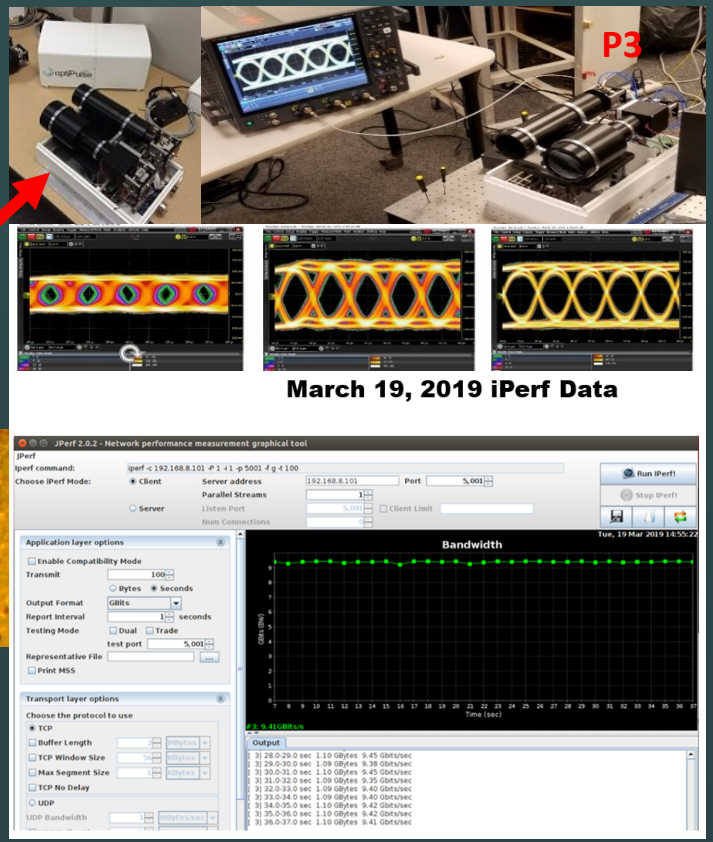


Systems Development- Wireless Extension Cord for Fiber

OptiPulse has developed 3 Prototypes and is now designing Prototype 4

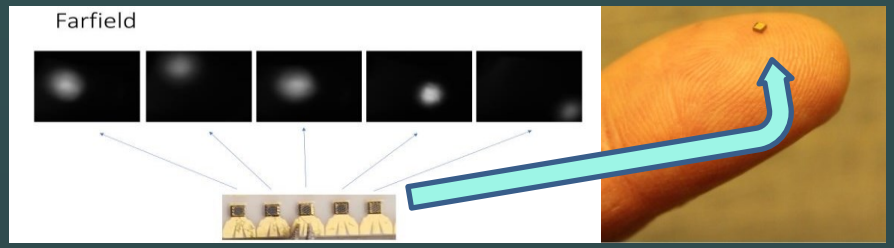


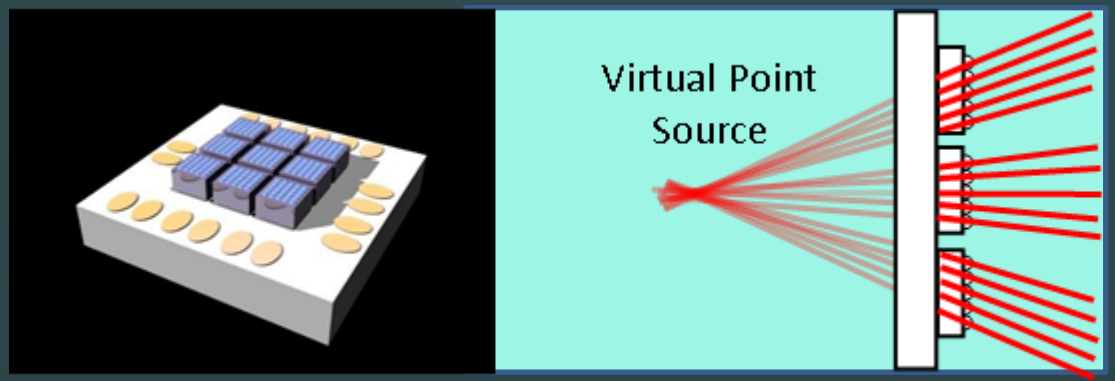




NSF Funded SBIR Non-Mechanical Beam Steering

Phase I successful in demonstrating 1D non mechanical beam steering





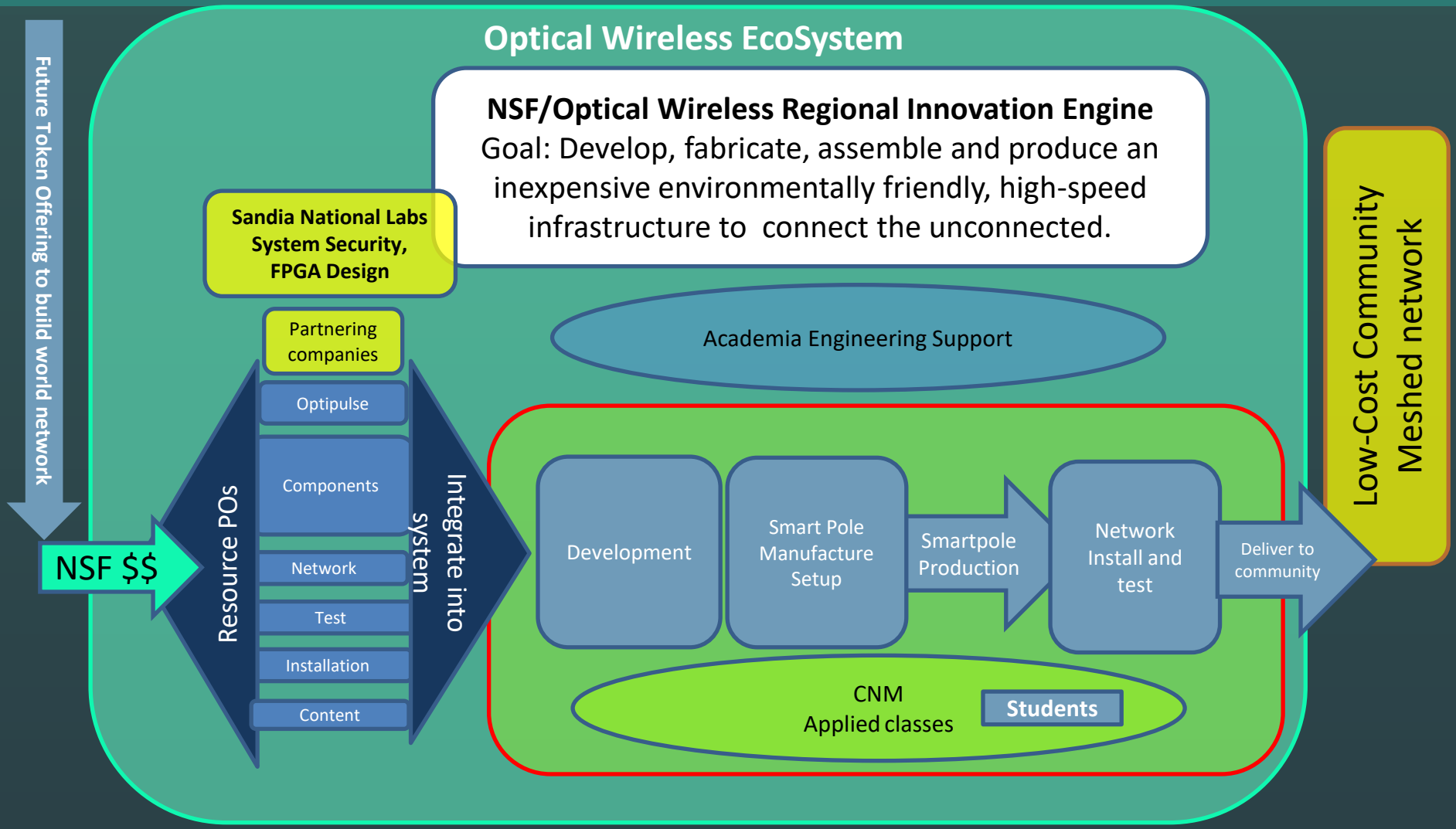
Phase II higher resolution 2D beam steering

- **Milestone 1 is a 9-direction 3D beam steering array**
- **Milestone 2 is a 3D device with 37 different beam directions**

Optical Wireless For An NSF Regional Innovation Engine

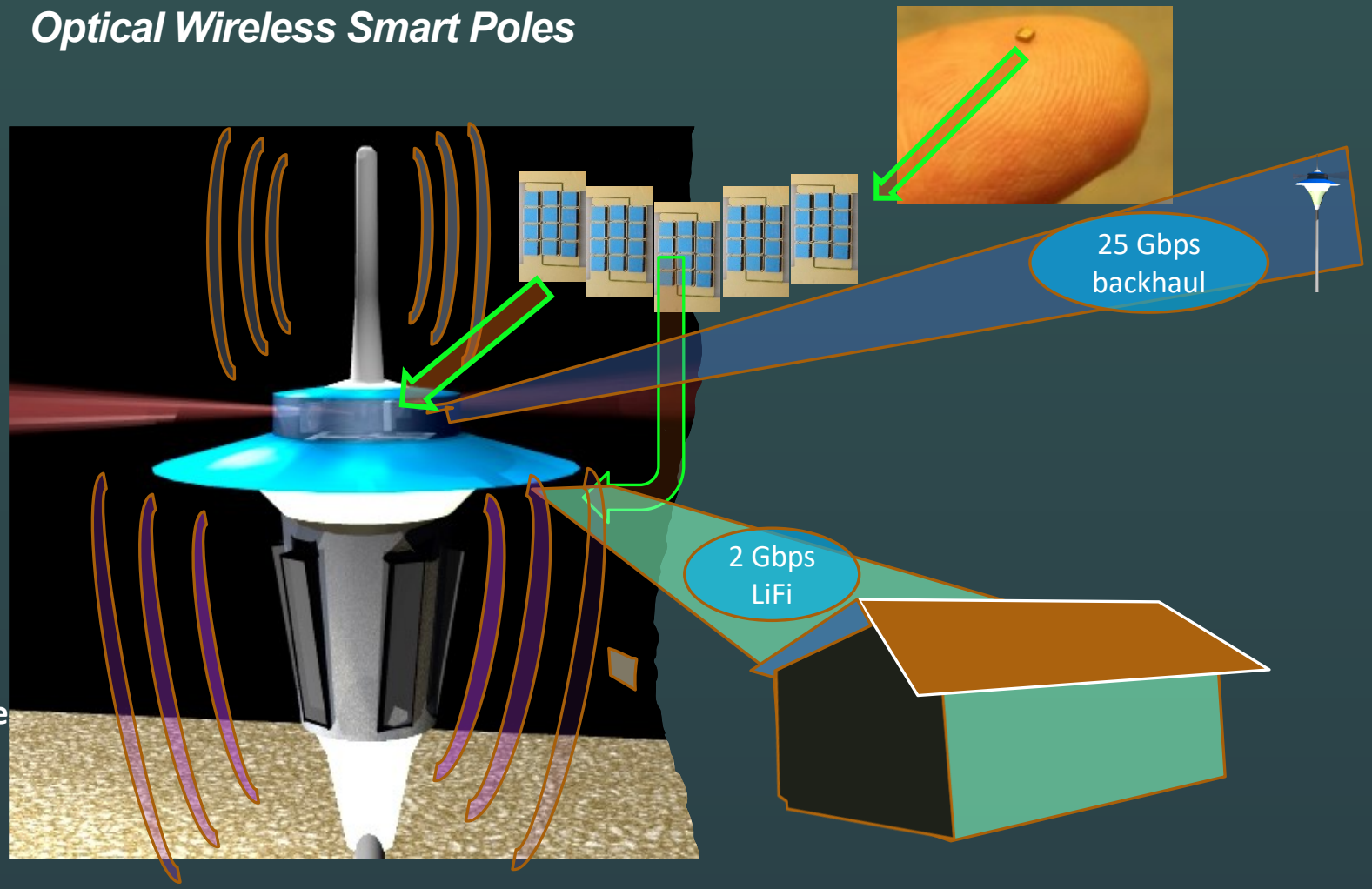
A Regional Joint Venture of Synergistic Companies will connect, educate, and employ the unconnected

Regional Innovation Engine Proposal

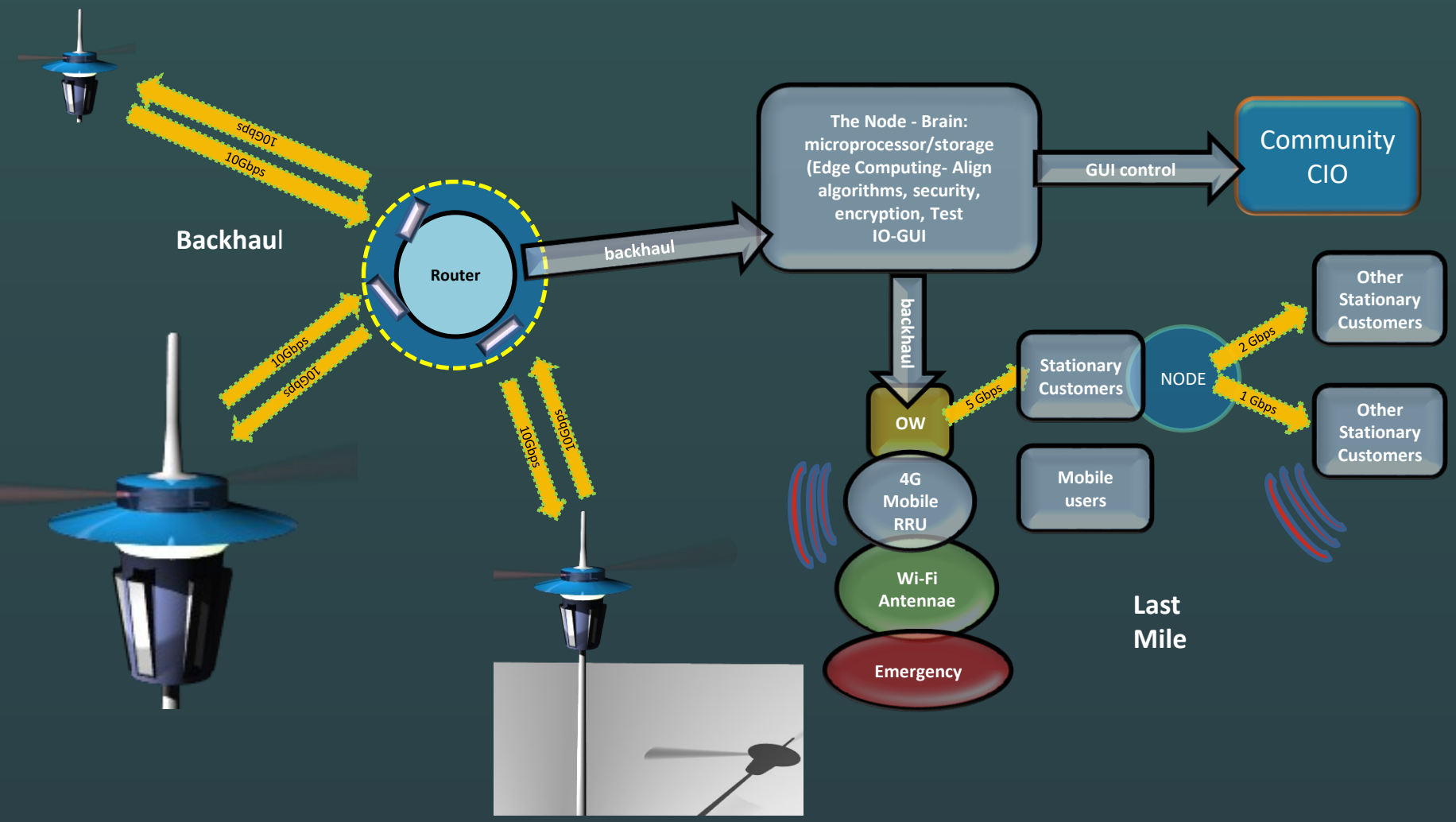


A Better Way to Distribute Communications

Optical Wireless Smart Poles



SmartPole Mesh Network



THANK YOU

NSF, DoD, Sandia Labs, and CINT and Tau Technologies

From the OptiPulse Team

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The Future of High-Speed Communication is here.

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