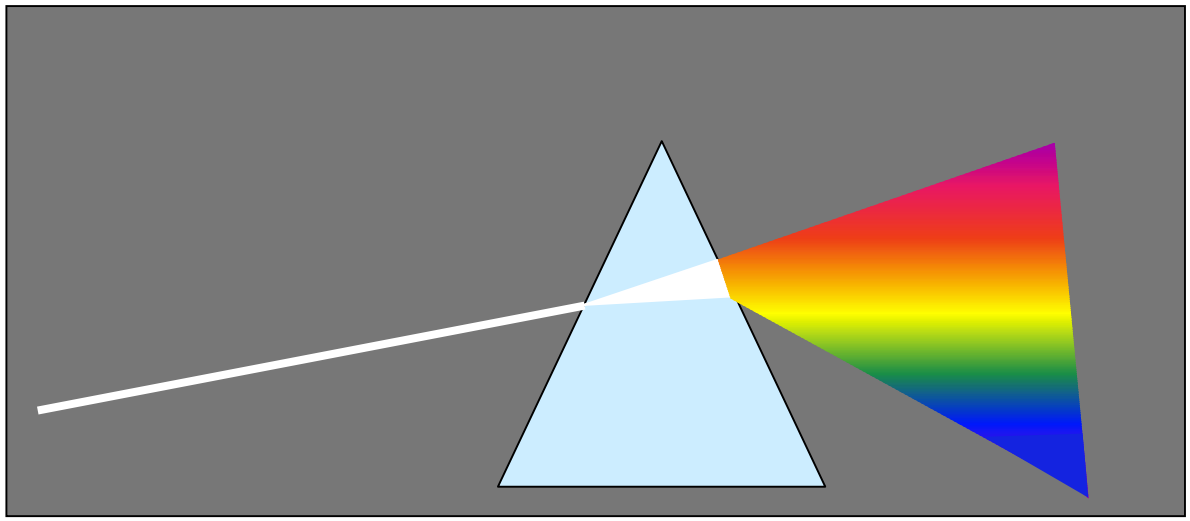


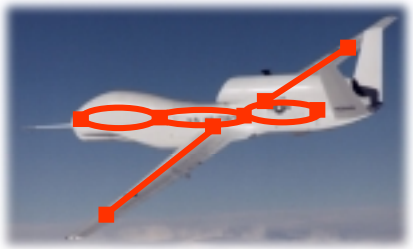
Photonics Overview

Elias Towe

DARPA/MTO

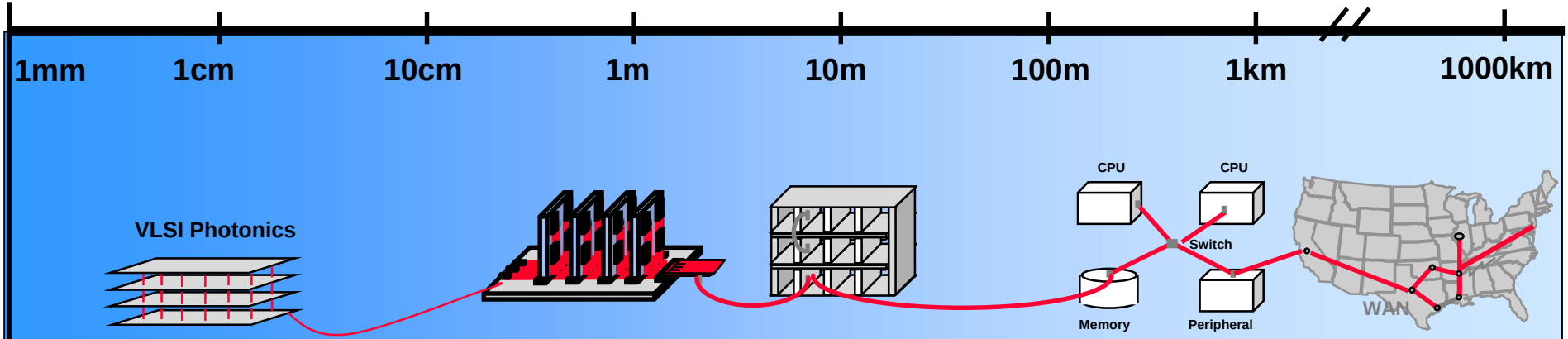
DARPATech 2000

Military Platform Information System Functions



RF
μw
MMW
IR
UV
Visible
Sensor(s)
Memory
Analog
Switching
I/O
Digital
A/D
Processor(s)
Human Interface
Machine Interface
Weapon Interface
Network Interface
Output

Recent DARPA Thrusts
Digital Data Communications



Key Enabling Technologies

Free Space
GaAs based O/E
Smart Pixels
Diffractive/Micro Optics
Integrated Fab

POF, Oxide VCSELs
Low Cost Packaging
GaAs based O/E
Parallel Links
1-2 Gb/s/channel@
12 Channels
10 Gb/s serial links

WDM/TDM,
SMF, EDFA
InP based O/E
10Gb/s channels
4-8 WDM channels

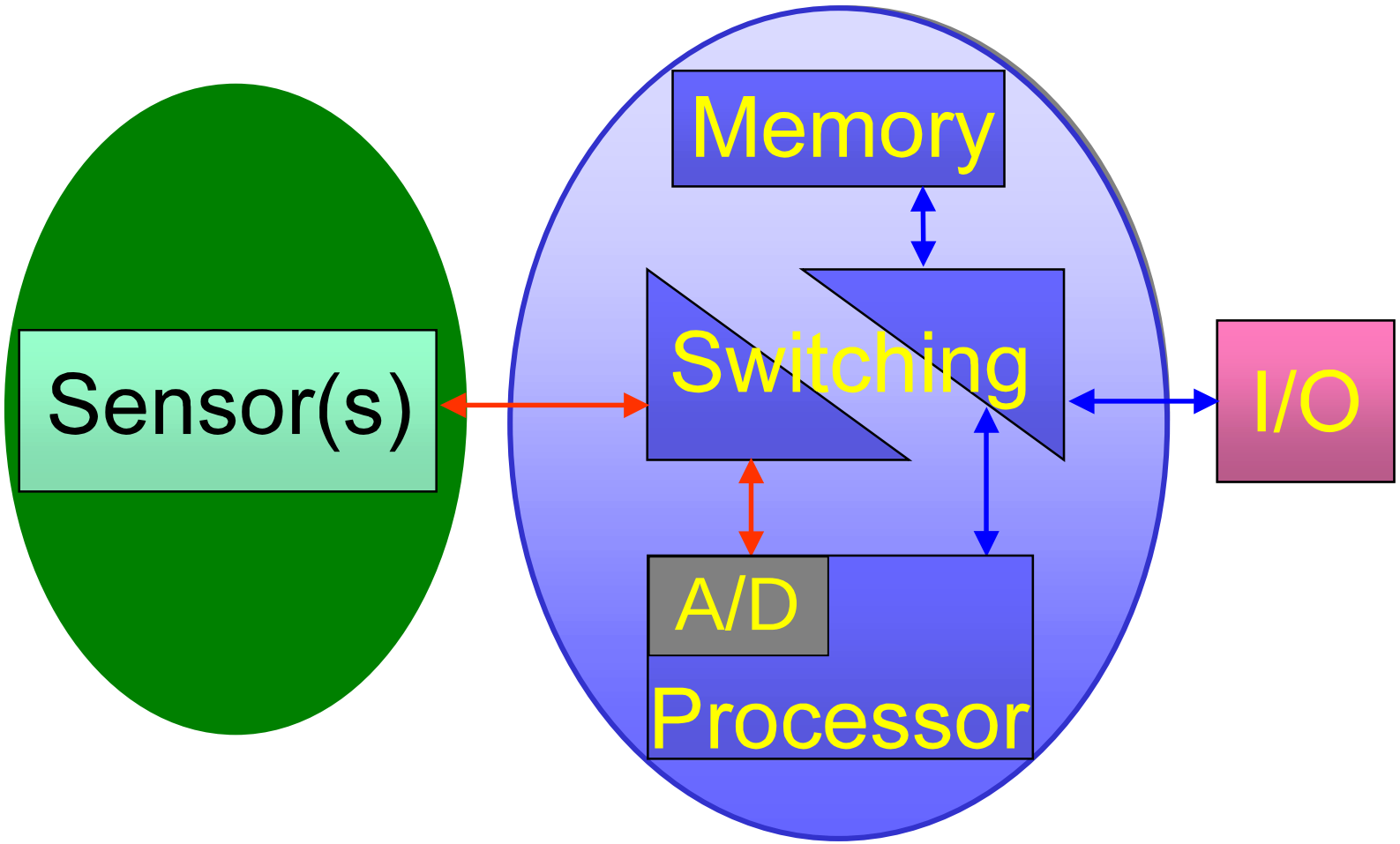
MTO - Photonics Programs

- Sensing
  - IR Sensitive Materials; GaN Sensors; Photonic WASSP
- Communication
  - RF Photonics; Steered Agile Beams (STAB)
- Processing
  - VLSI Photonics; Photonic A/D Converter

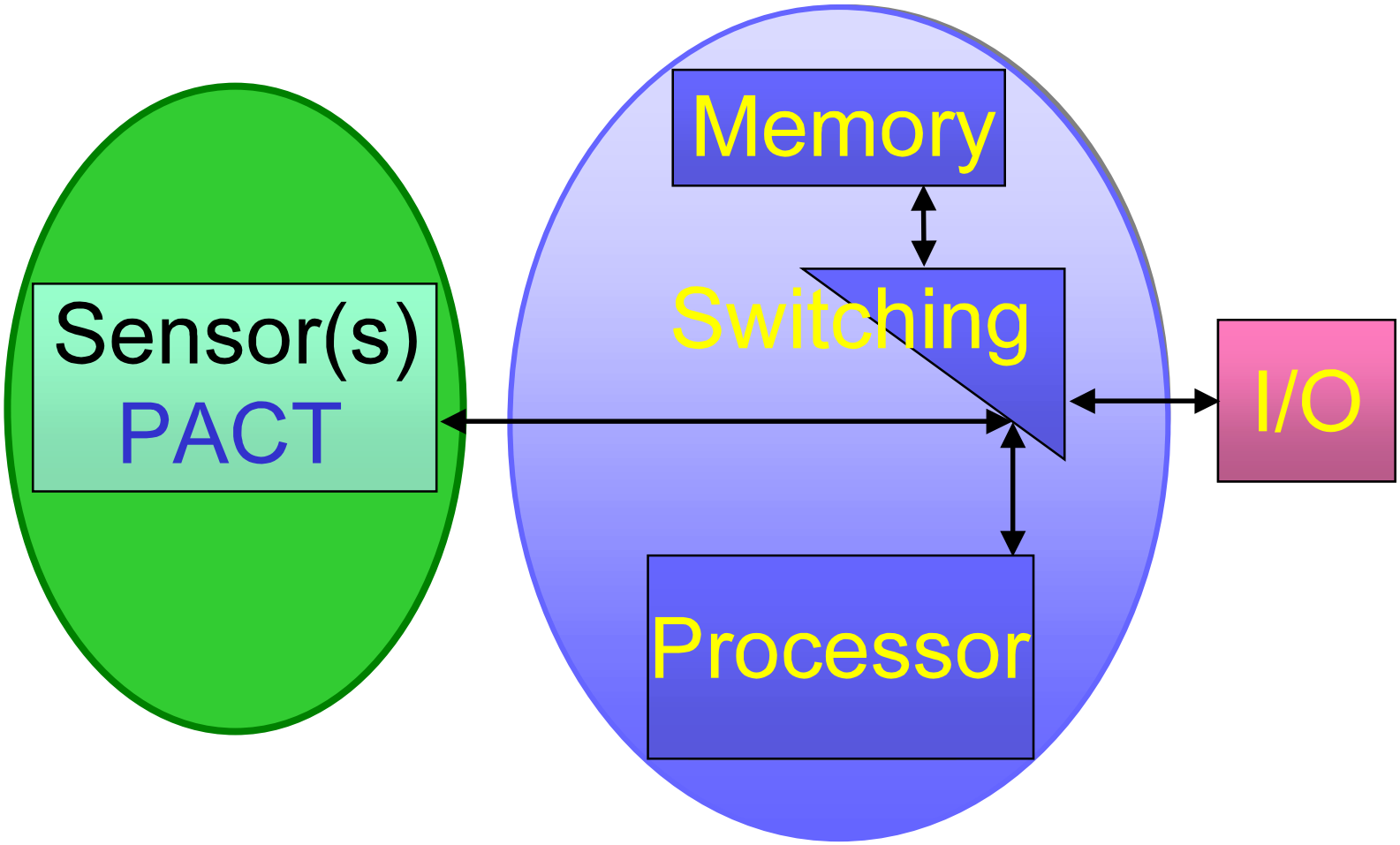
MTO - Photonics Program Managers

- Sensing
  - R. Balcerak, E. Martinez, E. Towe
- Communication
  - D. Honey
- Processing
  - D. Honey, J. Murphy, E. Towe

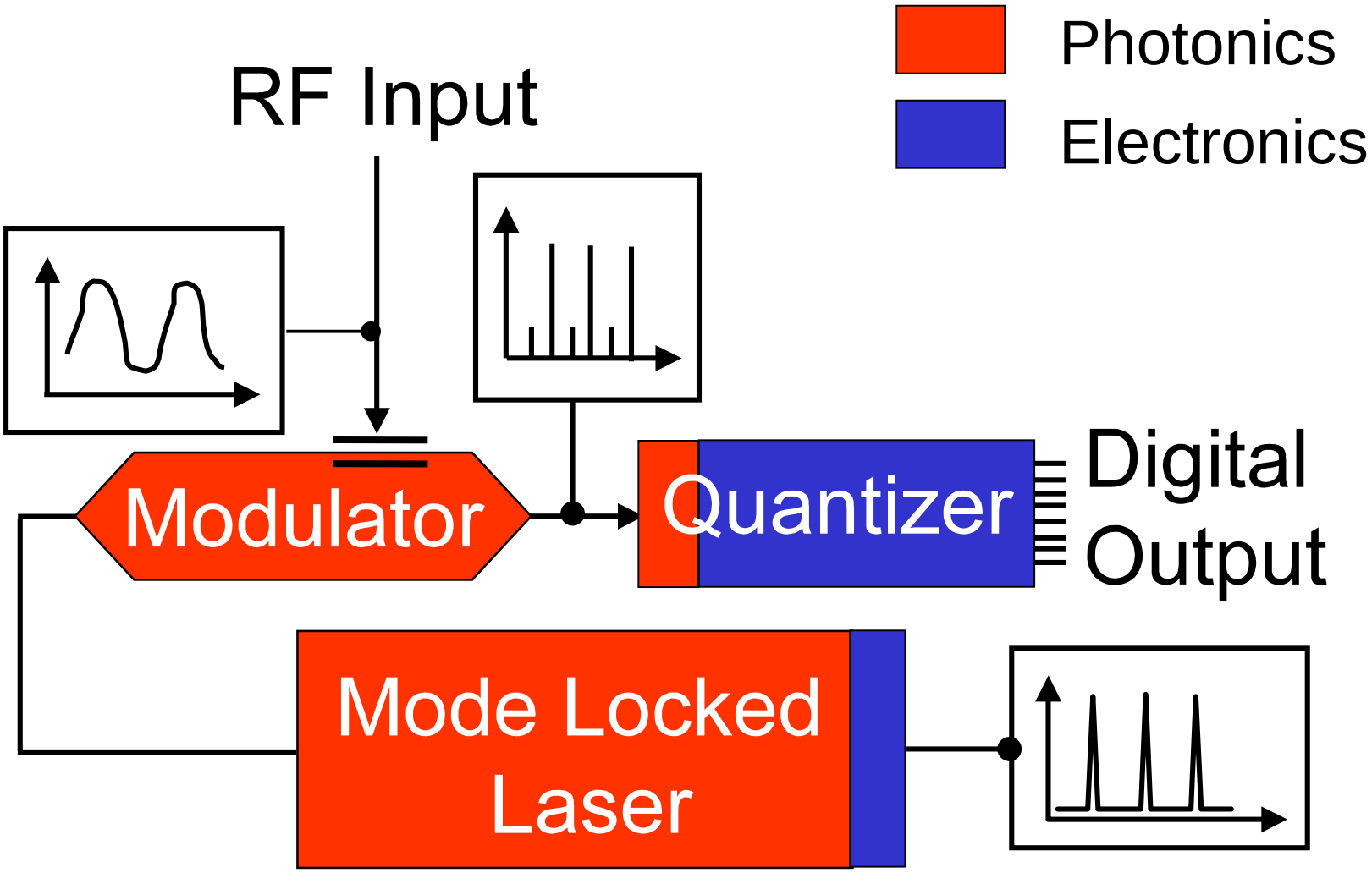
General Architecture



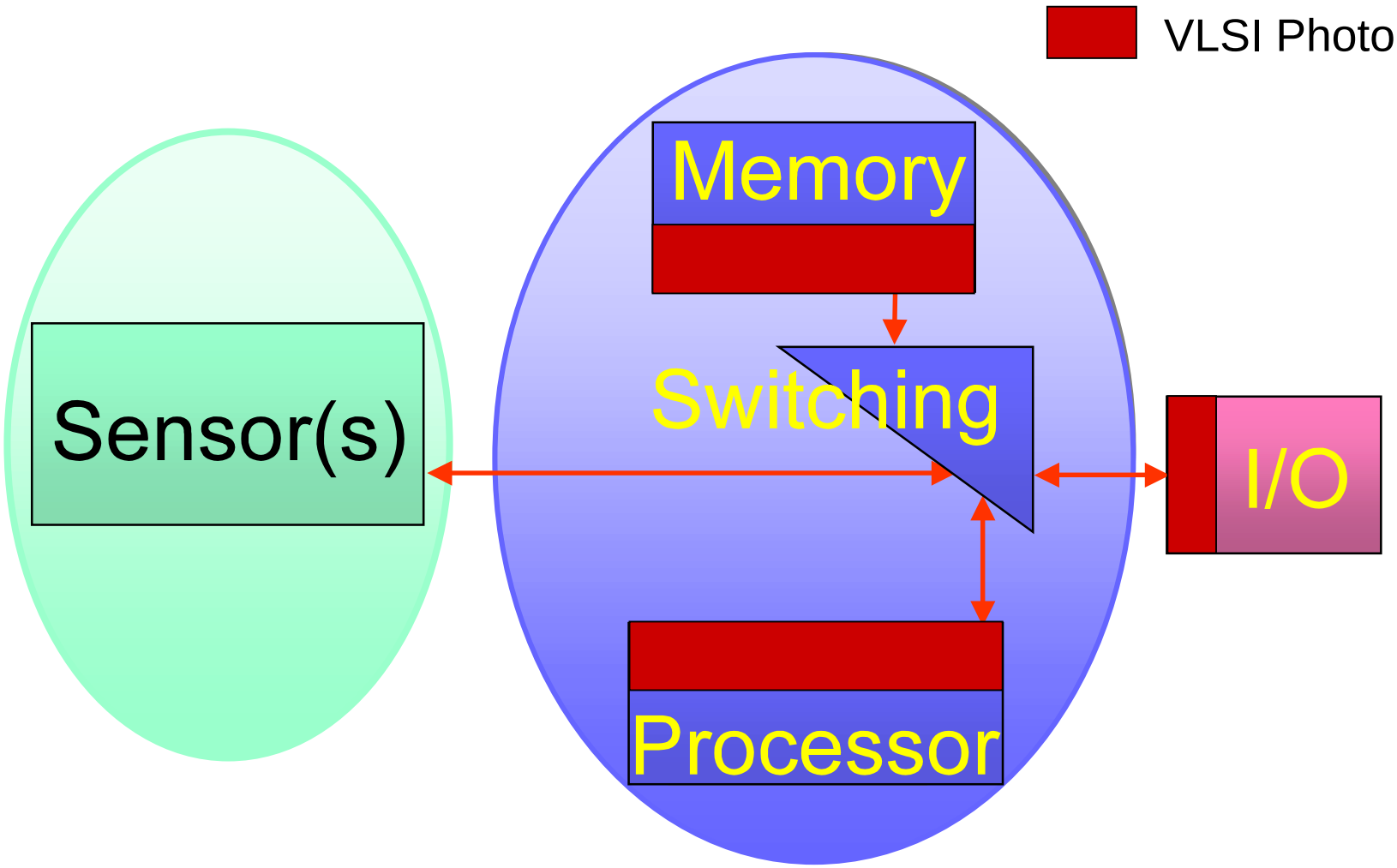
Photonic A/D Converter



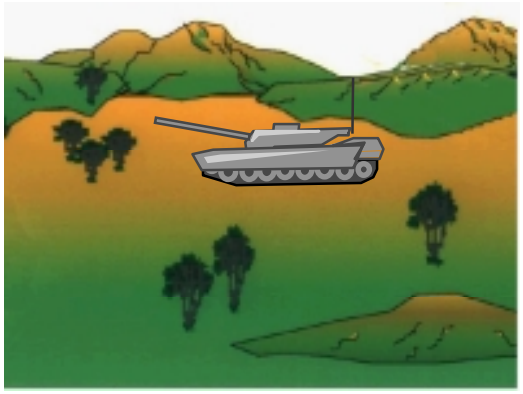
Photonic A/D Converter



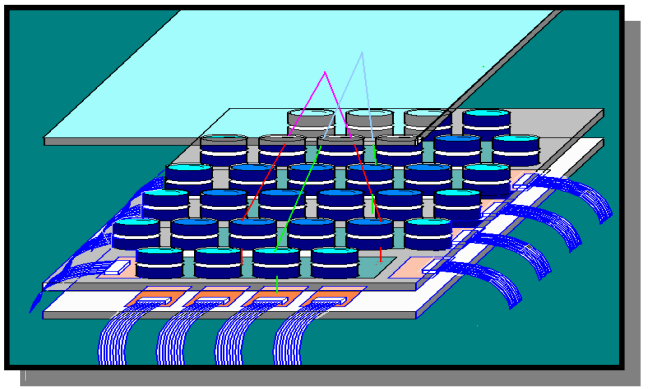
VLSI Photonics



VLSI Photonics

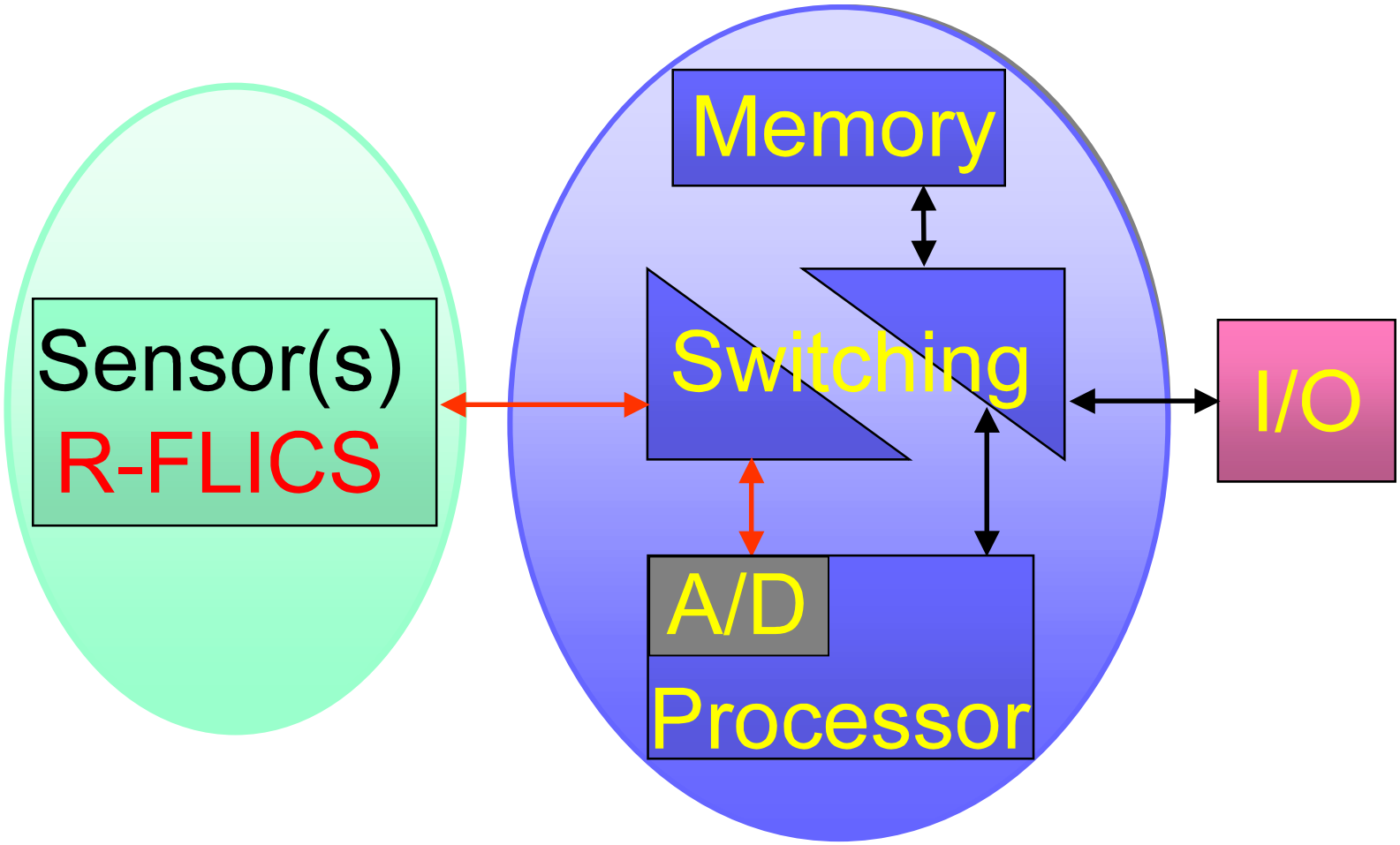


TBytes
of
Information

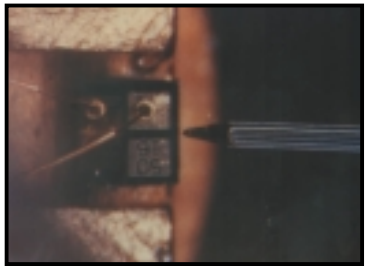


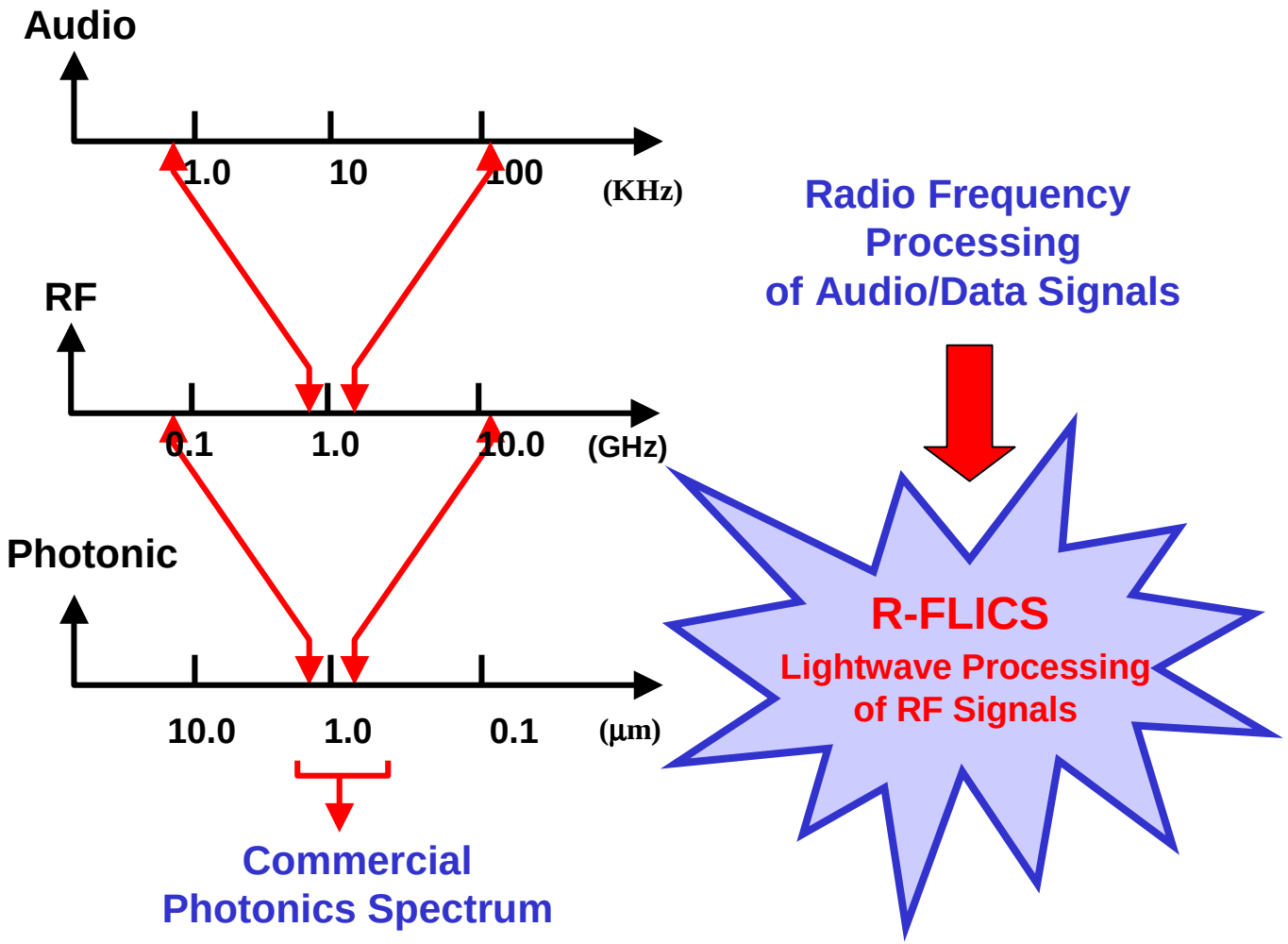
Chip-to-Chip Optical Interconnect

R-FLICS

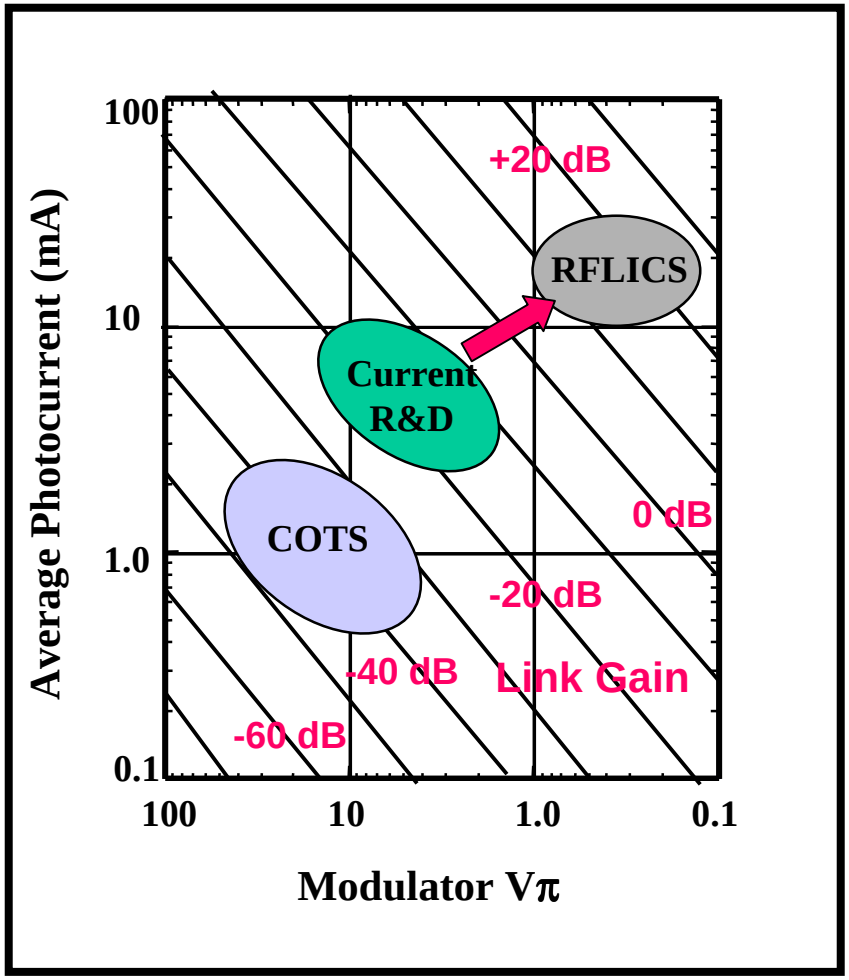


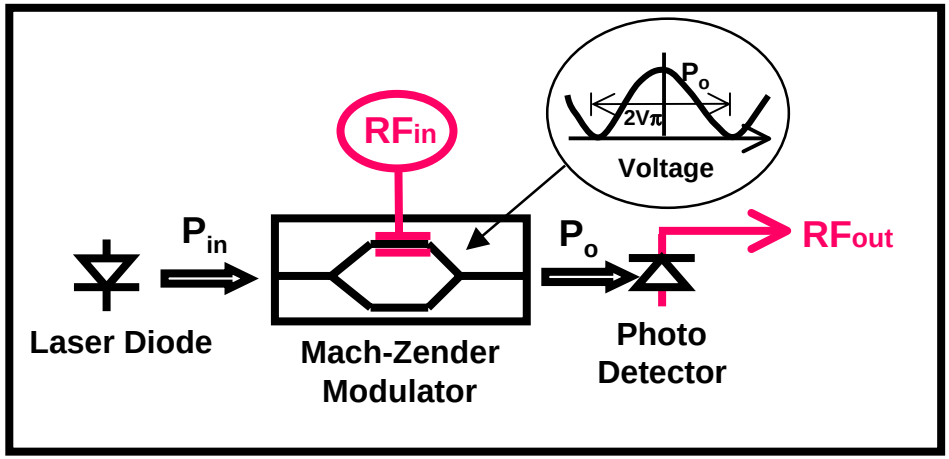
RF Lightwave Integrated Circuits (R-FLICS)





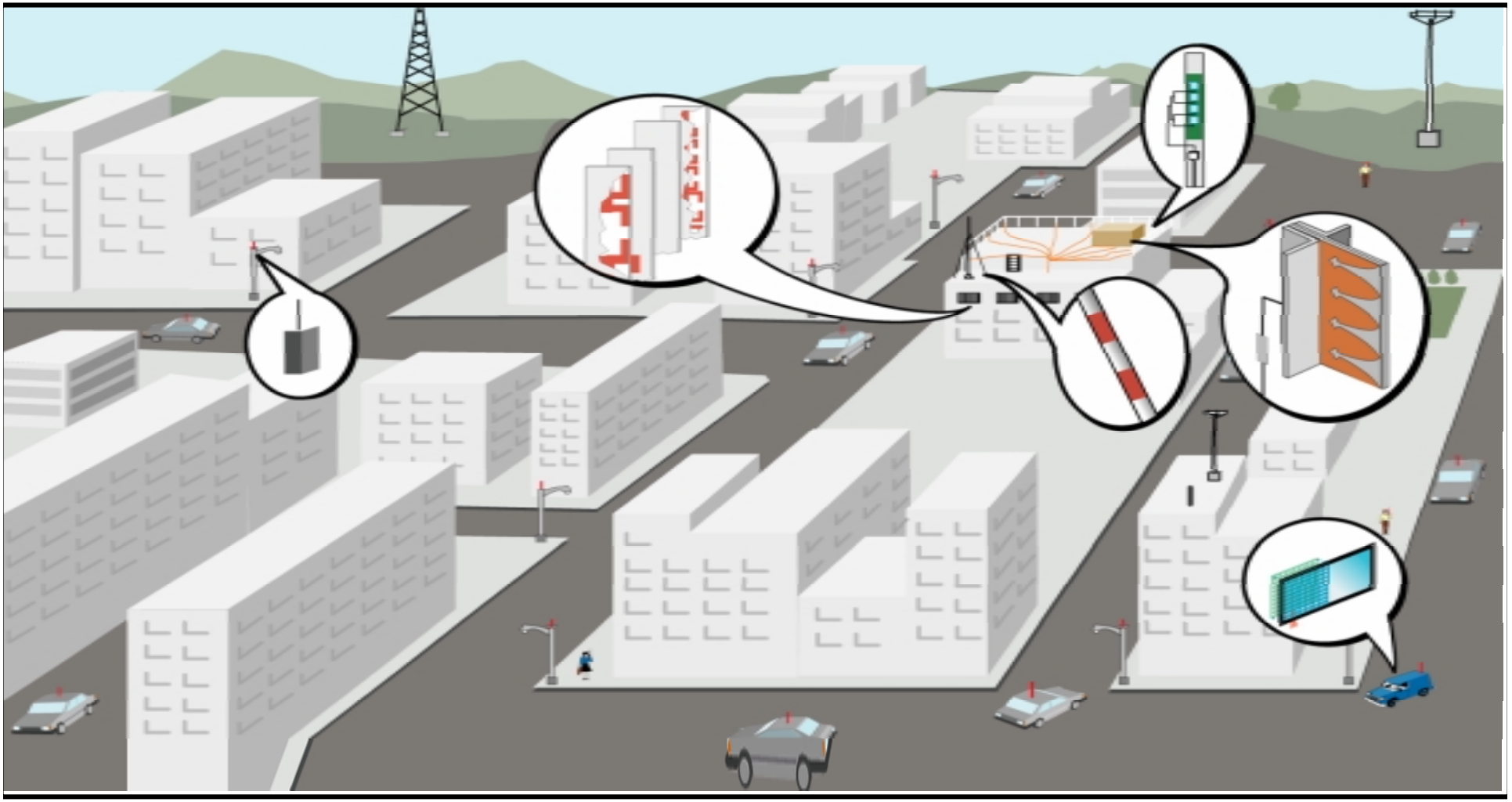
RF - Photonic Link Performance



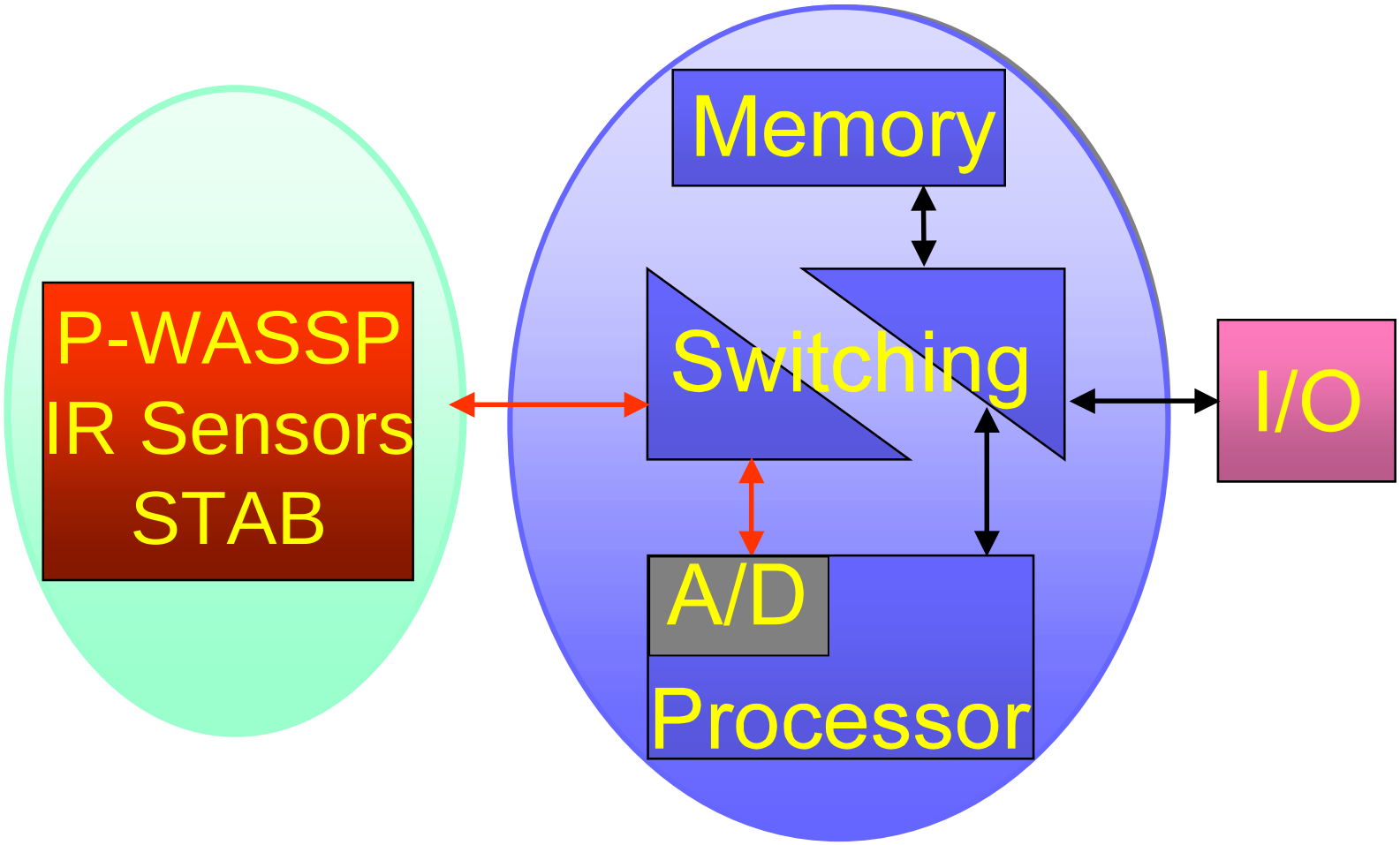


R-FLICS Application Example

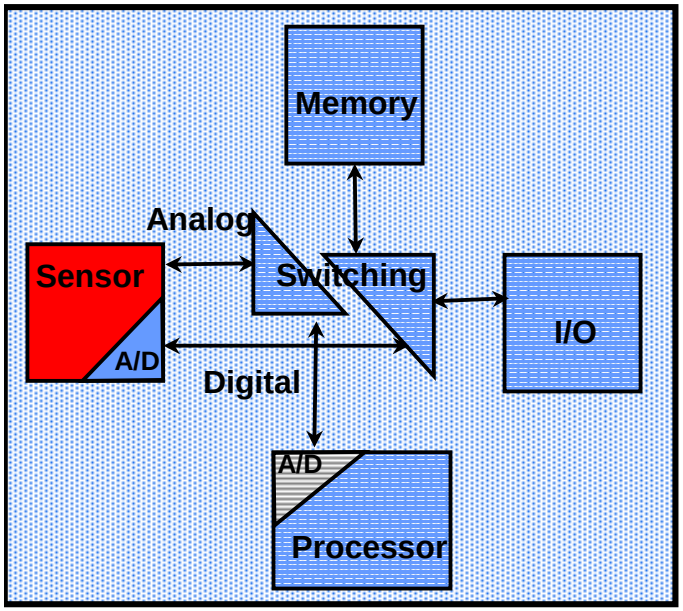
Urban Wireless Copy and Geolocation



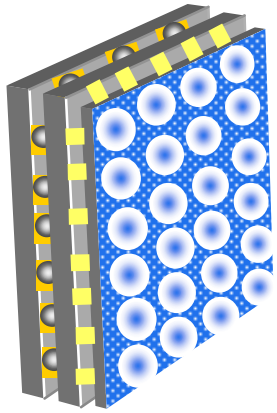
MTO Sensor Programs

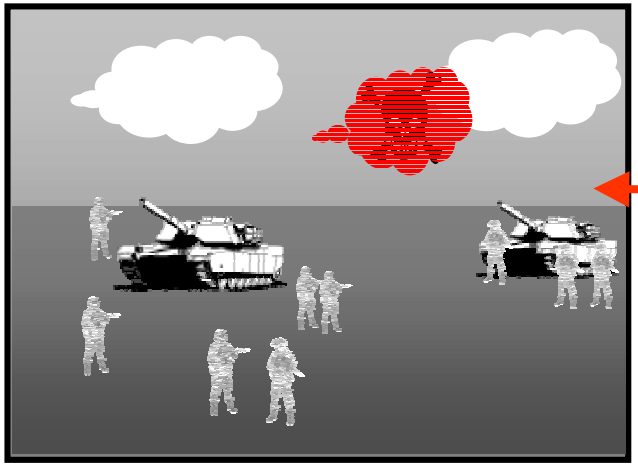


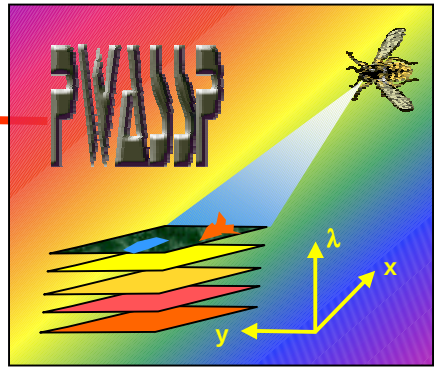
Photonic WASSP



Photonic WASSP





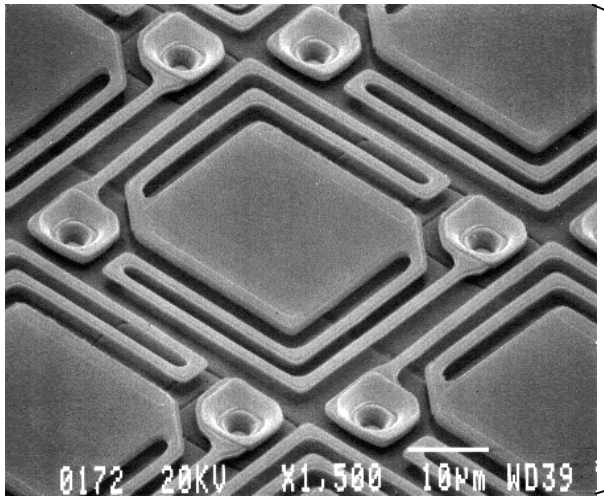


Advanced Uncooled IR Sensors

Missile Seeker

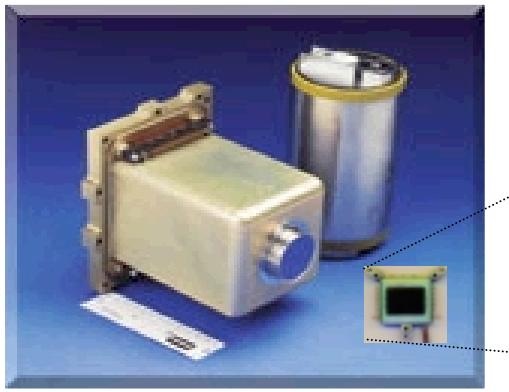
Target Acq.

Micro Sensor

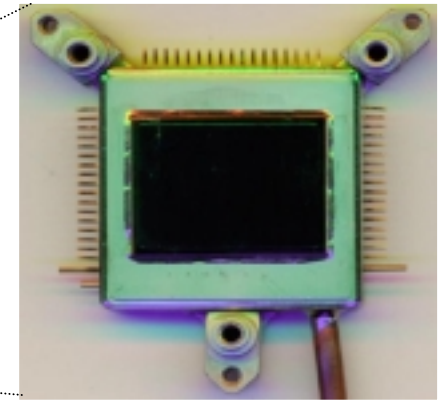


High Sensitivity Microbolometers

Why Uncooled IR Sensors?



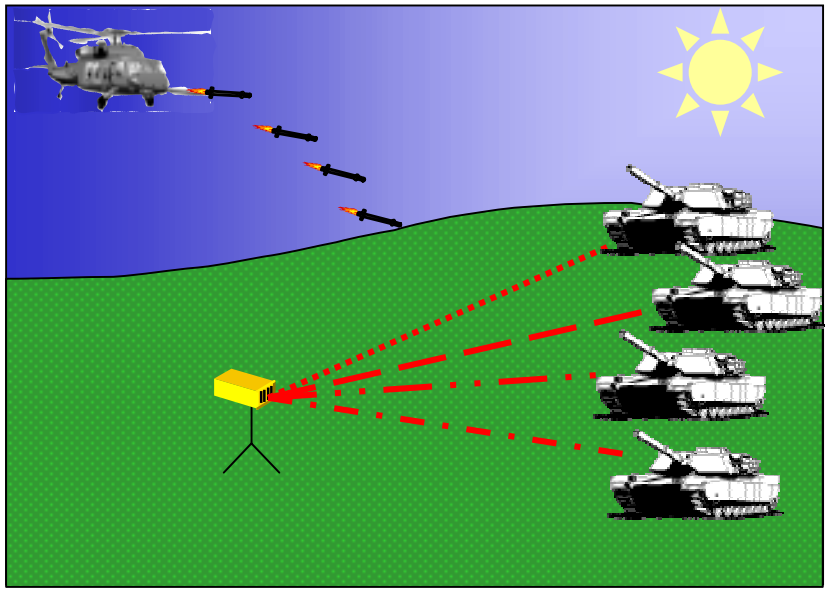
Cryogenic Sensor

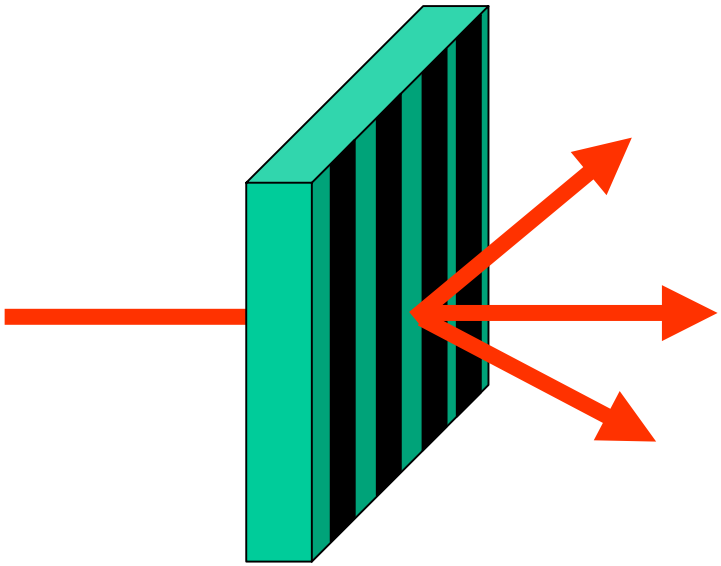


Uncooled Flat Pack

- 20 x Power reduction
- 10 to 100 x reduction in size
- 10 x Cost reduction

Steered Agile Beams





Multiple target engagements

Summary

- Use of photonics in analog and digital military/commercial systems in sensing, communications, and some limited signal processing
- Photonics can offer unique performance characteristics that purely electronic systems cannot
- Today, it is evident that significant benefits exist if we compute with electrons but communicate with photons