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WINLAB | Wireless Information Network Laboratory

# Mobile Optical Networks through Visual MIMO

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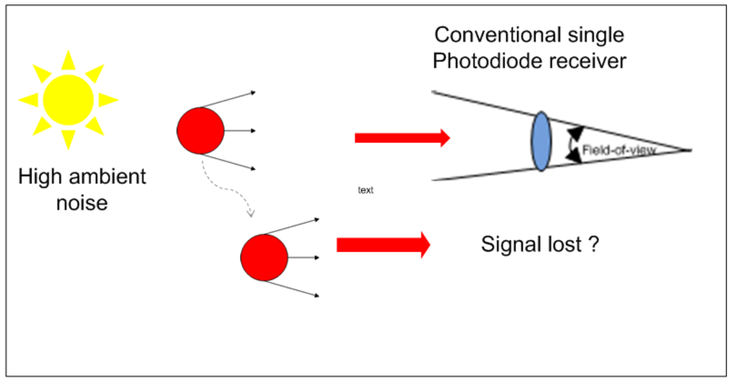
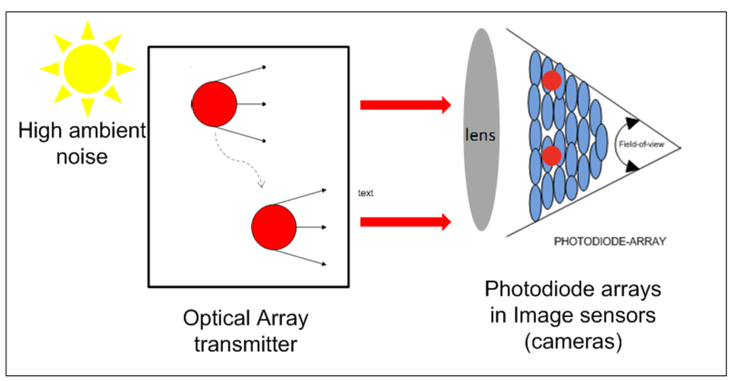
## 1. MOBILE OPTICAL COMMUNICATION

- **Conventional approaches are impractical**
  - highly directional communication
  - a few tens of meters of range – limited power and high background noise
  - mechanically steering transmitter and/or receiver is very costly
  - single photodiode receiver is the convention – primarily limited to static settings

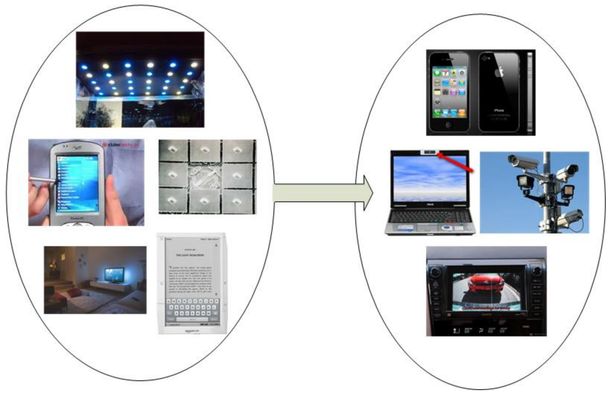
- **Optical array transmitters & receivers can help**




Optical Array transmitter + Camera receiver → VISUAL MIMO!

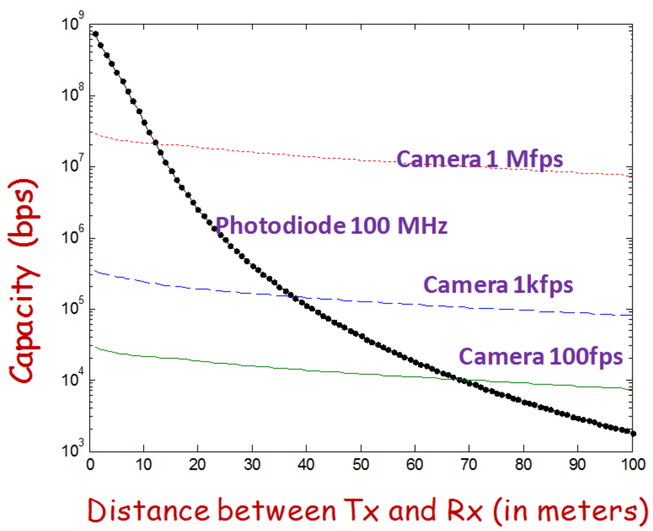
## 2. VISUAL MIMO MOBILE APPLICATIONS ARE NUMEROUS



Light Emitting Arrays and Cameras are ubiquitous these days !

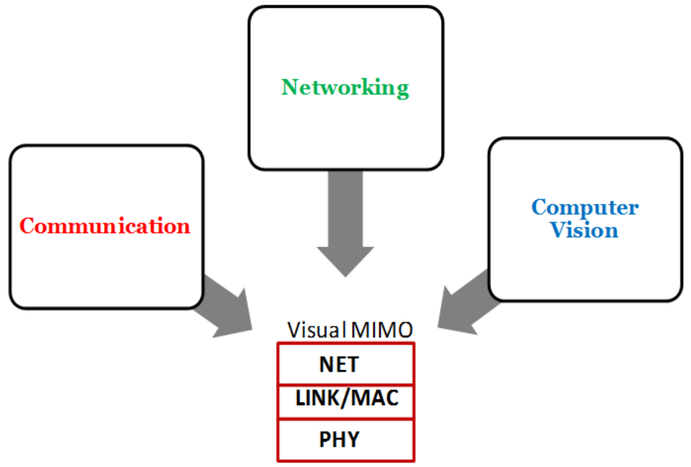
## 3. INTERESTING TRADE-OFF

| | |
|---|---|
| **array structures can help tolerate mobility and achieve good signal quality by reducing noise "interference free"** | **cameras are limited in sampling rates i.e. frame-rates** |



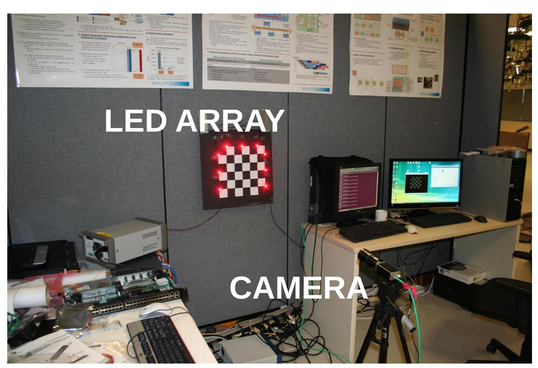

Shannon Capacity of a single LED transmitter Photodiode v/s Camera receiver

## 4. NOVEL CHALLENGES




- **Vision based PHY layer**
  - Vision based acquisition and tracking
  - Modulation and coding techniques to address perspective distortion, partial occlusions, embedding in visual imagery
- **Spatially aware LINK & MAC layer**
  - revisit ARQ, Error detection, Rate Adaptation protocols
  - free for all access with inherent "Interference cancellation"
  - SDMA for partial occlusions
- **Network Layer**
  - Relaying and routing for interference free channels
  - Visual localization
  - New energy tradeoffs – complex receiver processing

## 5. PRELIMINARY EXPERIMENTAL PROTOTYPE

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## 6. REFERENCES

Ashwin Ashok, Marco Gruteser, Narayan Mandayam, Jayant Silva, Michael Varga, and Kristin Dana. **Challenge: Mobile optical networks through visual MIMO**. In *Proceedings of the sixteenth annual international conference on Mobile computing and networking* (MobiCom '10). ACM, New York, NY, USA, 105-112