



Research Consortium in Speckled Computing

Free Space Optical Communication System Using VCSELs

James Mathews

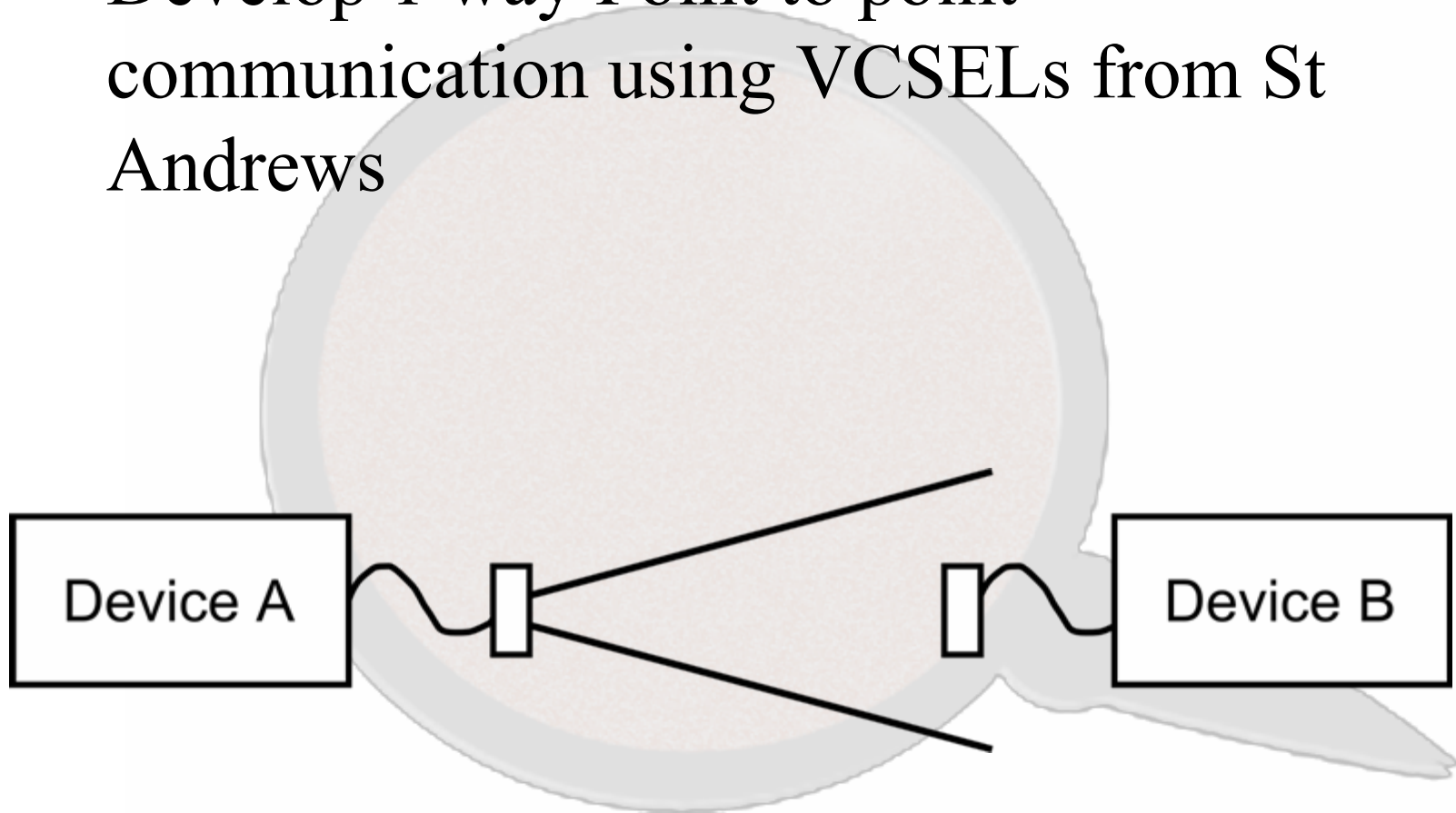
University of Edinburgh

jammers@gmail.com



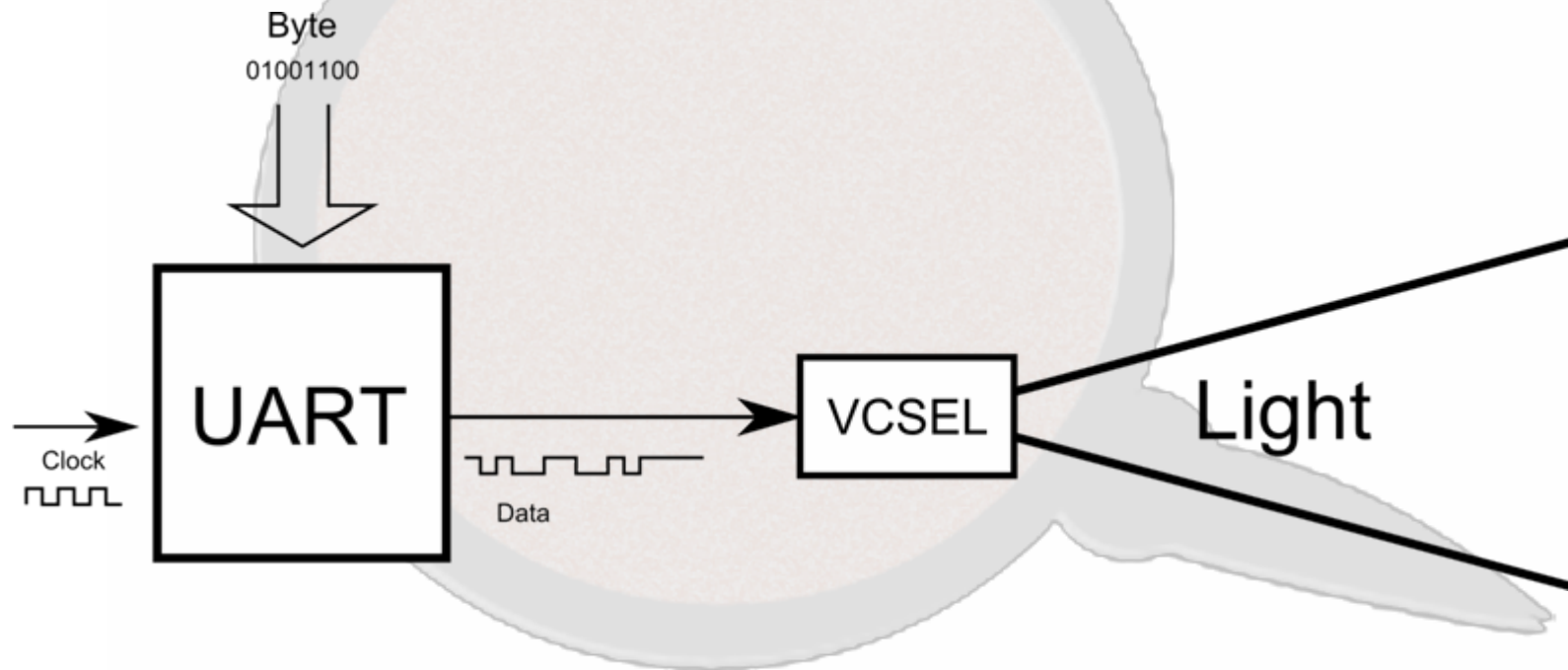
Goal

- Develop 1 way Point to point communication using VCSELs from St Andrews



Sending

- Used a UART to transmit data
- Pulses the laser



Receiver

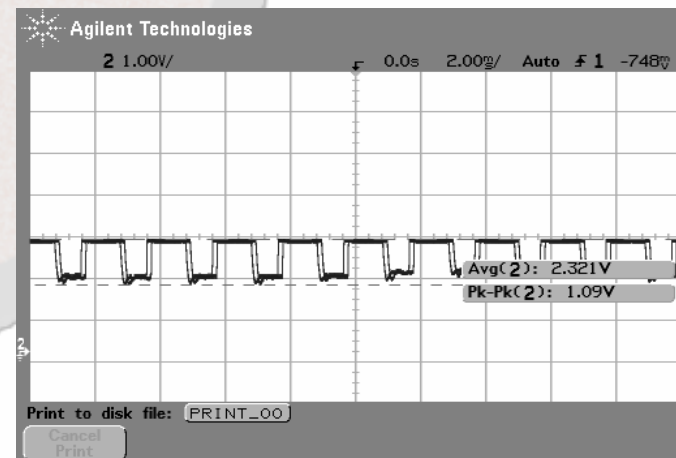
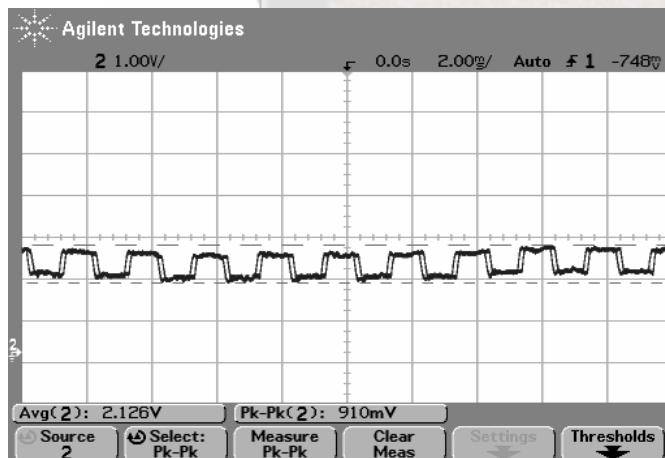
- Operates the detector in photo **Photovoltaic** mode.
- Detector produces current when light falls on it
- **Transimpedance** stage converts generated current to voltage
 - Low noise
 - Higher received signal strength
 - Slower response

Receiver

- Trade off between transmission speed and received signal strength
- Absolute limit determined by internal capacitance
- Current transmission speed, about 4Kbaud.

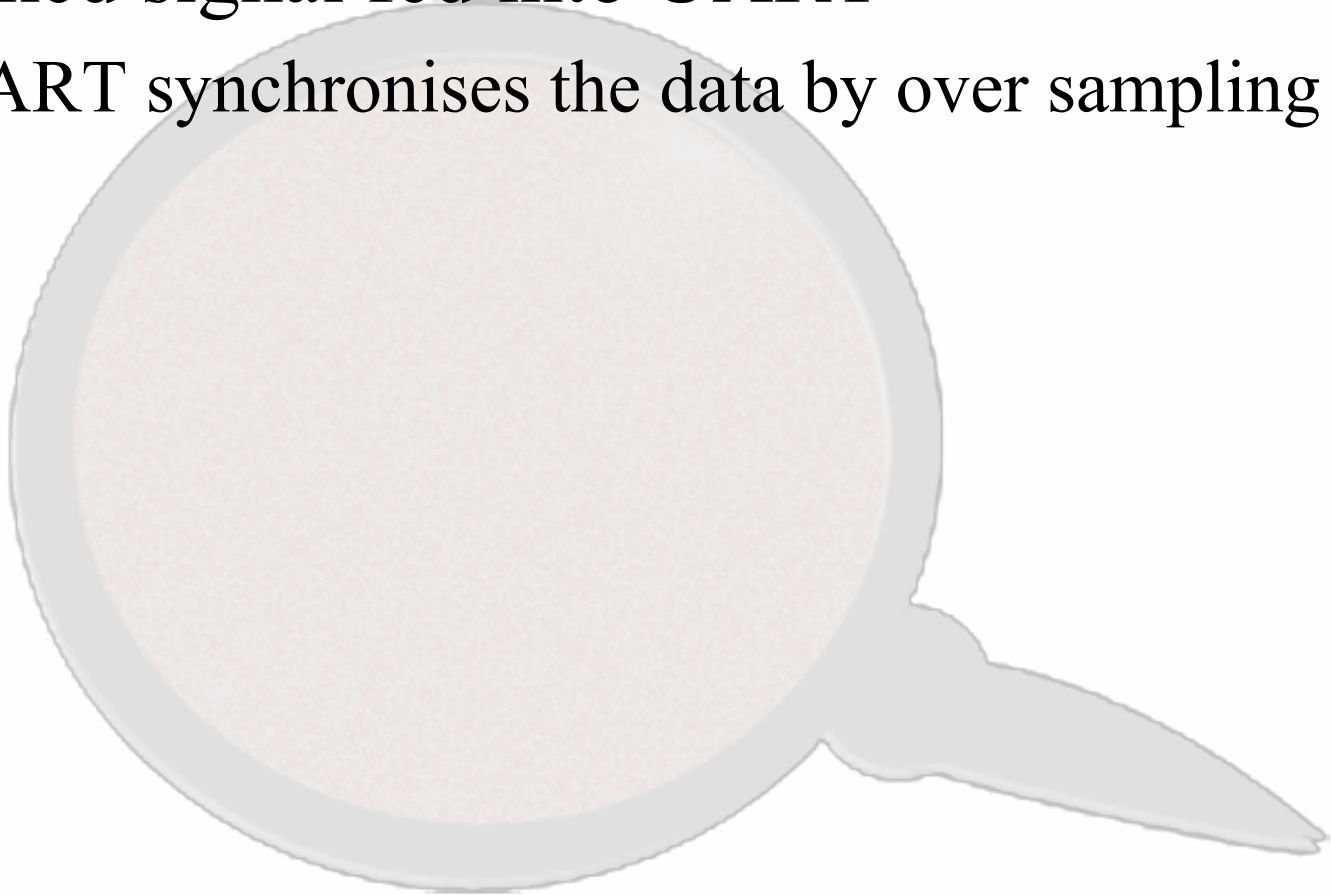
Receiver

- Signal needs to be tracked due to biases
 - Biases arise through amp stages, detector biases and other sources
- Either in software or hardware

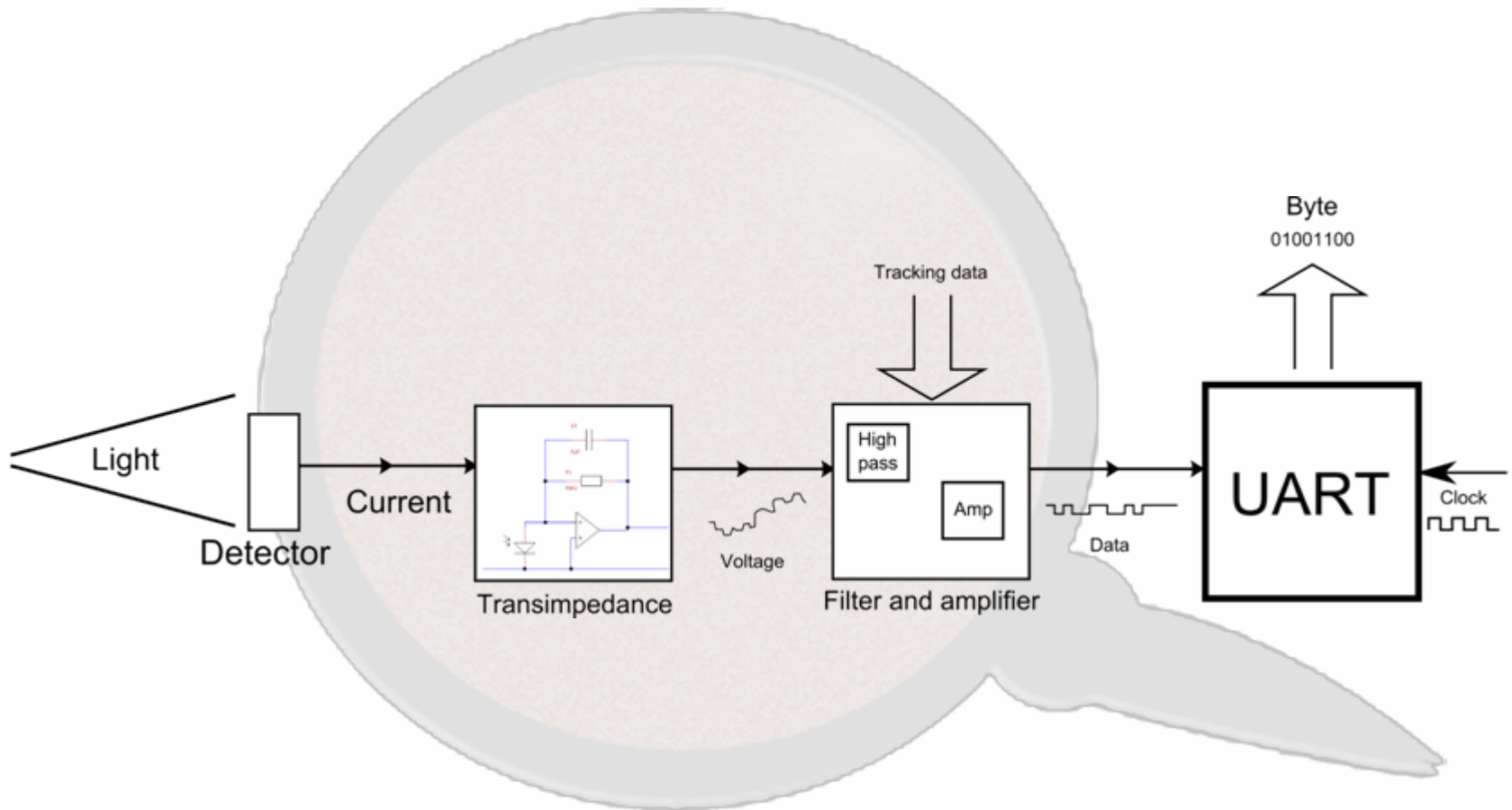


Receiver

- Tracked signal fed into UART
 - UART synchronises the data by over sampling



Receiver



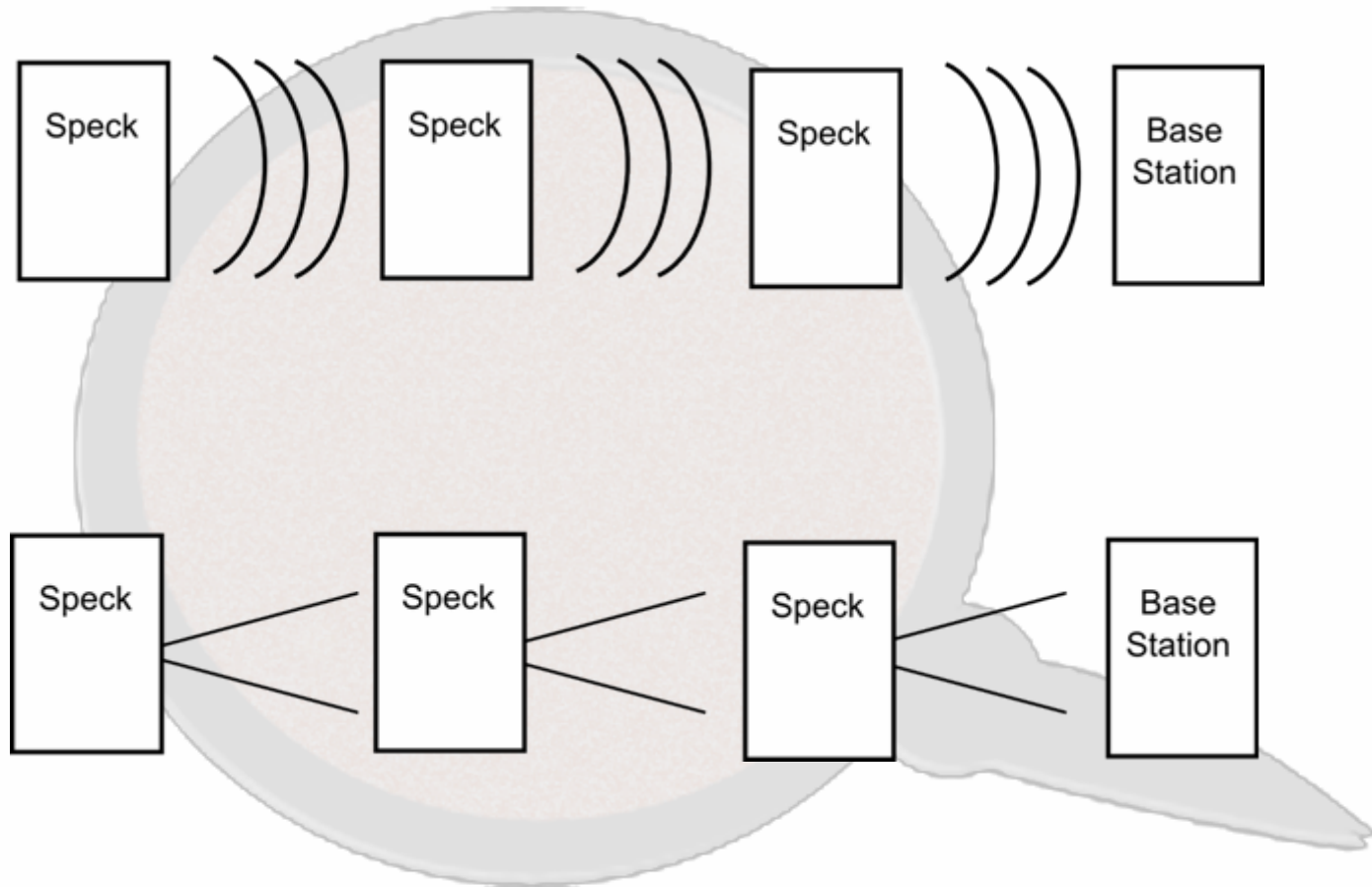
Receiver

- Power consumption of current receiver
 - 240 μ A
 - 2 orders of magnitude lower than Prospeckz II radio!
 - Low enough to keep running constantly powered from solar cells.
 - Wake up processor on receive

Asynchronous, Low Latency communication

- Multi hop network of specks.
- Messages require multi hop routing.
- Duty cycled MAC protocols may increase latency at each hop.
- Using lasers to wake up and forward message on reduces delay.

Asynchronous, Low Latency communication



Receiver

- Current receiver setup uses software tracking
- Range just under 1m
- Transmit current: $\sim 66\text{mW}$ ($\sim 20\text{mA}$, 3.3v)
- Receive current: $\sim 800\mu\text{W}$ ($240\mu\text{A}$, 3.3v)