

Single Photon Technology for 21st Century Connectivity and Autonomy

Mark Itzler

Princeton Lightwave Inc.

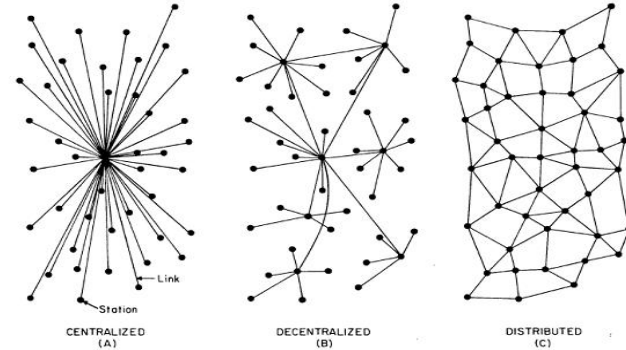
mitzler@princetonlightwave.com

www.princetonlightwave.com

21st century technology explosions

Connectivity of devices

Distributing information



Autonomy of devices

Collecting information

Processing information



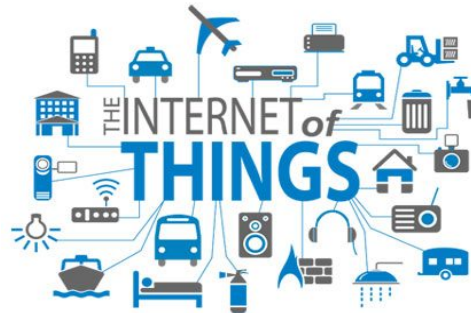
Device Connectivity

Distributing information with

High Performance

High Sensitivity, High Rate

Security (= Privacy)



Device Autonomy

Collecting information

Processing information

to achieve

Environmental Sensing / Situational Awareness



From 20th to 21st century challenges...

For **distributing** and **collecting** information:

RF (20th cent.)  Photonics (21st cent.)

Copper  Fiber

Radio  Free-space optics

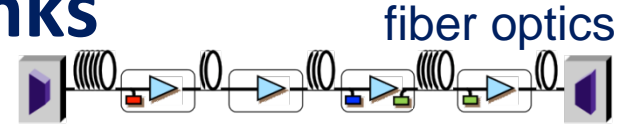
Radar  LiDAR

Optical bandwidth \gg RF bandwidth
10,000 X

Maximum efficiency }
Minimum power } using **single-photon technology**

Connectivity with Photonics:

20th century: “short” terrestrial links



21st century: links are much longer

Expanding the internet

Sky-Fi

Apr 11, 2015



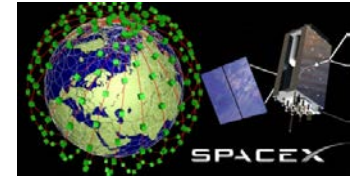
balloons



drones

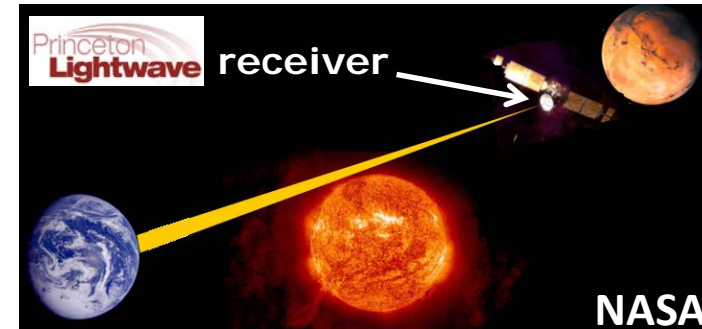


satellites



Networking the solar system!

Single-photon technology
for long-range connectivity



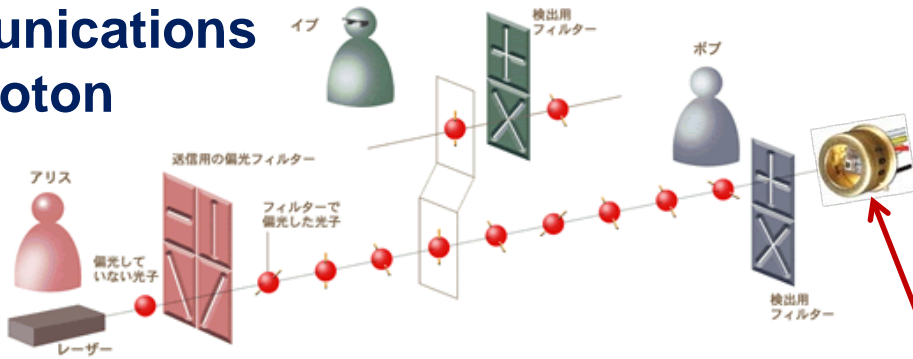
For Security / Privacy:

20th century: security by inaccessibility



21st century: security w/accessibility

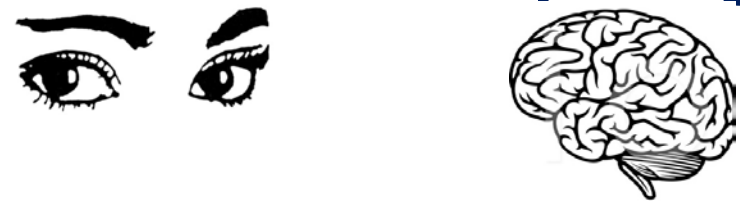
Secure communications
with single-photon
technology
(QKD)



Princeton
Lightwave
single-photon
detector

For Autonomy:

Replace human sensors & computing... (20th cent.)



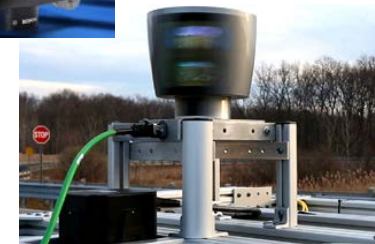
...with robotic sensors & computing (21st cent.)

“auto-mobile” → autonomous mobility

- | | |
|-------------------------------|------------|
| passive optical cameras | 2D |
| radar (reflected radio waves) | low-res 3D |
| LiDAR (reflected light waves) | hi-res 3D |



Single-photon LiDAR w/ Princeton Lightwave detectors



Example: disruptive data collection

Environmental sensing by aerial mapping

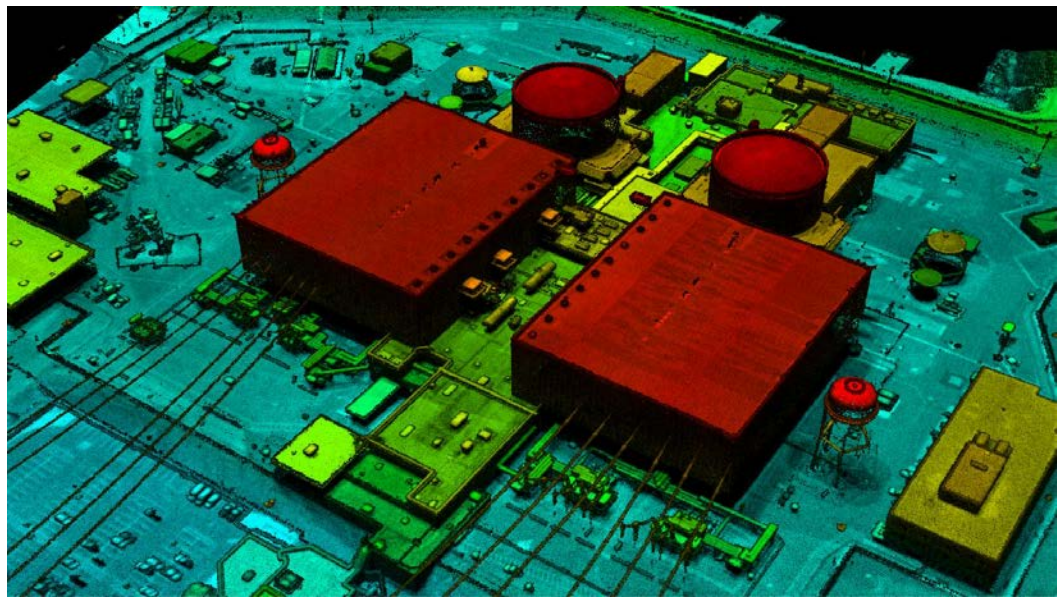
Single-photon 3D LiDAR imaging

enables 10X faster data collection than other technologies



Princeton
Lightwave
single-photon
3D LiDAR
camera

data courtesy of
HARRIS



Photonics for 21st century challenges

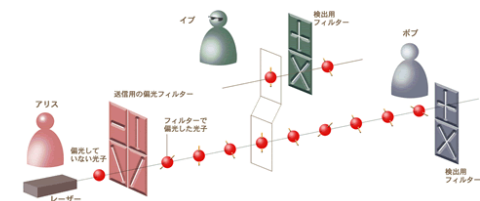
Connectivity → Distributing information

High Performance: single-photon tech

Long-distance communication

Security & Privacy: single-photon tech

Quantum cryptography



Autonomy → Collecting/Processing information

Environmental sensing: single-photon tech

3D LiDAR imaging

