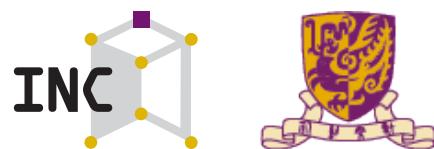


# Update on the Deployment of BATS Codes

Raymond W. Yeung

Institute of Network Coding  
The Chinese University of Hong Kong



n-hop technologies  
Hong Kong



# Why BATS?

- Multi-hop is a longstanding problem in wireless communication
- Transmission can sustain no more than a few hops **if data packets are treated as commodities**
- **The multi-hop curse**
- **BATS** can sustain tens or even hundreds of hops, without relying on link-by-link retransmission (very bad for video transmission)
- Recoding is employed at the intermediate nodes



MORGAN & CLAYPOOL PUBLISHERS

# BATS Codes

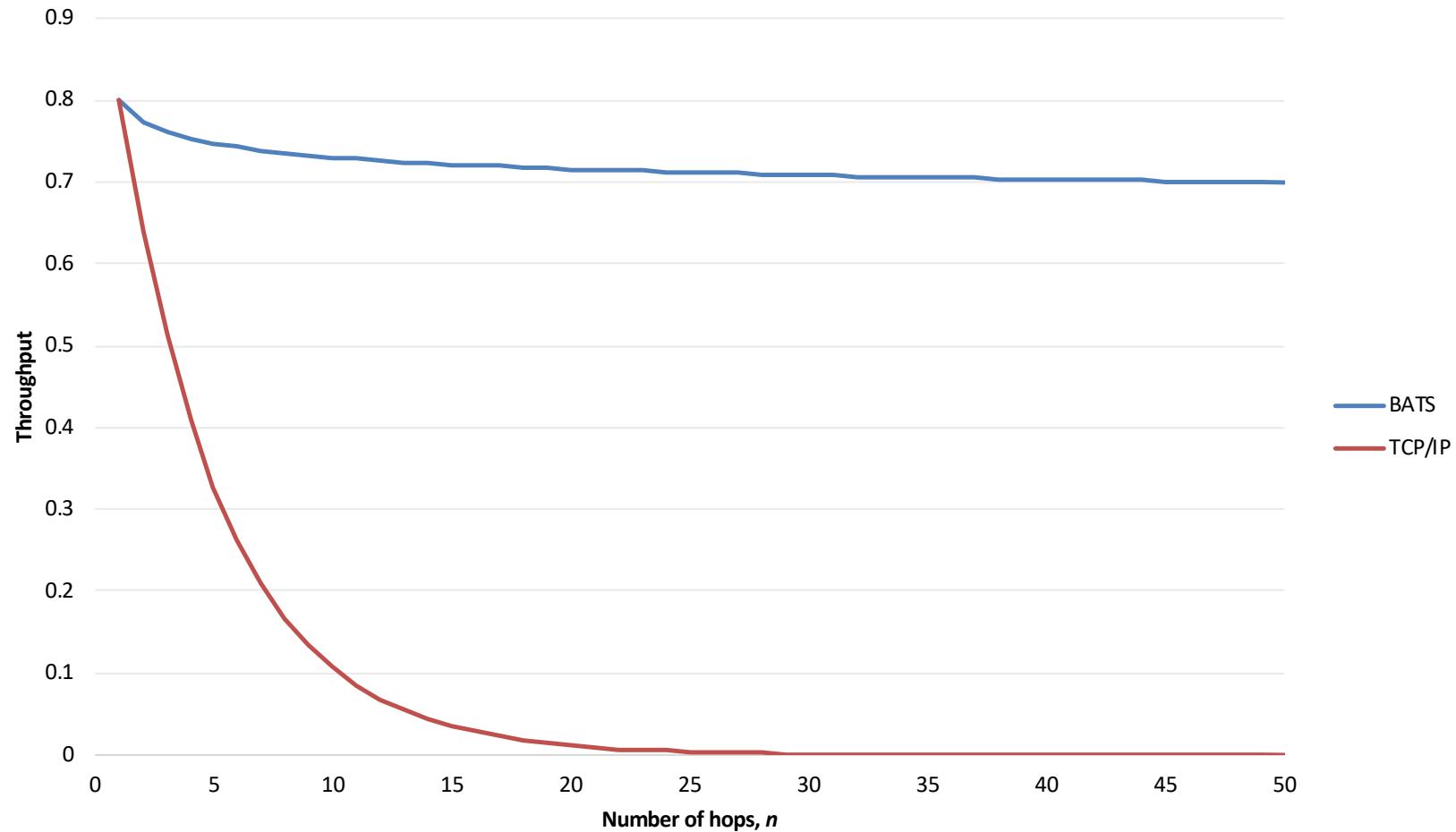
## *Theory and Practice*

**Shenghao Yang  
Raymond W. Yeung**

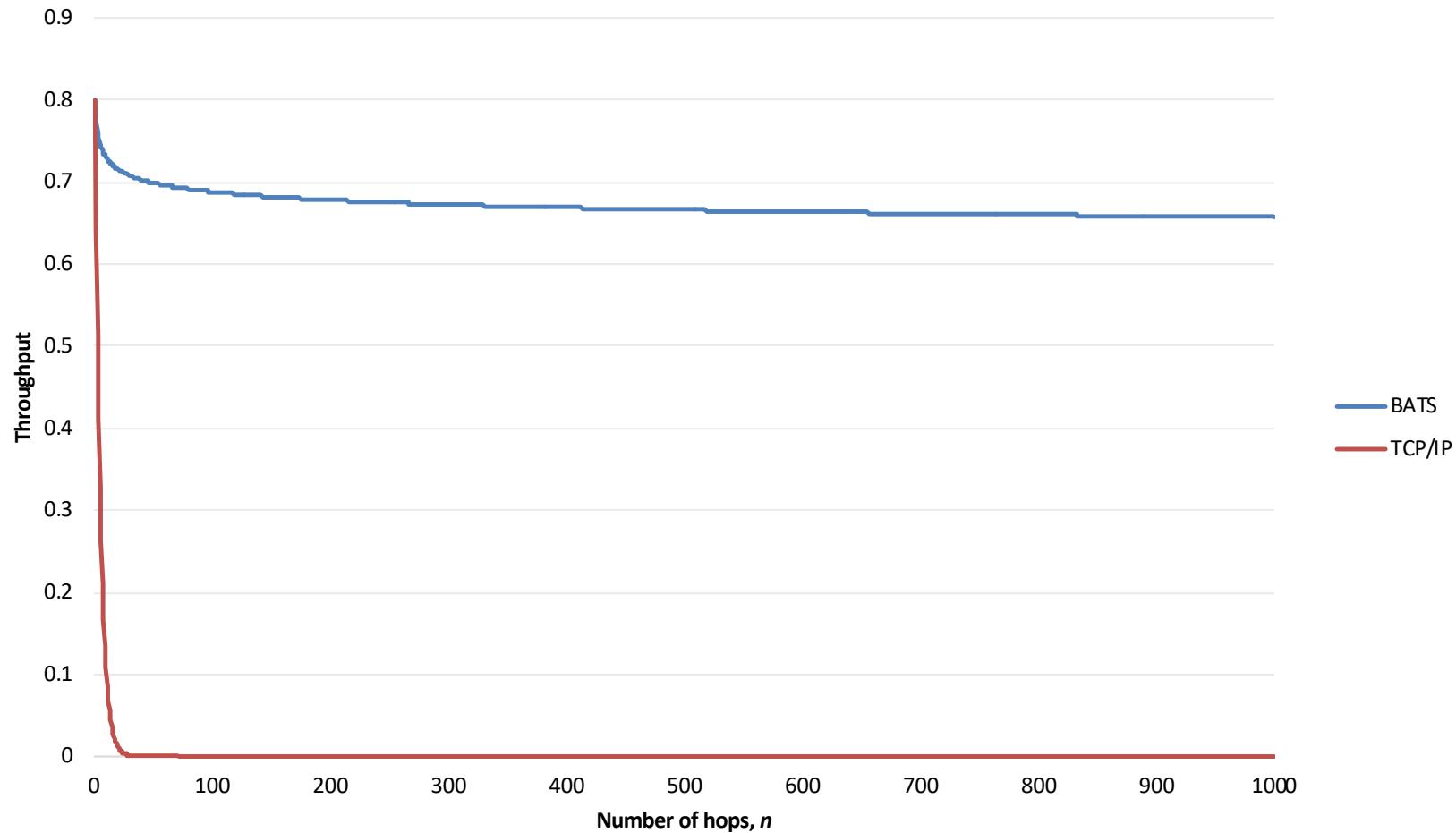
*SYNTHESIS LECTURES ON  
COMMUNICATION NETWORKS*

R. Srikant, *Series Editor*

# Performance Comparison

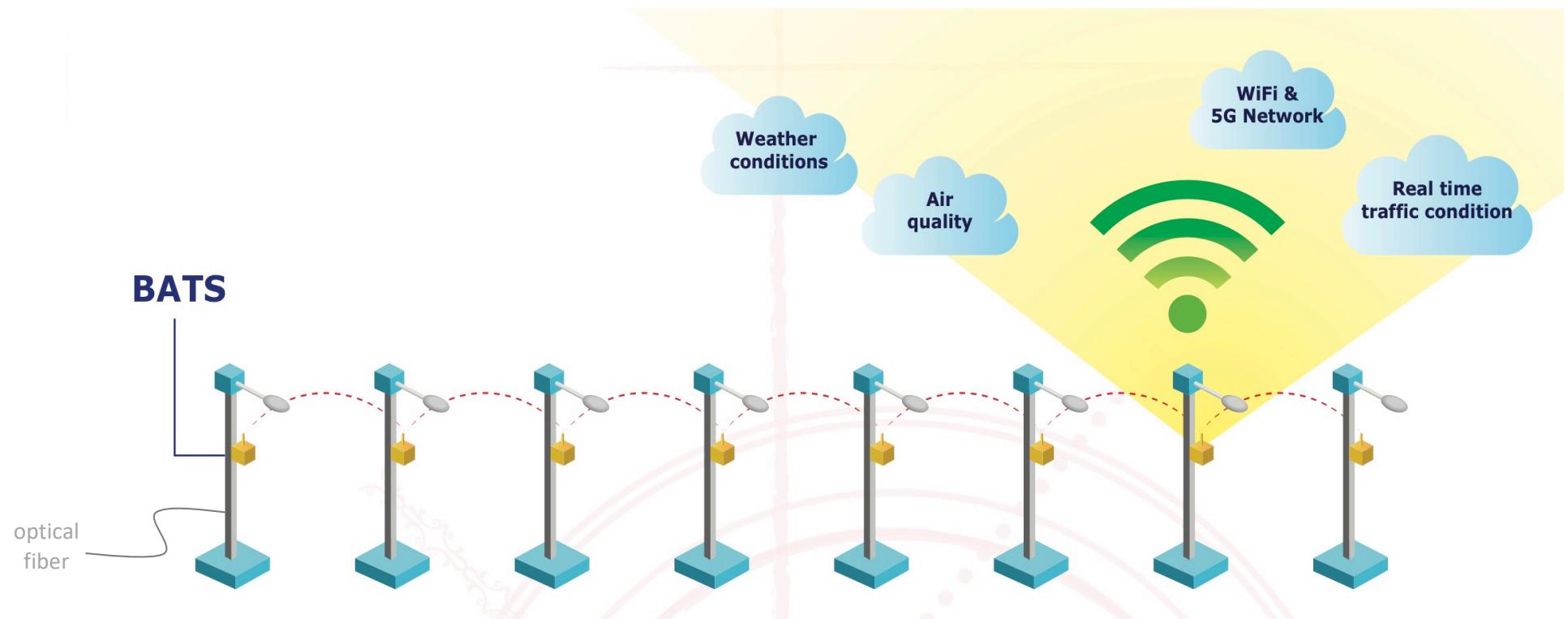


# Performance Comparison



# Hong Kong Smart Lamppost Project

# Smart Lamppost Connectivity



# Pilot Project

- Successfully deployed BATS in 36 smart lampposts
- The general public has concern about the installation of video cameras on the lampposts due to possible infringement of privacy
- Hopefully can resume by end of 2021, with video cameras replaced by LiDARs



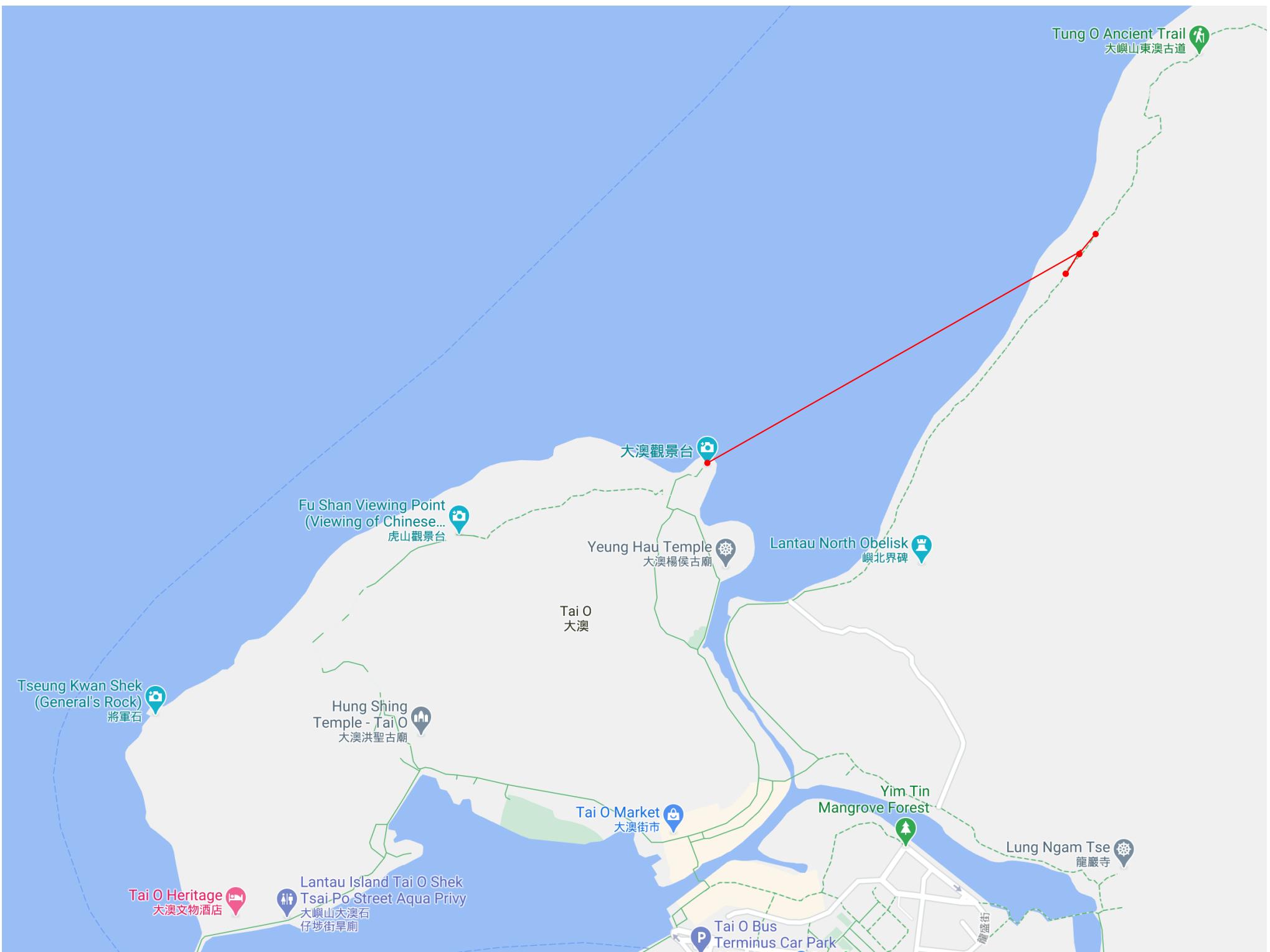
# Smart Lamppost Testbed on CUHK Campus

# BATS + Fog Computing

- BATS is inherently a fog computing application because the computation must be done at the edge
- Installing 20 fog computing based smart lampposts on the CUHK campus, with BATS being provided as a service
- Services to be provided
  - WiFi access
  - Lamppost-assisted autonomous driving
  - Real-time traffic monitoring with AI applications

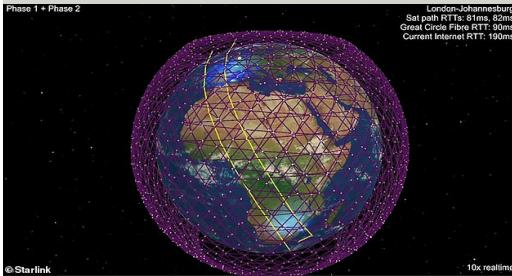


# Hong Kong Country Park Pilot Trial





# Addressable Markets



Satellite communications



Rural communications



Private networks



Rapid response



Smart cities



V2X



Safety & surveillance



Internet of Things



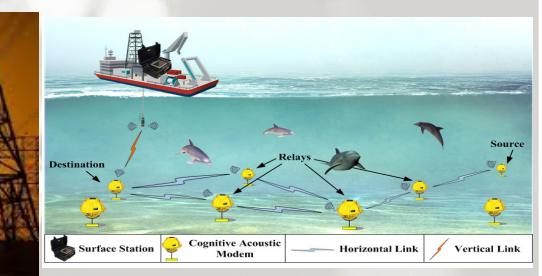
Confined space



5G



Powerline communications



Underwater communications



## Field Programmable Gate Array (FPGA) for Mass Market

In-house  
development and  
implementation in  
progress.

Supported by  
Intel FPGA  
development  
team

Address mass  
equipment market  
for cost and  
performance.

Facilitated and  
supported by  
Arrow  
Electronics on  
logistics and  
market  
development.

Mass  
market



# Internet Draft Submitted

BATS Coding Scheme for Multi-hop Data Transport  
draft-irtf-nwcrg-bats-00 (Feb 02, 2021)

Prepared by

Shenghao Yang

The Chinese University of Hong Kong, Shenzhen

Xuan Huang, Raymond W. Yeung

The Chinese University of Hong Kong

John K. Zao

National Chiao Tung University

# Main Contents of the Draft

- Basic data delivery procedures using a BATS code
- A baseline BATS code specification
- Related research issues (**new**)
  - Coding design issues
  - Protocol design issues
  - Application related issues
- Security Considerations

# Thanks to

- NWCRG Chairs Marie-Jose and Vincent
  - suggestion to add discussions on related research Issues
- Dave Oran
  - pointer to Byers and Luby’s recent work on “Liquid Data Networking”

# BATS IPs

- 3 US Patents
  - US Patent No. 8693501
  - US Patent Application No. US10425192
  - US Patent No. US10237782
- 5 EU Patents
  - DE validation of EP Patent No. 2644004
  - FI validation of EP Patent No. 2644004
  - FR validation of EP Patent No. 2644004
  - GB validation of EP Patent No. 2644004
  - SE validation of EP Patent No. 2644004
- 3 China Patents
  - CN Patent No. ZL 201180055775.3
  - CN Patent No. ZL 201610857698.8
  - CN Patent No. ZL 201811256029.0
- 1 MO Application
  - MO Patent Application No. J/004408

# Thank you

