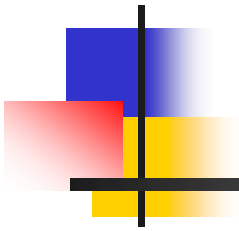

Improving TCP performance in mobile satellite IP communications

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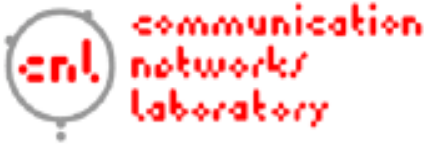


Simon Fraser University

Roadmap

- Background
  - mobile satellite communications
  - transmission control protocol (TCP)
- Motivation for TCP performance improvement
- Mobile satellite services
  - risks
  - uncertainties
  - ethics
- Possible scenarios
- Conclusion and References

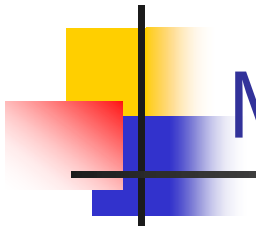
Background

- Mobile satellite communications:
  - occurs between an earth station or mobile entities to another earth station via artificial satellites
- Seamless, ubiquitous system–based on integrated satellite/ground-based technology:
  - provides coverage for both land and maritime areas not reachable by cable
- Satellite link characteristics:
  - high bit error rate (BER)
  - long and varying propagation delay
  - varying bandwidth
  - asymmetric path (uplink and downlink bandwidth)

Background

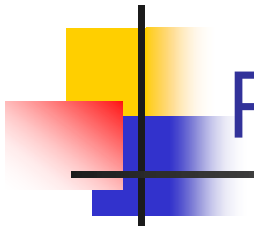
- Transmission Control Protocol (TCP) and Internet Protocol (IP):
  - specify rules of communication between end-hosts on the Internet
  - used for most Internet applications such as Telnet, HTTP, and FTP
- TCP was originally designed for wired network:
  - random BER is negligible
- The Internet:
  - has witnessed tremendous growth in wireless IP communications

HTTP: hypertext transfer protocol
FTP: file transfer protocol
BER: bit error rate



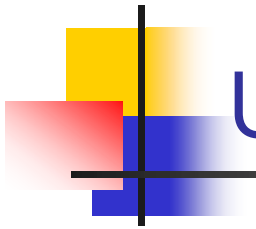
Motivation

- Ubiquitous computing:
  - “everywhere computing: a human-centric system”
  - quality of service (QoS) is maintained for network services as in wired networks
- The problem:
  - packet losses occur in satellite networks due to link characteristics
  - TCP misinterprets packet losses as an indication of congestion
  - QoS is affected by long propagation delay and jitter
  - design issues arise in satellite transmission circuits using TCP as primary transport protocol



Risks

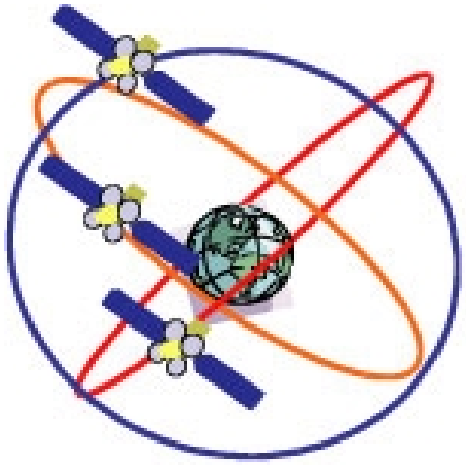
- Security concerns:
  - unlicensed operators/users
    - interfere with existing systems
    - hack into existing systems
  - license exempt frequencies
- Financial implications in providing affordable services:
  - remote areas in developed countries (aboriginal communities in Northern Canada)
  - developing nations



Uncertainties

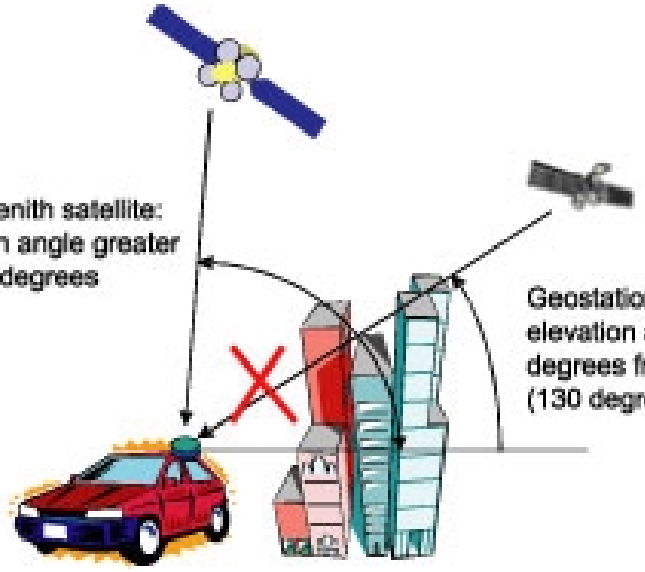
- Continuous proposals on frequency band allocation:
  - additional frequency bands being introduced
- Multiple stages from conception to actualization:
  - time-consuming
  - unpredictable outcomes
- Various types of artificial satellites still in developmental phases:
  - geostationary
  - non-geostationary
    - highly elliptical orbit, medium earth orbit, low earth orbit, and quasi-zenith (Japanese initiative)

Quasi-zenith satellite system



Satellites are placed on two to four orbital planes

⇒ two to four satellites pass over Japan, with one satellite located near zenith over Japan



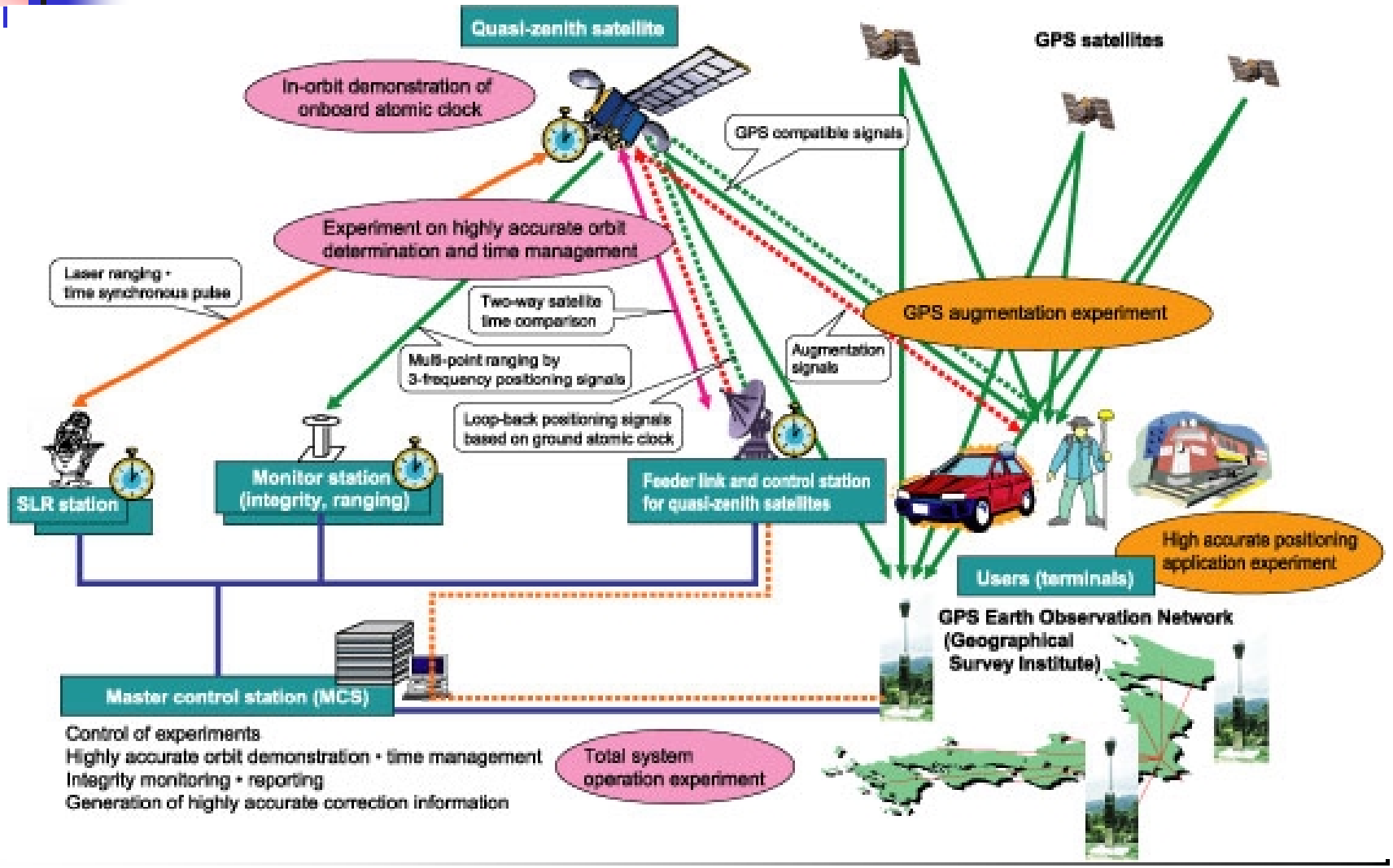
Ethics

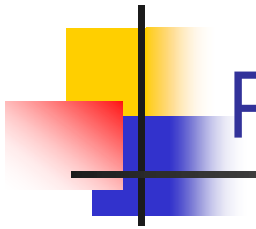
- Public vs. commercial needs:
  - true technological partnerships to improve quality of daily life for communities with the greatest need
- Standardization of domestic, national, and international policies
  - fairness in capacity allocation and sharing:
    - primary vs. secondary services
    - incumbent vs. future services
    - developed vs. developing countries
      - have issues of wasted bandwidth due to excessive spam (Nigeria, Nepal)

The art

- Examine all risks exhaustively and ensure that they can be mitigated
- Identify all uncertainties, conceptualize and experiment to get predictable outcomes
- Address issues government versus commercial influence on policies and fair representation of nations both developing and developed
- Create a workable framework

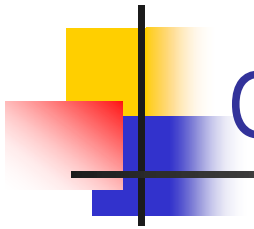
Application of art to quasi-zenith satellite development





Possible scenario


- Mobile services on aircraft vs. airborne service for disaster recovery site (Indonesia)
  - risk: finance, short-term or long-term, topography
  - uncertainty: frequency to be allocated
  - ethics: necessity or commercial gain
  - art:
    - examine the risks
    - certify outcomes of concepts and experiments
    - ensure fairness in policies formulated



Conclusion

- Efficient satellite transport:
  - can provide mobile communications even to the most remote and unreachable areas
  - possesses horizons of opportunities that are boundless
  - has social and economic implications

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