Technical and Political Issues With Alternatives to Undersea Cables

Scott Bradner
Harvard University
sob@harvard.edu

Problems with using Undersea Cables for Internet Service

- installation cost
- construction duration
- limited reach
- relatively low capacity
- inflexible after installation
- history of telco management

Telco Background

- pre-buy cable slots
  - normally through telco consortium
- big $$ to play in the game
- price based on assumption of use for voice
- generally blind to data needs

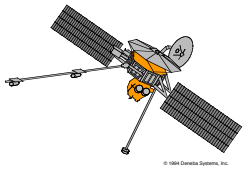
Alternatives to Undersea Cables

- point to point radio
  - need mid-sea platforms
  - or sky hooks
- worm hole routing
  - next generation
- satellites
  - = sky hooks

Types of Satellite-Based Systems

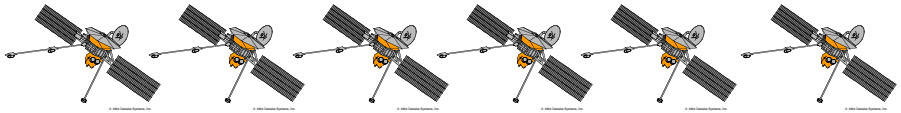
- geosynchronous (GEO)

  36,000 Km



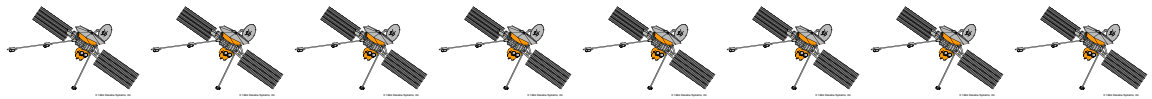
- Middle Earth Orbit (MEO)

  16,000 - 25,000 Km



- Low Earth Orbit (LEO)

  <~ 16,000 Km

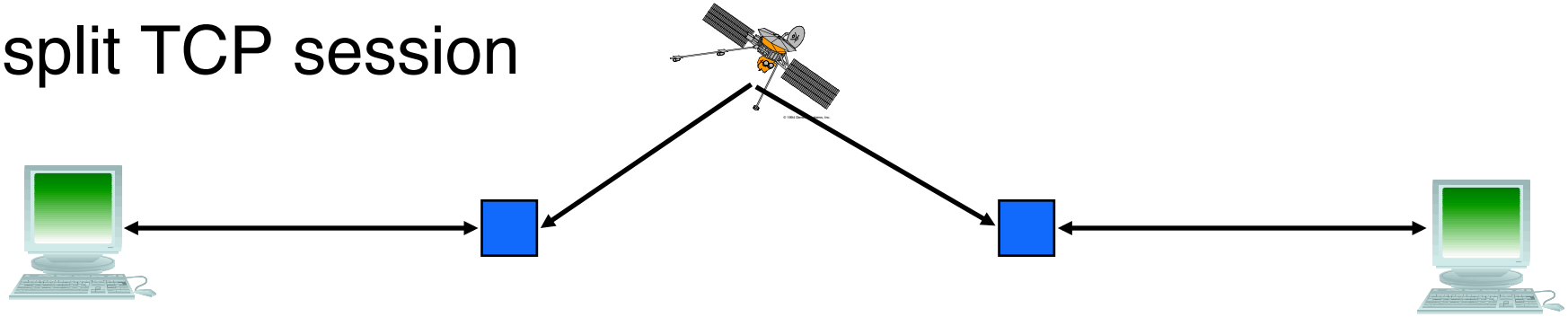


Technical Issues

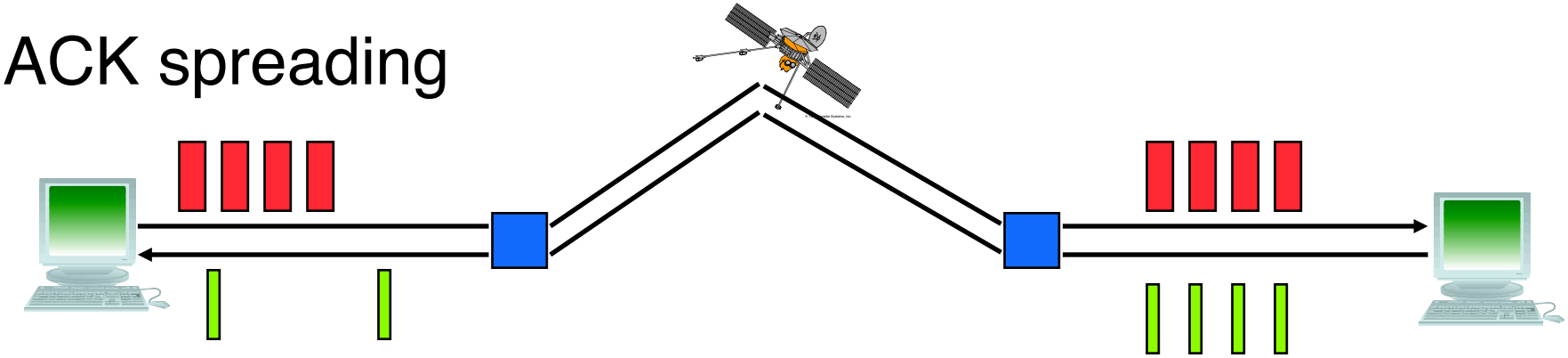
- latency
  - geo - >500 msec rtt
  - meo & geo - variable, 20-160 msec rtt
    - tracking satellite as it passes overhead
  - deep space ...
- large bandwidth-delay product
  - lots of data “in flight”
- transport reliability
  - high(er) non-congestion related packet loss
- asymmetric use
  - e.g. telephone for return path
- intermittent connectivity
  - when switching between satellites

Technical Issues - Ideas

- split TCP session



- ACK spreading



- forward error correction

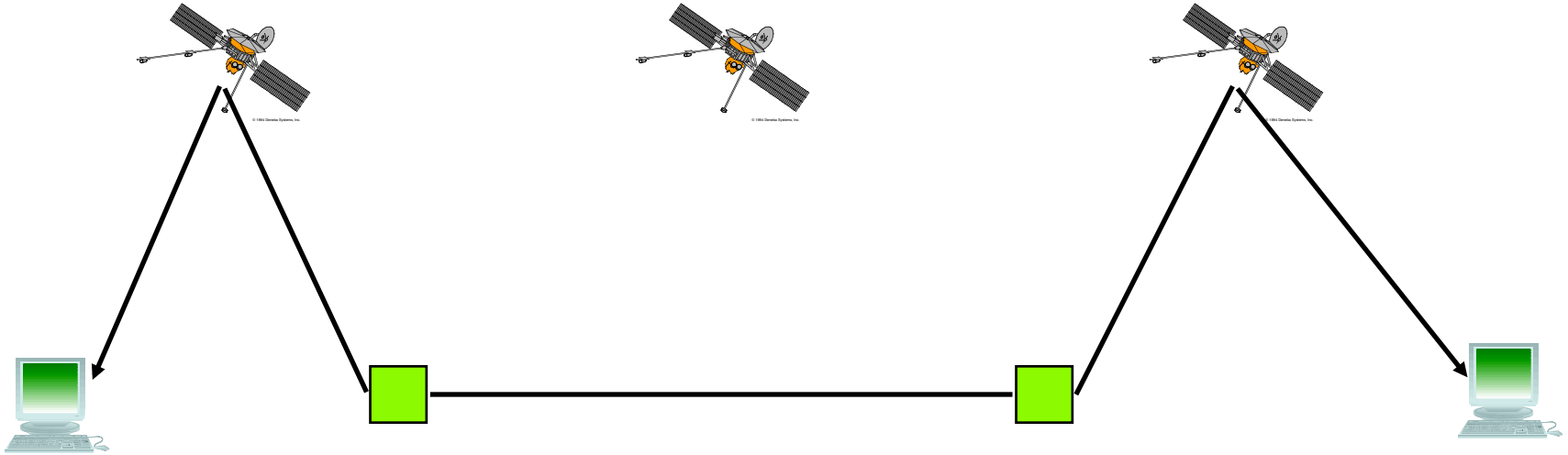
Technical Issues - Ideas, contd.

- larger initial window
  - 2 or 4 packets vs. 1
- turn off delayed ACKs during slow-start
  - always ack received data rather than every other
- use T/TCP
  - bypass 3-way handshake
- congestion experienced notification
- TCP pacing
- TCP spoofing
- . . .

Political Issues

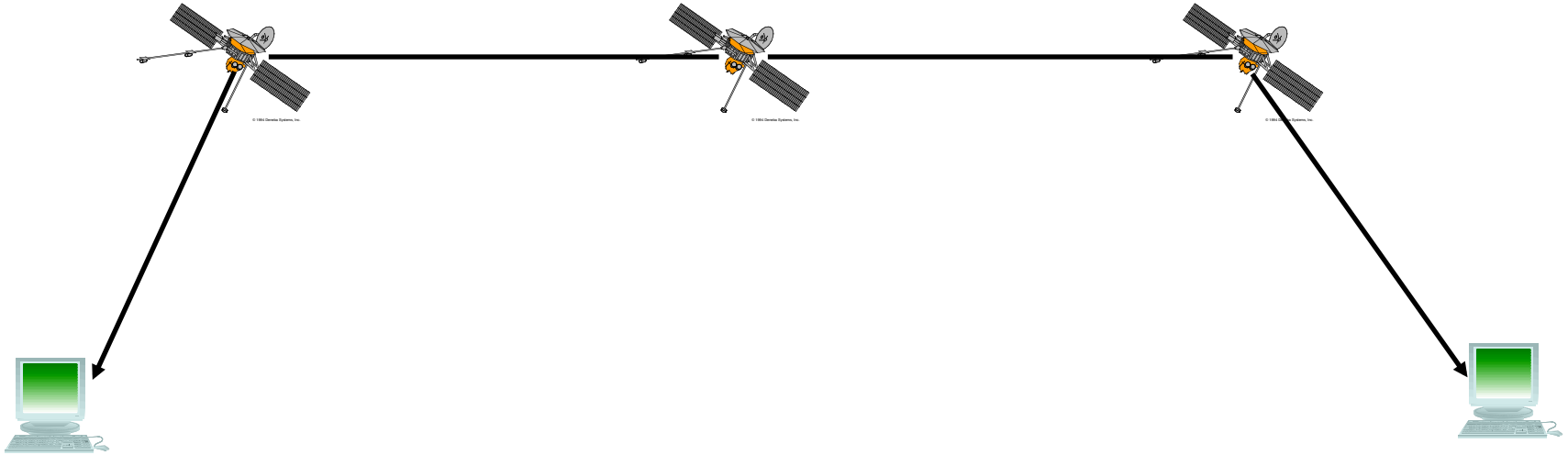
- two operational models
  - ground <-> satellite only
  - with intersatellite

W/O Intersatellite



- communications through "normal" ground stations
- local government gets control point
- local government gets taxing point

With Intersatellite



- communications bypass in-country ground station
- local government loses taxing and control point

  humm, LEO is not that far up...