Tera-Op Networking:
Local Adaptation to Congestion

Ken Calvert
Ellen Zegura
Samrat Bhattacharjee

Networking and Telecommunications Group
Georgia Institute of Technology, Atlanta

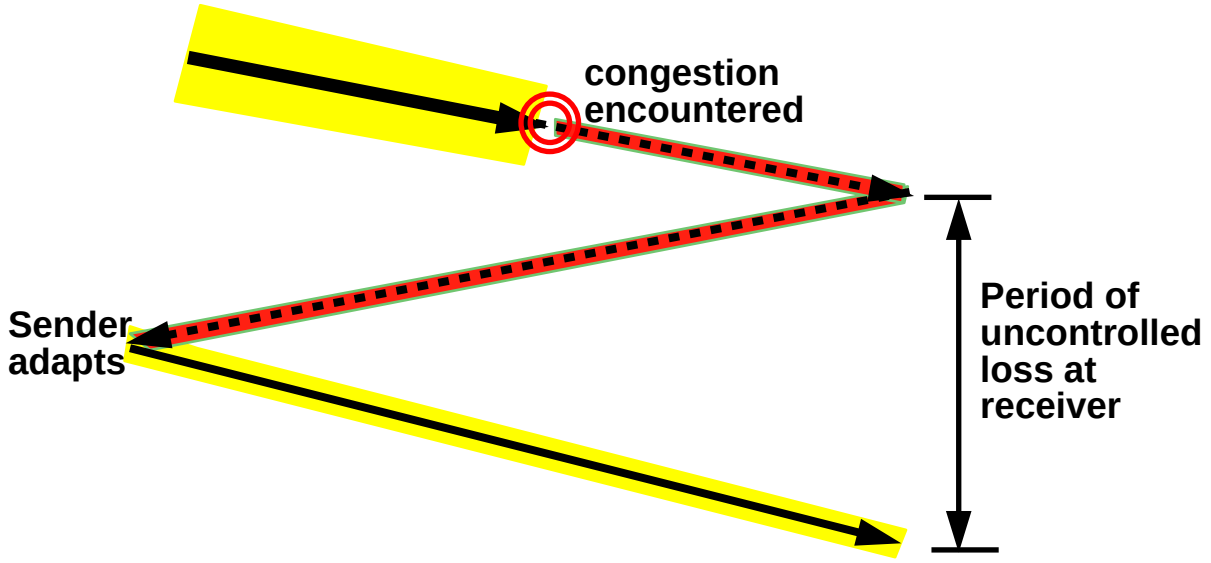
The Case

Assumption: $/MIP continues to decrease

Problems that won't go away:

- propagation delay (i.e., round-trip-time)
- congestion
- applications that don't know what they want
  (or aren't willing to pay for it up front...)

Result: Periods of uncontrolled loss



Active Networking

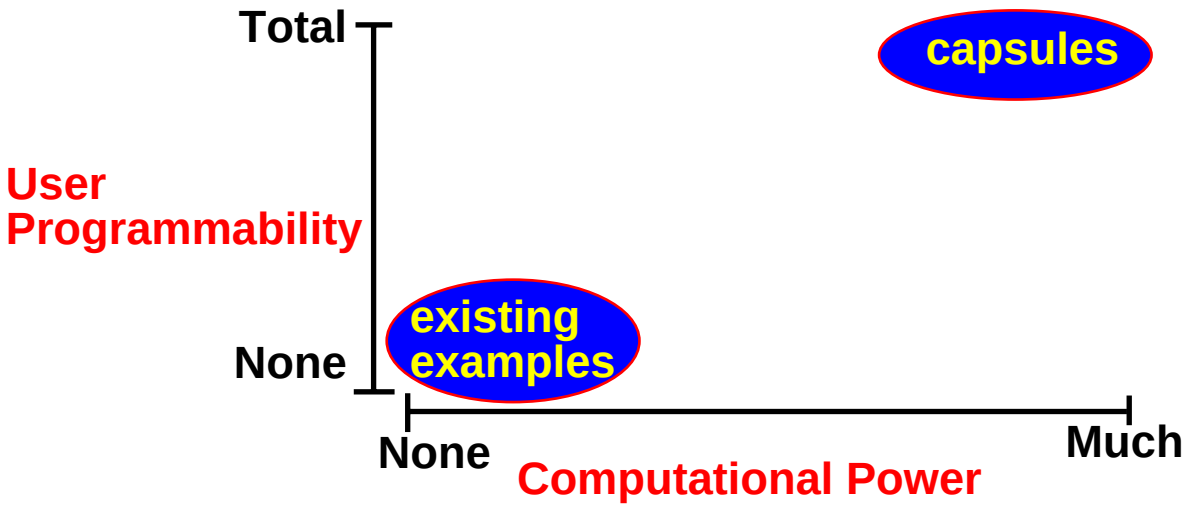
Objective: put the *adaptation* where the problem is

It is already happening:

- TCP snooping [Katz et. al.]
- ack dropping [Karn and others]
- packet-level dropping [Floyd & Romanow]
- video transcoding gateway [Amir et al.]

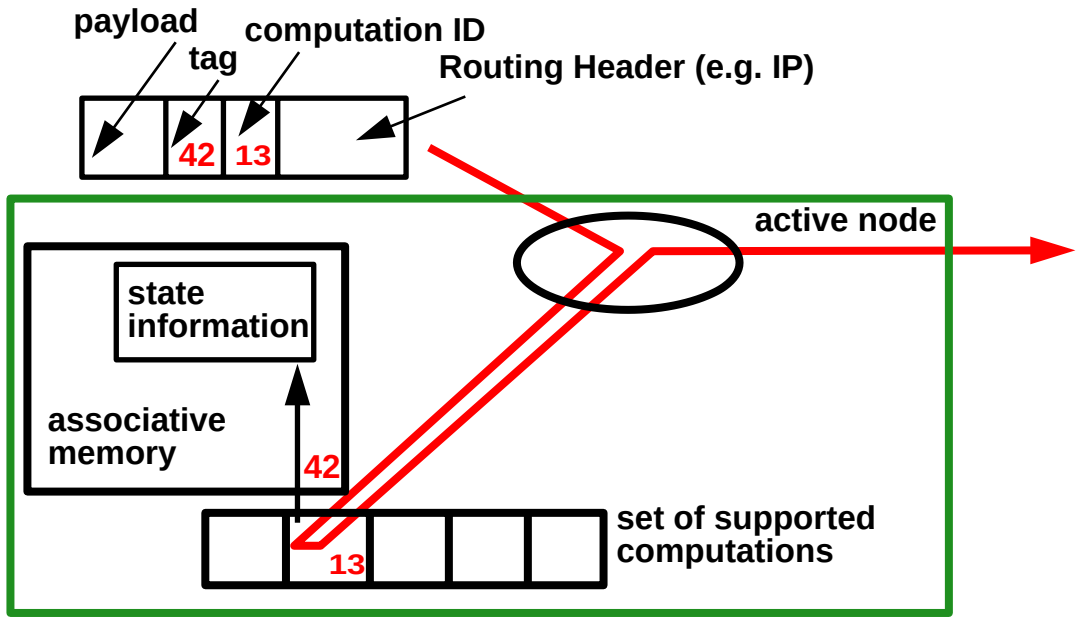
Observation: a more general capability might be interesting

- capsules: headers = programs [Tennenhouse et al.]



An Approach to Active Networking

- Network supports set of predefined computations.
- Computations may involve state.
- Packets labels identify
  (i) computation (ii) state.
- State eventually evaporates.

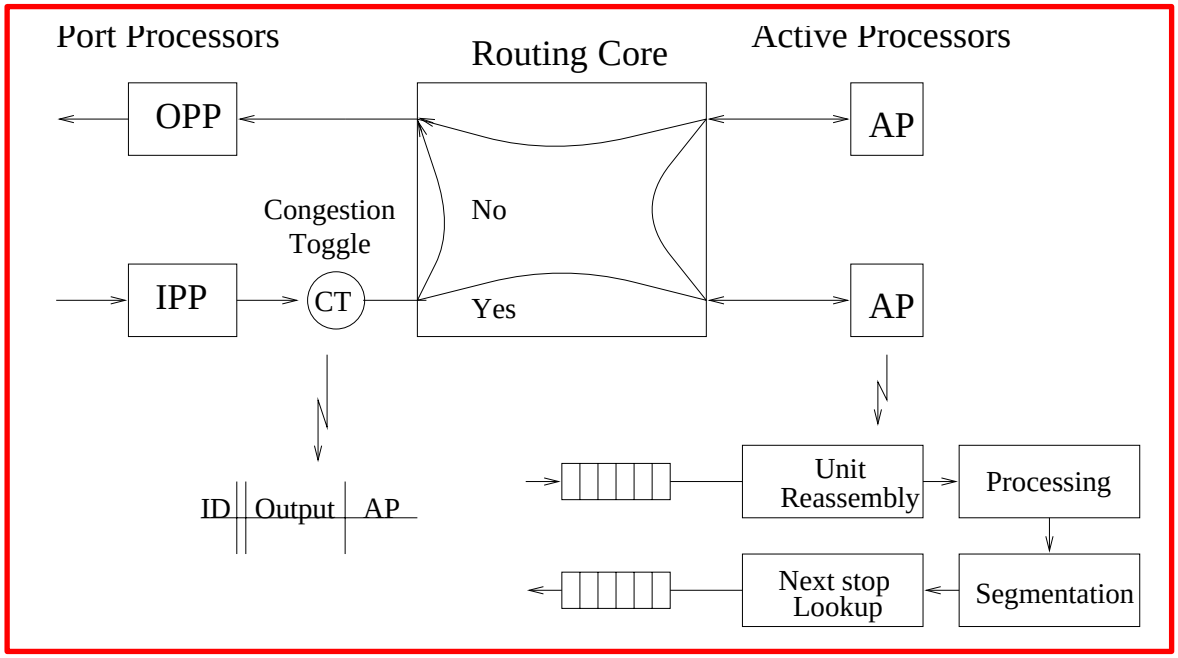


Interface

- Language to describe computation.
- Namespace and invocation mechanism.

Active Networking Architecture

Hardware:



Advantages:

- **Motivated by a real problem (adaptation to congestion).**
- **Incremental deployment.**
- **Separates mechanism and policy.**
- **Allows for evolution, addition of new computations.**

What We've Done

Active Node Processing

- Generalized Unit-level drop.
- Rate-control.
- MPEG transformation (selective frame dropping).