Is IPv6 The Key to a Global Network Infrastructure

Glenford Mapp

Networking Specialist

AT&T Laboratories-Cambridge

© 2001

IPv4 Success Disaster

- IPv6: an improvement of IPv4
- Things have moved on
- New technologies have been deployed
- Some have challenged the traditional ways of networking using IP

© 2001

Deployed Technologies

- Mobile Systems
  - Mobile IP
    - Micro-mobility issues
- ATM backbones
  - Virtual Circuit Technology
    - MPLS
- Location Systems
  - GPS

© 2001

More Technologies are coming!

- New technologies will stress IP even further
- Home Networking is the next wave
  - Broadband appliances
- Sentient Computing
  - Taking account of location
- New Networks
  - Network Surfaces – benefit of wired and wireless
- High Speed Wireless Systems

© 2001

The Broadband Phone

- Developed at AT&T Cambridge Labs
- Uses 100 Mbps Ethernet
- Each phone has an IP address
- Has a graphical display
- Uses VNC so that changes are centrally managed

© 2001

The Broadband Phone

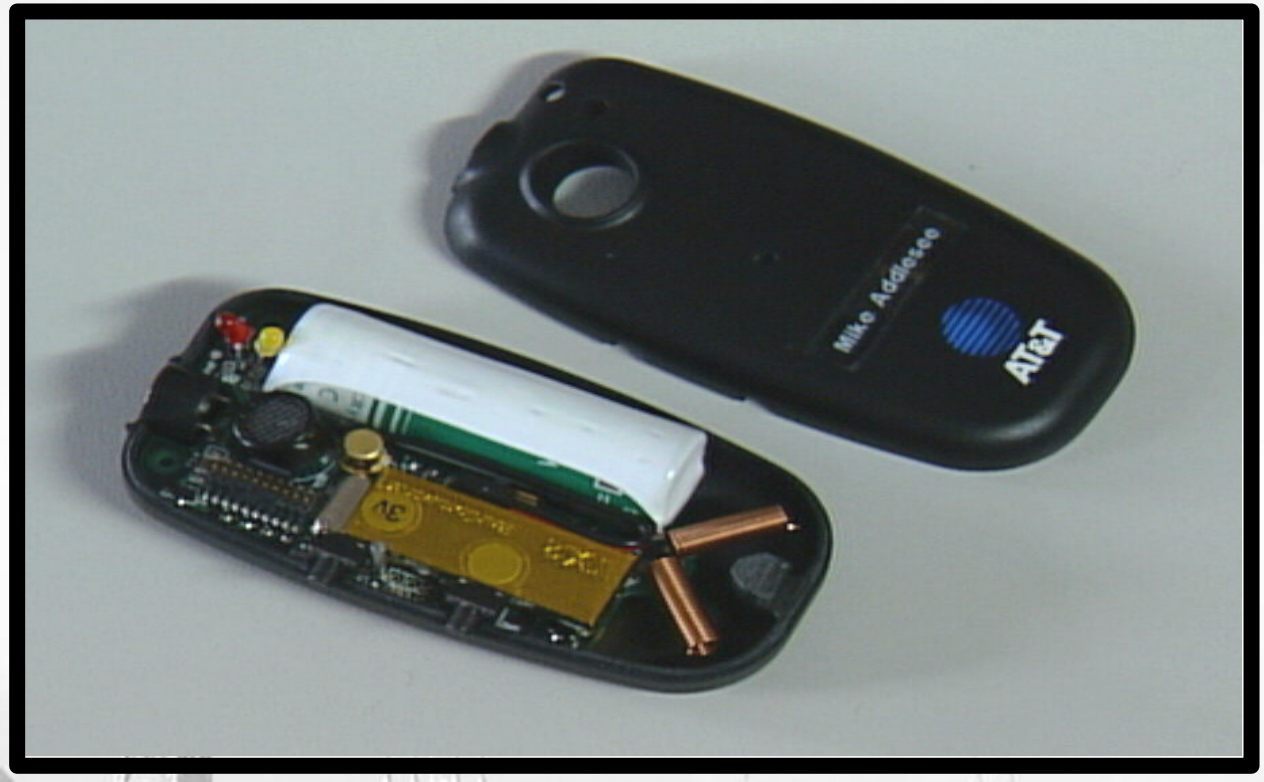
© 2001

Sentient Computing Project

- See http://www.uk.research.att.com
- Uses sensor and resource information to enhance the experience and/or productivity of users
- Based on the Bat Location System
  - Accuracy :
    - 3cm - 95% 10cm – 98%
- Spatial Programming

© 2001

The Bat Location System



© 2001

Network Surfaces Project

- Done at the LCE in Cambridge
  - See http://www.lce.eng.cam.ac.uk
- Provides network connectivity using physical surfaces, e.g. desks, floors
- Provides a number of data buses and support for recharging low power portable devices, e.g. cell phones

© 2001

Network Surfaces Project

© 2001

Cambridge Broadband Wireless Trial

Field Trial System
Jan 1999

Pilot System
March 2000

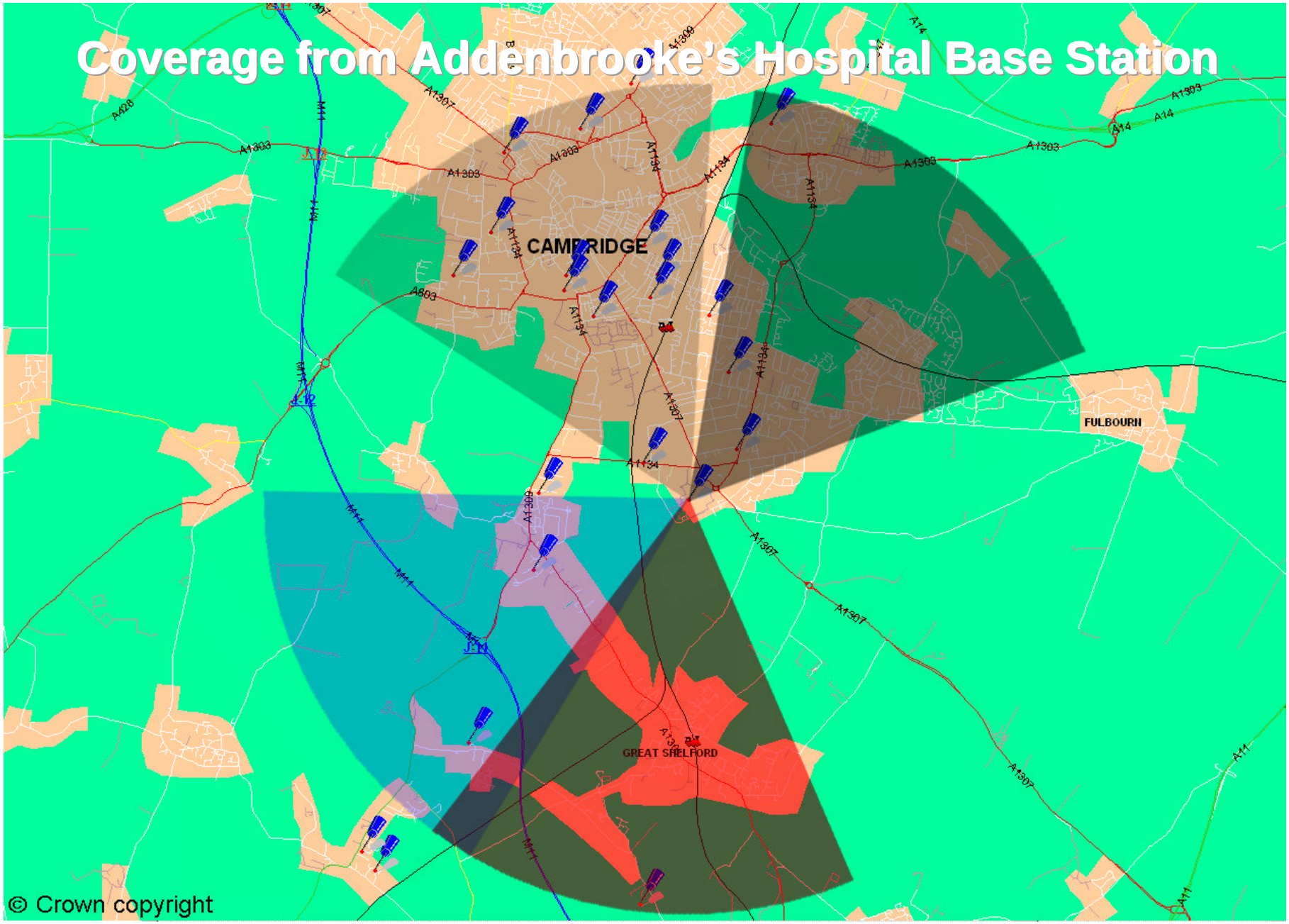
Commercial wireless system from Adaptive Broadband Ltd.

© 2001

Addenbrooke's Hospital Basestation

© 2001

Coverage from Addenbrooke's Hospital Base Station



© 2001

Here's what we want, what we really, really want!

- Better IP address schemes
- Support for Location Systems
- Seamless integration of datagram and connection-oriented technologies
- Support for QoS

© 2001

Efforts so far

- Mobile IP
  - Gets us a lot of the way there but a more general paradigm is needed
- MPLS
  - Good, does not offer an end-to-end solution.
- RSVP and Diffserv
  - Yet to be widely deployed

© 2001

A Different Tack

- Every time something comes along we try to mangle IP to work with it
- We should look at defining IP as a standard which would seamlessly allow new technologies to interface to it
- A good example is in telephony

© 2001

Where they got it right

- The telephone standard was defined in terms of being able to carry a signal of 3.5 KHz bandwidth
- It was not media-specific
- It was easier to add new technologies to voice systems

© 2001

Key Problem

- Right now an IP address is used both to identify an object and also to determine how data is routed to it
- Not suitable for highly mobile environments
- Inflexible and prevents network evolution

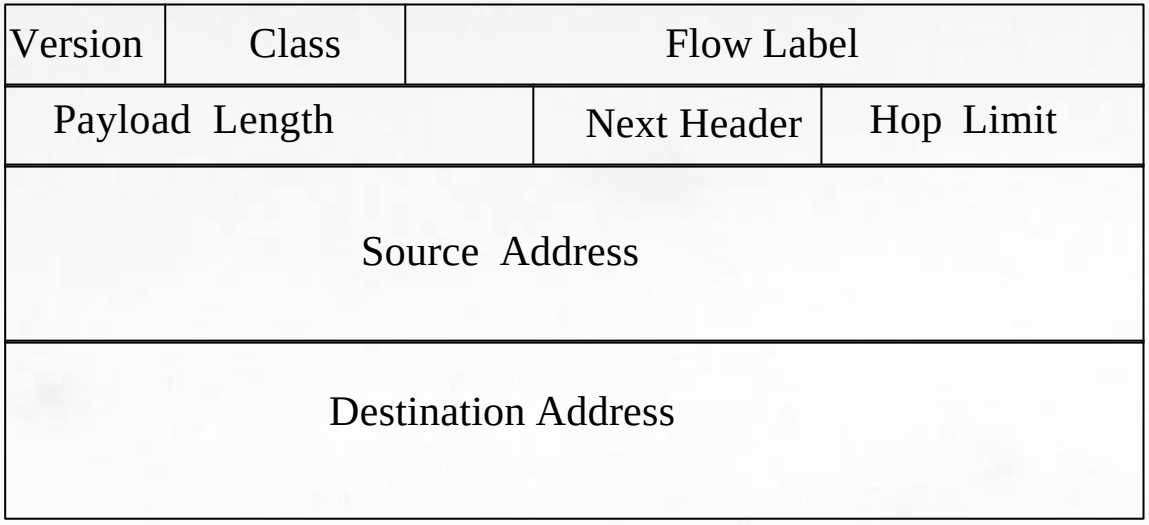
© 2001

Proposal

- We take the IPv6 address space and split it into two parts
- The first part is a 64-bit globally unique id (similar to Ethernet MAC addresses)
- The second part is a location field which is a hint of where the object is presently located

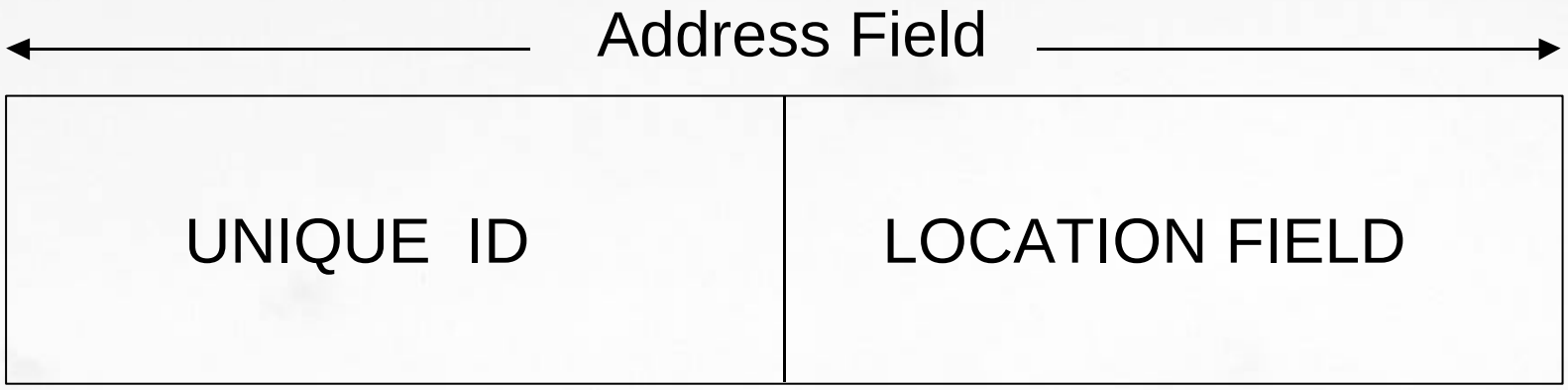
© 2001

IPv6 Header



© 2001

Our Proposal



© 2001

Globally Unique IDs

- Separately administered
- Doesn’t change even if you move networks
- Manufacturers burn these ids into their products
- Modified DNS
  - a name returns the unique object id

© 2001

Location field

- The location field is used as a hint of how data should be routed to that object.
- This can be fixed or can change quite rapidly
- Find out location by various means

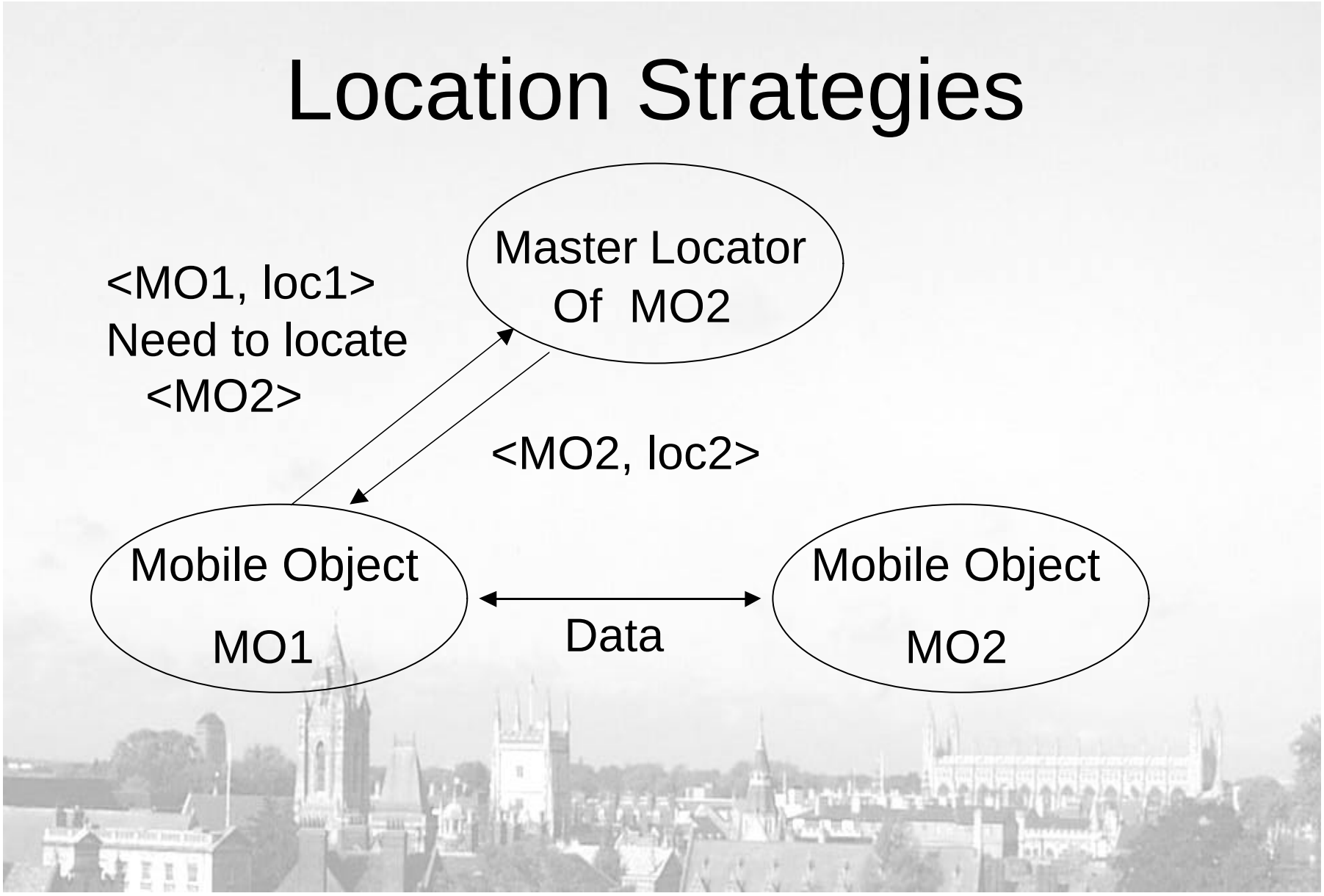
© 2001

Location Field Continued

- Need to facilitate various location systems
- Concept of a master locator for an object – stored in the DNS
- An entity which knows how to fill in the location field for a given object or ..
- Knows of another entity that knows how to fill in this field

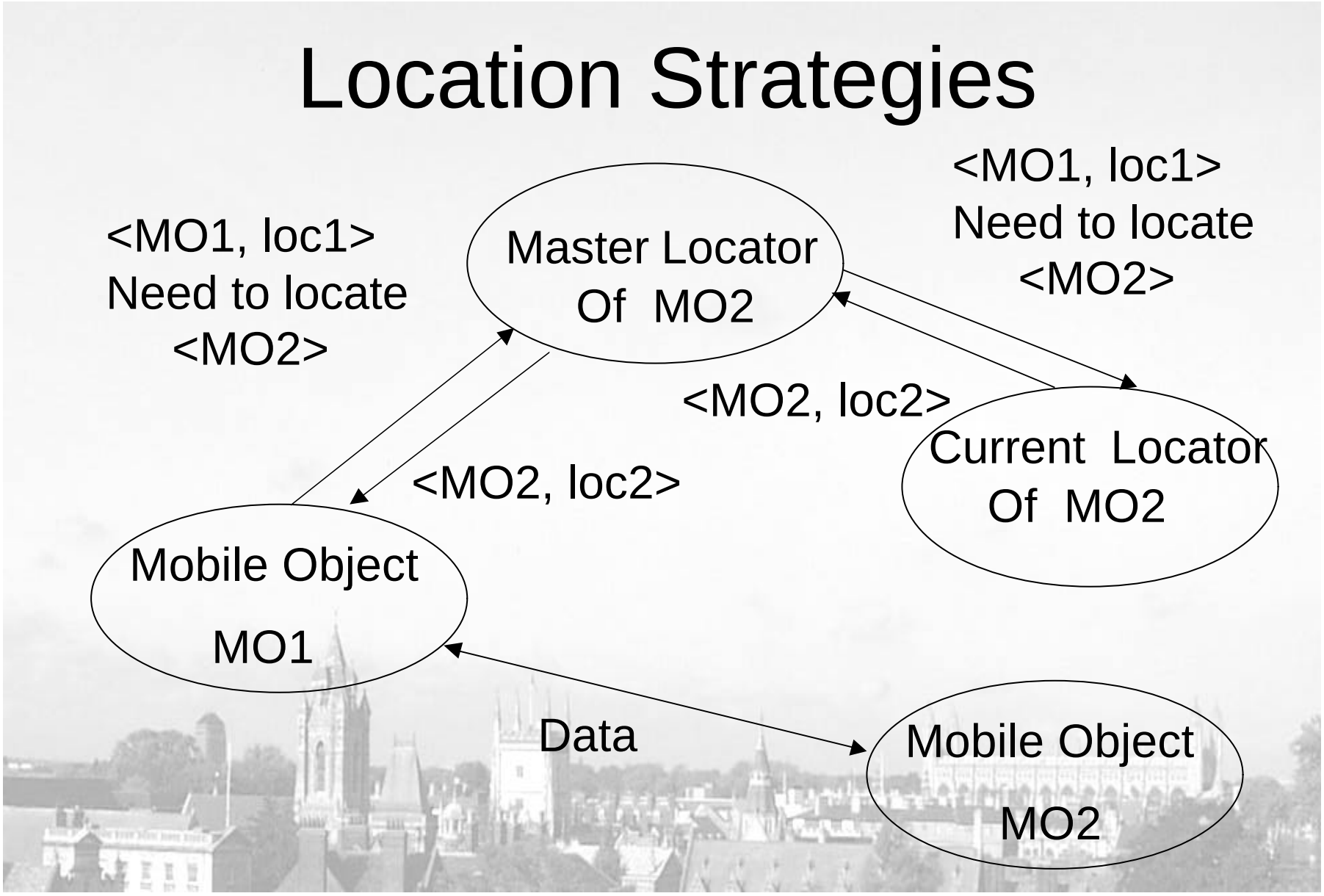
© 2001

Location Strategies



© 2001

Location Strategies



© 2001

Location Field Continued

- The locator may return different answers depending on a number of factors including..
- The object that is trying to contact the destination object
- The location of the object trying to contact the destination object

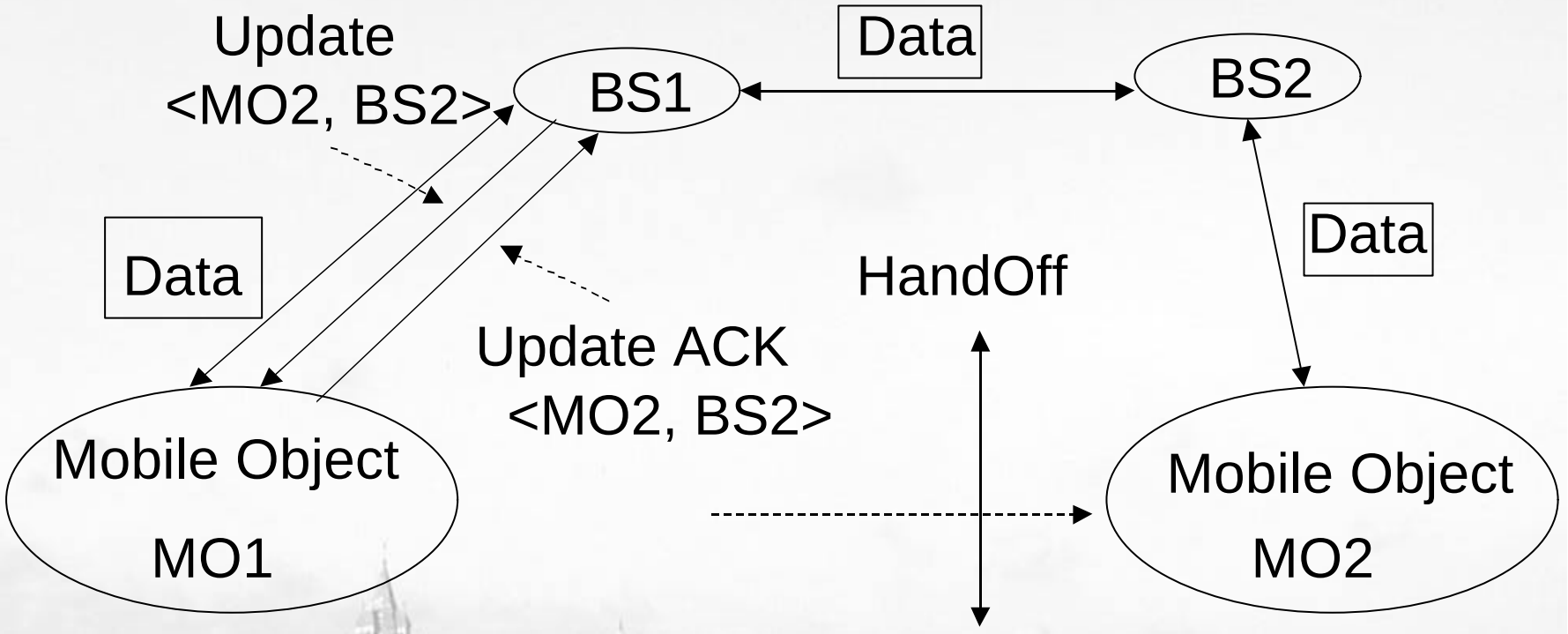
© 2001

Location Changes

- Location field is a hint
- Location strategies get close to the object
- Location of the object may change as packets are being sent

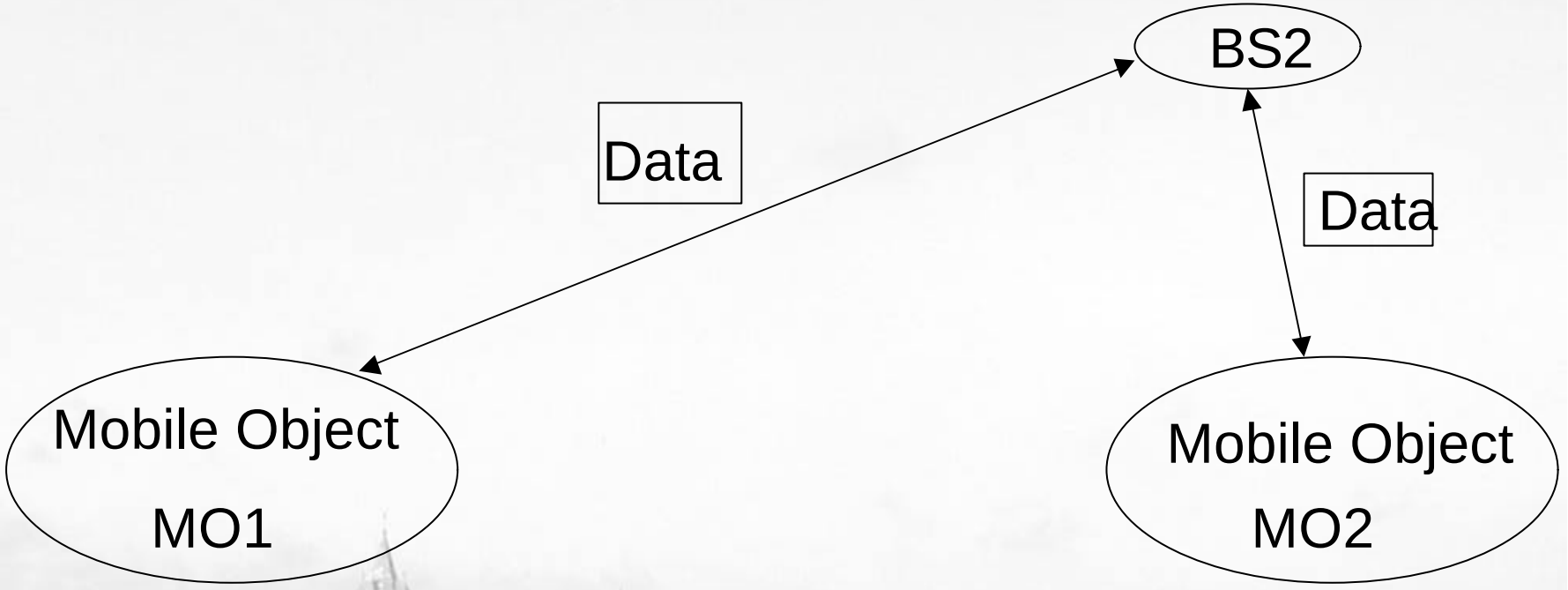
© 2001

Possible Handoff Scenario



© 2001

Location Updated



© 2001

Support for Location Changes

- Use of IPv6 header extensions to support dynamic changes in location
- Need to support a number of location and handoff strategies
- Transparent to higher protocol layers e.g. tcp and udp

© 2001

Project Status

- We are setting up an experimental IPv6 network with the LCE
- We are about to change the address format to support unique object ids and the location field
- Trying to integrate old and new networks

© 2001

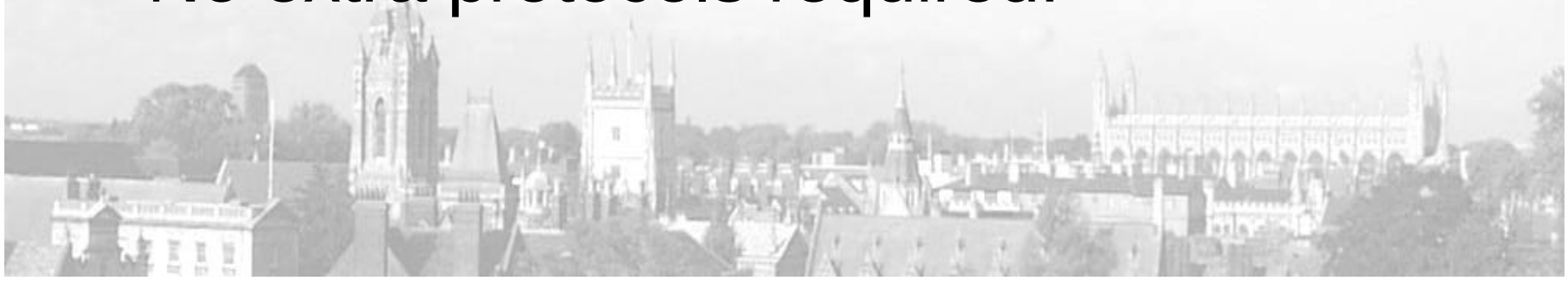
Support for Virtual Circuits

- The new Internet needs to provide support for both datagrams and end-to-end virtual circuits
- Virtual circuits are useful as a handle for
  - QoS, Virtual Private Networks
- The Flow Label field in the IPv6 header should be used to identify end-to-end flows

© 2001

Setting Up Virtual Circuits

- Since IP is already a datagram service it can be used to signal that a virtual circuit should be set up
- Use bits in the Flow Label to set up virtual circuits
- No extra protocols required!



© 2001

Prototype System on IPv4

- Uses the two bits in the ToS field to set up virtual circuits
- Developed the concept of Ethernet Virtual Circuits (EVC)
- Port this system to IPv6

© 2001

Conclusions

- We believe that IPv6 can be used to build a global network infrastructure
- Providing good support for a number of services including:
  - Mobility, QoS
- Need a good implementation of these ideas

© 2001