Geographic Locality of IP Prefixes

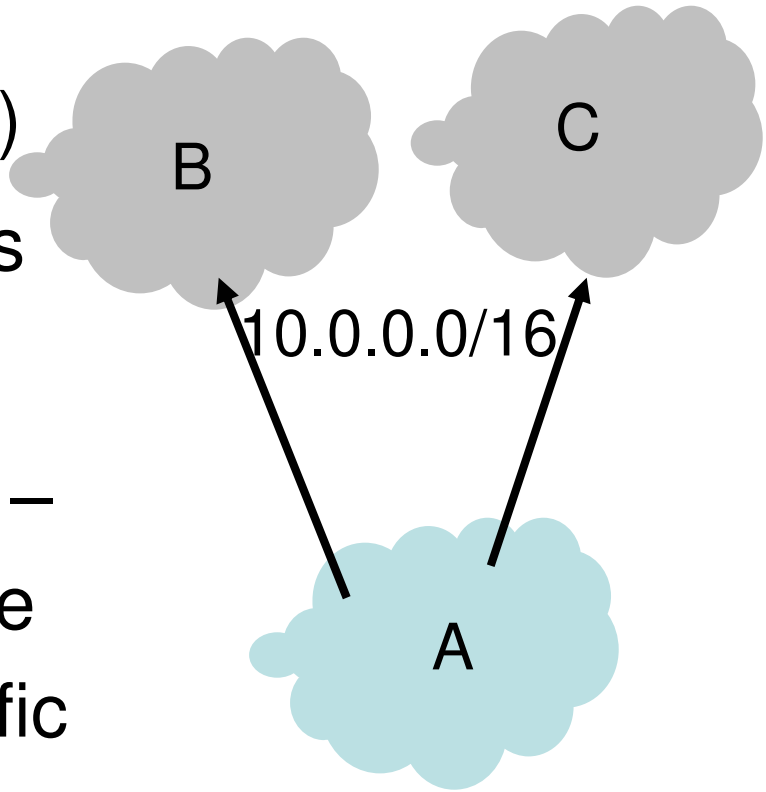
Mythili Vutukuru

Joint work with
Michael J. Freedman, Nick Feamster and
Hari Balakrishnan

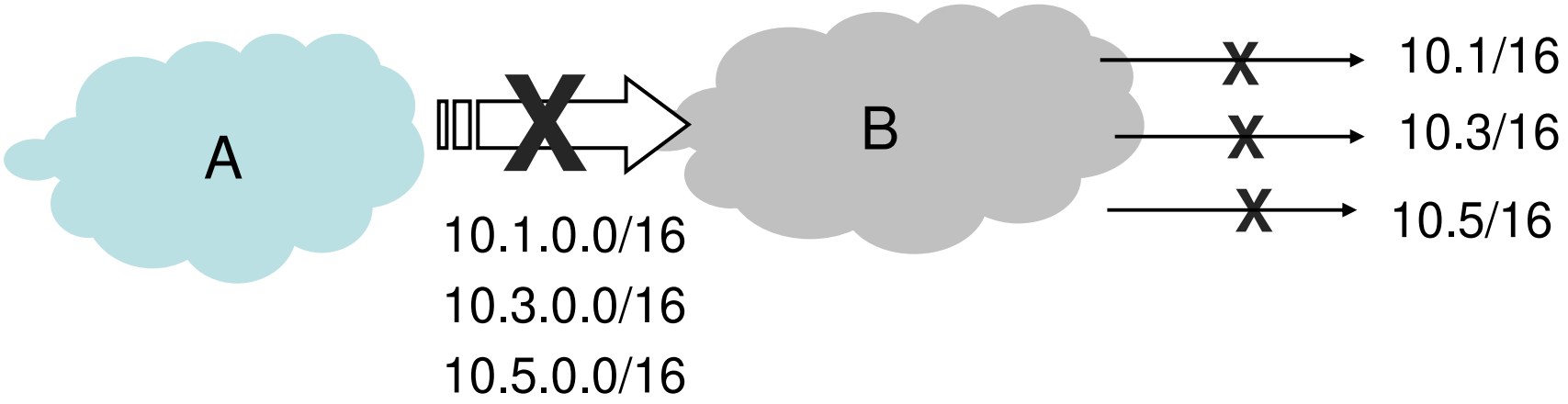
Internet Measurement Conference '05

Motivation

- Autonomous Systems (ASes)
- IP Prefixes in BGP messages
- “Routing handles”
- Granularity of routing handle – tradeoff between routing table size and ability to control traffic
- **Is prefix the right granularity?**

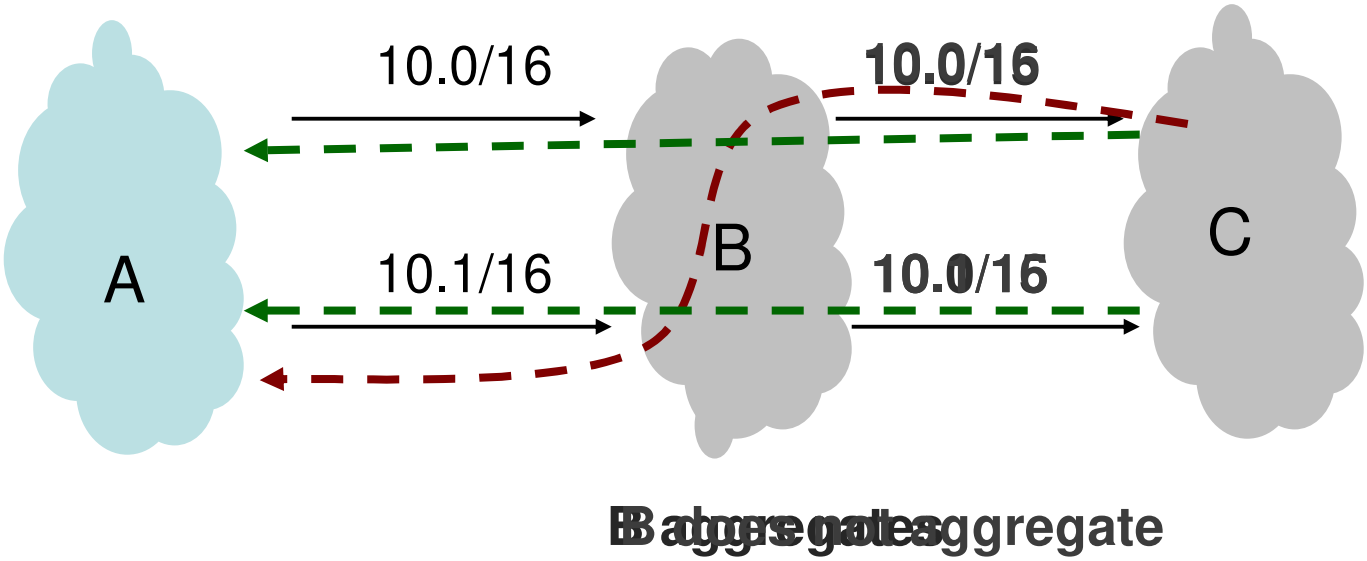


Too fine-grained?



- Discontiguous prefixes from same location
- Likely to share fate
- Multiple routing table entries to be updates
- Close in geography, far in IP space →fine-grained

Too coarse-grained?



- Contiguous prefixes from different locations
- Aggregate → less control over traffic
- Artificially inflates “opportunities” for aggregation
- Close in IP space, far geographically → coarse-grained

Questions we investigate

IP space	Geography	Granularity
Far	Close	Fine-grained
Close	Far	Coarse-grained

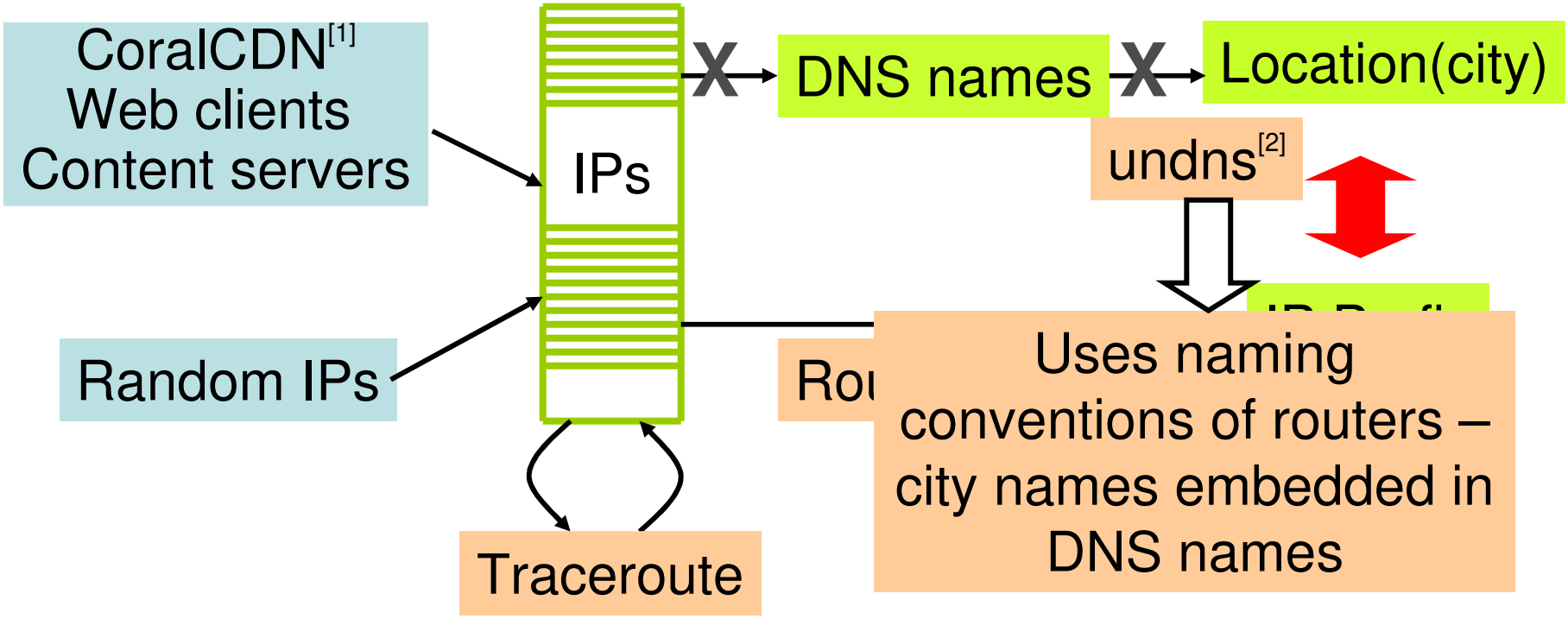
How often do ASes announce discontiguous prefixes from same location?
How often do ASes announce contiguous prefixes from different locations?
Correlation - locality in IP space & geographic locality

Major Findings

- Discontiguous prefixes, close geographically
  - 70% of discontiguous prefix pairs
  - Fragmented allocation to fate-sharing entities
- Contiguous prefixes, far geographically
  - 25% of contiguous prefix pairs
  - Unsuitable to express traffic control policy

Method

GOAL: Associate an IP prefix with a set of locations (cities)

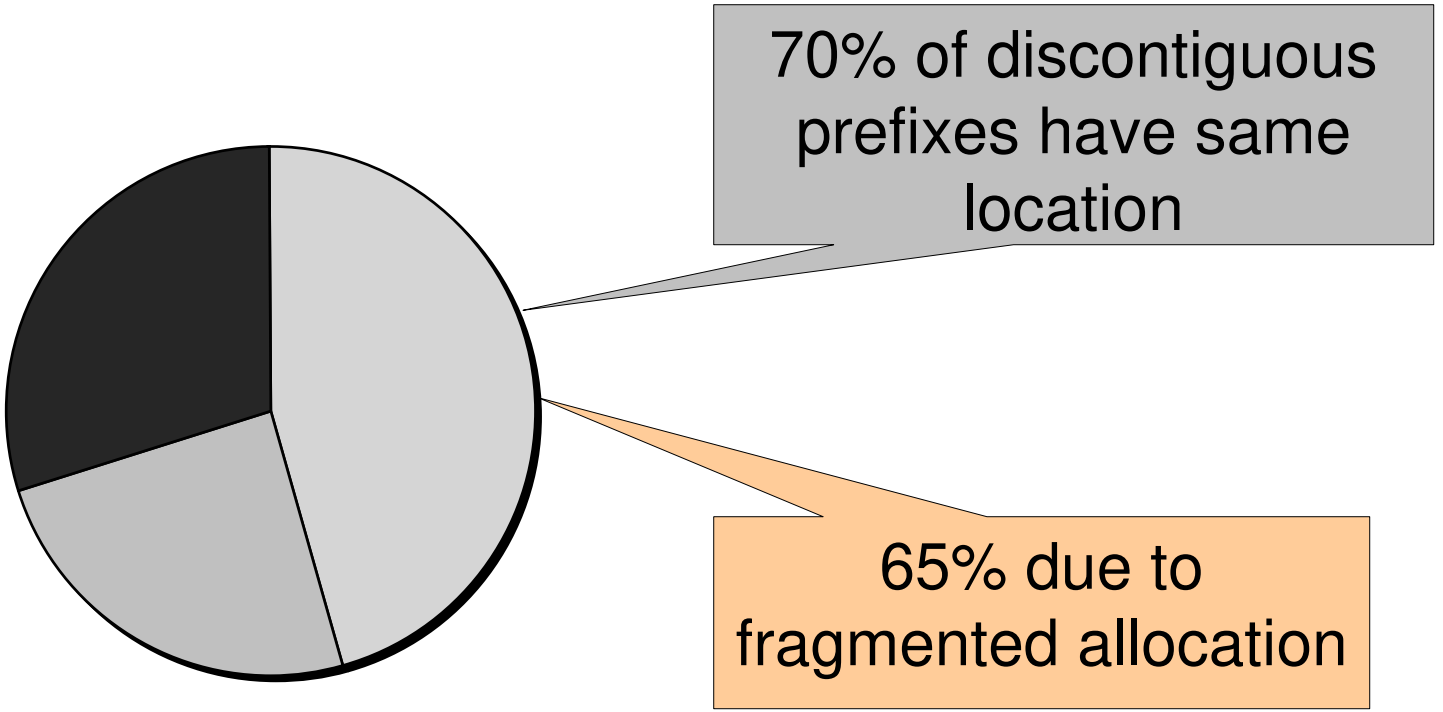


[1] http://www.coralcdn.org

[2] http://www.scriptroute.org

[3] http://www.routeviews.org

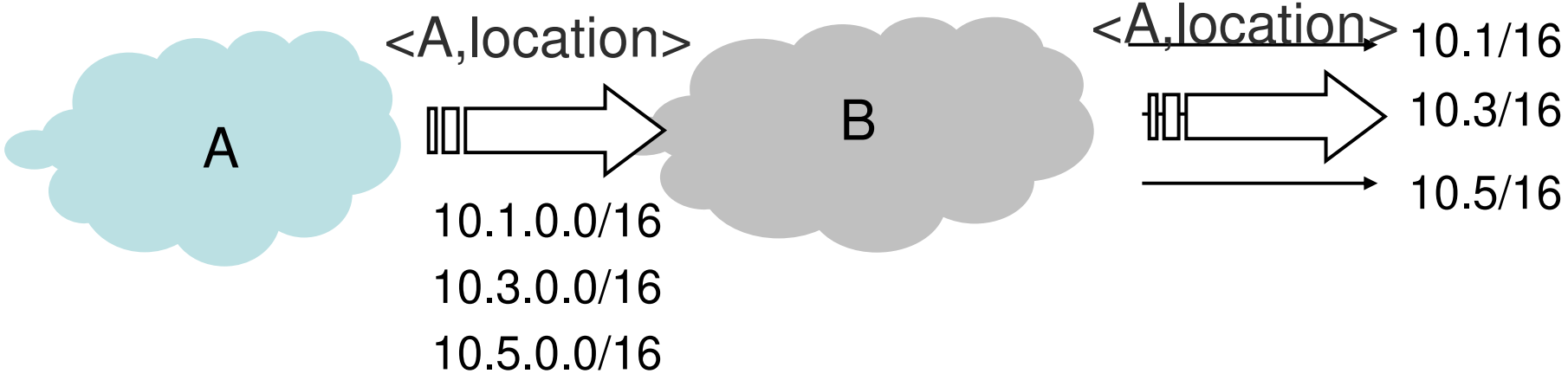
Prefixes too fine-grained



- Analyzed top 20 <AS, location> pairs
- 23% of them allocated on the same day

Implications

- Renumber?
- Change granularity of routing??
  - Eg: PoP level



Prefixes too coarse grained

- 25% of contiguous prefixes - different location
- CIDR Report[4]

Prefix	AS Path
10.0/15	A B C D
10.1/16	A B C D

64% reduction

- Same AS path + close geographically

Prefix	AS Path	Location
10.1/16	A B C D	L1
10.0/16	A B C D	L1

20% reduction

[4] http://www.cidr-report.org

Implications

- Potential for aggregation over-stated
- Aggregate too coarse grained – poor traffic control

Take-home lessons

- Is prefix the right granularity for routing?
- Prefix too fine-grained
  - Discontiguous prefixes from same location
  - Causes many routing table updates
  - Change routing granularity: group by shared fate?
- Prefix too coarse-grained
  - Contiguous prefixes from different locations
  - Potential for aggregation is overstated
  - Aggregate prefix unfit for traffic control

Questions?