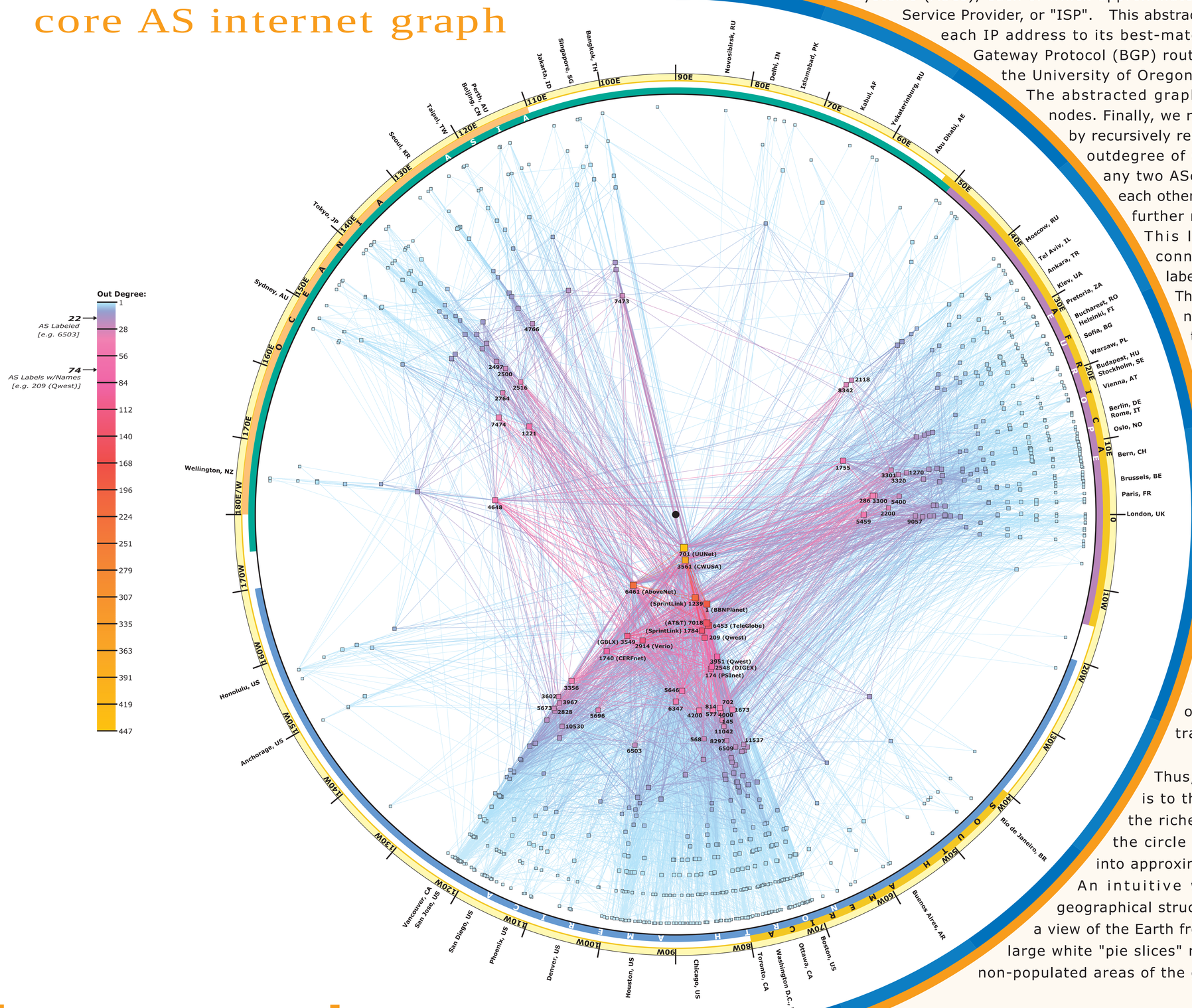
skitter

core AS internet graph



This visualization represents a macroscopic snapshot of the Internet for sixteen days in mid-January 2000. The graph includes 220,533 nodes obtained by merging three datasets: one from Bill Cheswick on January 14, 2000; one gathered from traceroutes to Cheswick destinations from CAIDA's network in San Diego during January 15-22, 2000; and the last using data from 14 skitter monitors taken on January 08, 16, and 24, 2000.

This view of the network is then abstracted into a topology of Autonomous Systems (ASes), each of which approximately maps to an Internet Service Provider, or "ISP". This abstraction occurs by mapping each IP address to its best-match origin AS in Border Gateway Protocol (BGP) routing tables collected by the University of Oregon's RouteViews project. The abstracted graph consists of 5107 AS nodes. Finally, we remove "non-core" ASes by recursively removing all ASes with an outdegree of 0, as well as removing any two ASes that connect only to each other ("leaf" nodes), until no further nodes can be removed. This leaves a set of well-connected ASes, which we label an "AS core" snapshot. The final AS core has 1516 nodes, or 29.7% of the total ASes seen in the data sets.

The position of each AS node is plotted in polar coordinates, *pos(radius, angle)* *(pos(r,θ))*, where:

radius =

$$1 - \log\left(\frac{\text{outdegree(AS)}}{\text{maximum.outdegree}}\right)$$

θ =

(longitude of the AS headquarters in whois records)

The "outdegree" of an AS reflects the number of other ASes that accepted traffic from that AS.

Thus, the closer an AS node is to the center of the graph, the richer its peering. Radii of the circle naturally cluster ASes into approximate geopolitical areas. An intuitive way to consider the geographical structure in this graph is as a view of the Earth from the North Pole. The large white "pie slices" map to oceans or other non-populated areas of the globe.

By graphing dimensions of peering richness versus geographic information, this graph clearly reveals the "highly core-connected" nature of ASes based in the United States. The top 15 ASes are all headquartered in North America: fourteen in the U.S. and one in Canada. Also, while both Europe and Asia have many peering relationships with the U.S., there are far fewer links between Asia and Europe.

One of CAIDA's skitter project goals is to develop and depict more insightful measures of macroscopic Internet connectivity.

CAIDA - cooperative association for internet data analysis

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