nominet

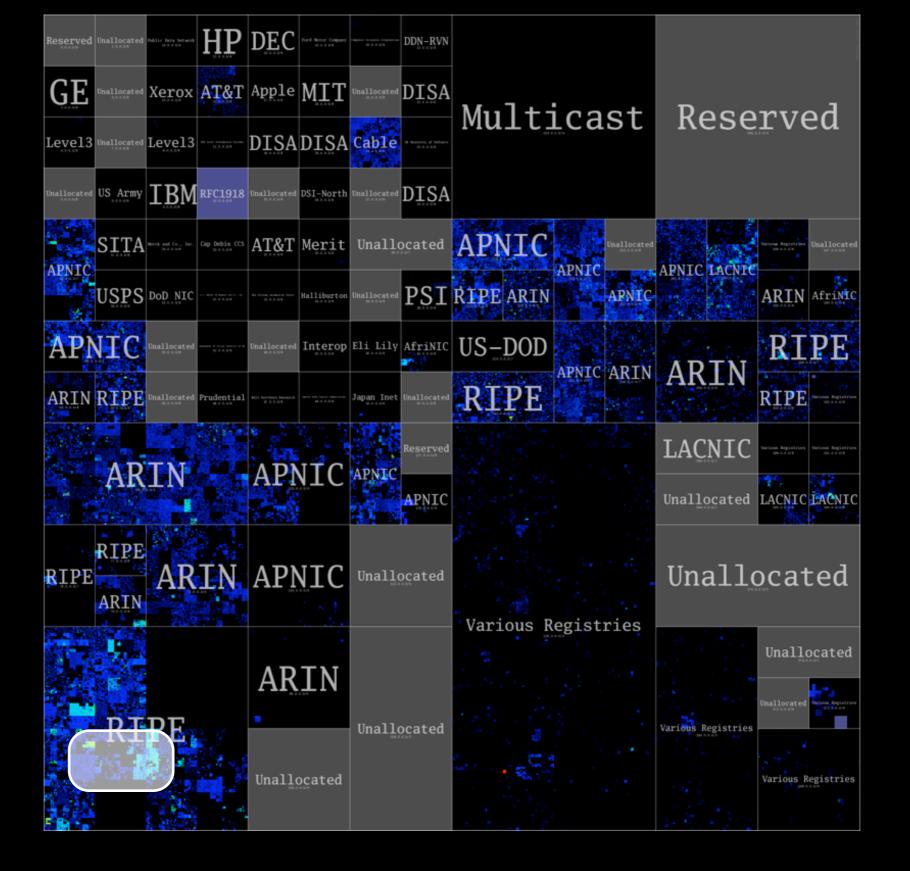
Fun with IPv4 Heatmaps

Roy Arends

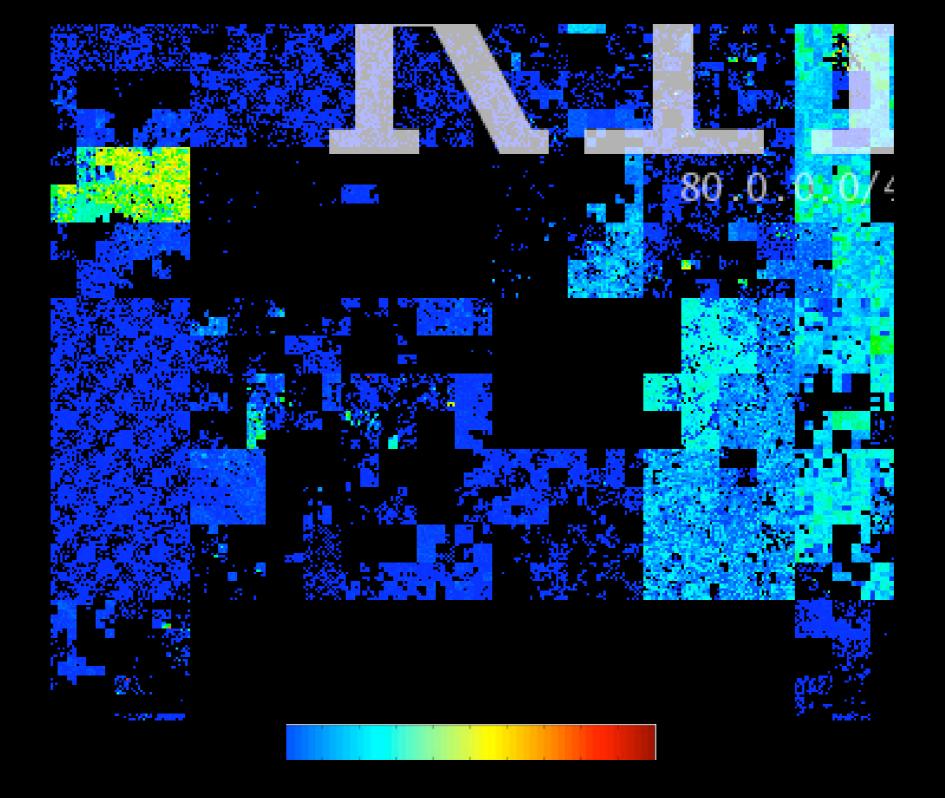
Nominet UK



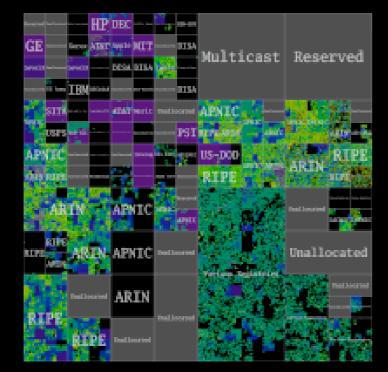
Inspired by XKCD



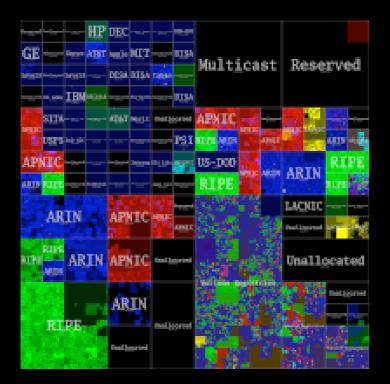
More than 16,000,000 open resolvers during a sweep of the IPv4 address space.

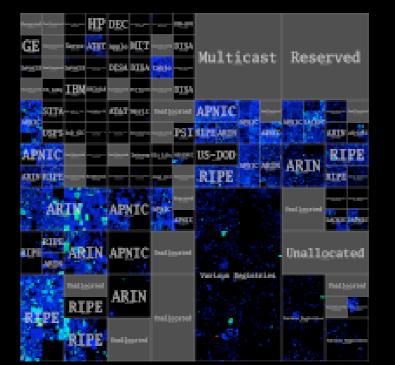


detail of 80.0.0/4 One /24 network per pixel, colored by saturation.

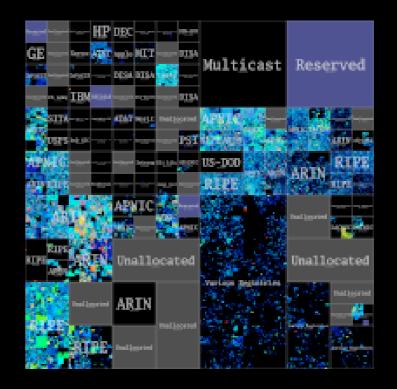


BGP Routeviews





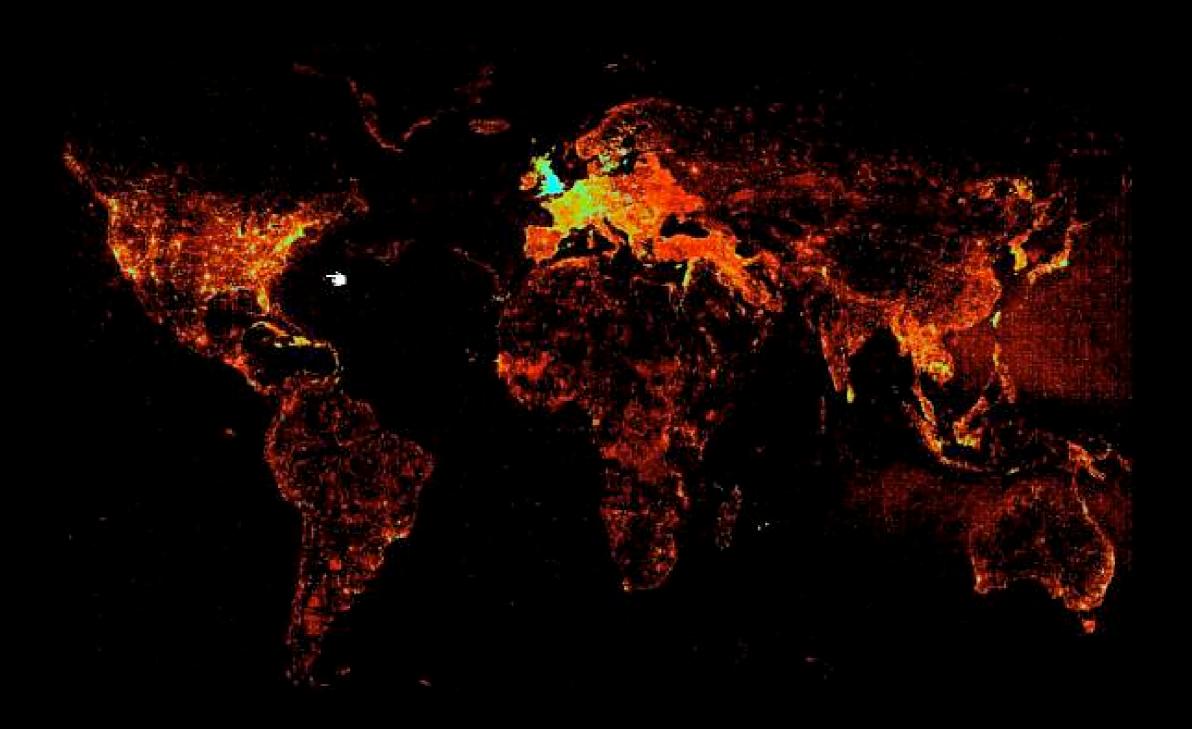
Open Resolvers



RIR whois



Examples of Heatmaps



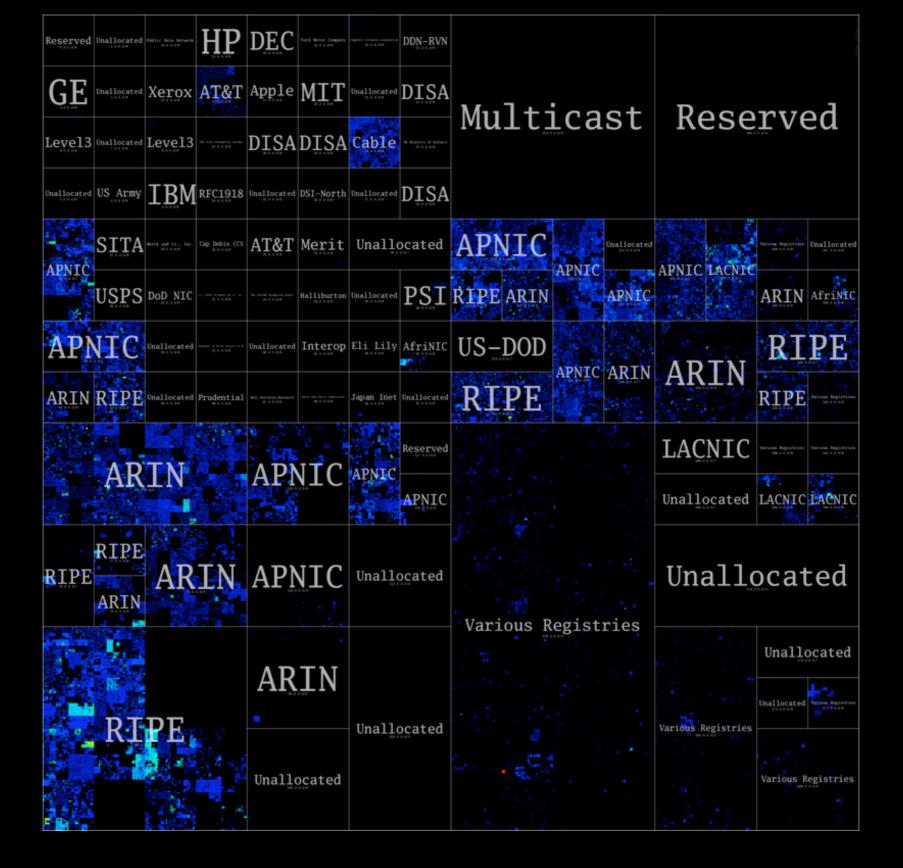
Ed Parsons "the Cathedral and the GPS" footprints of google's KML/GeoRSS database

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2005	

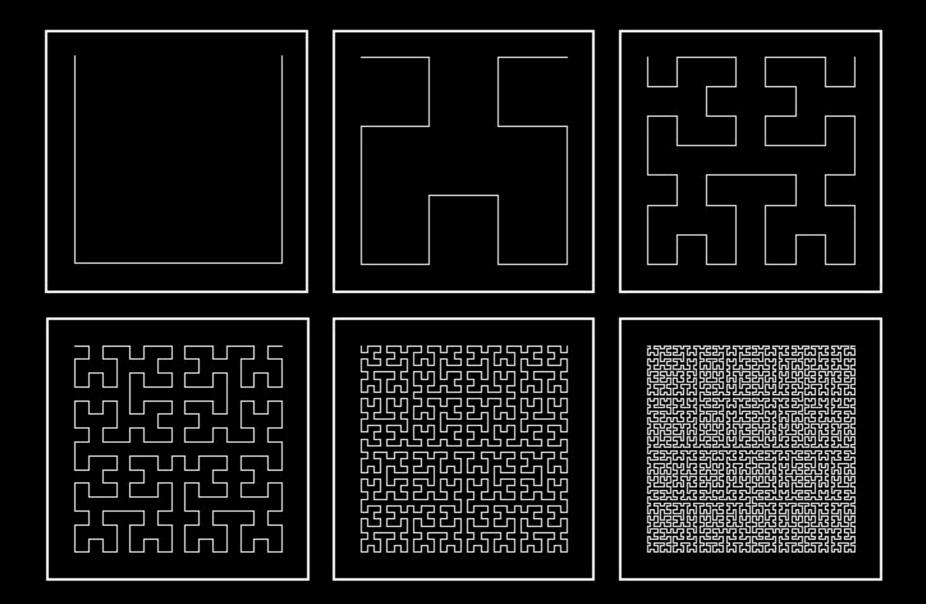
Eyetools heatmaps Where do viewers look and click



GeoIQ Heatmap layer for Google maps



IPv4 Heatmap in Hilbert Order.



Hilbert curves, order 1 to 6 Direction changes with every order

1 2 15 16 4 3 14 13 5 8 9 12 6 7 10 11

16 points on a 2nd order hilbert curve

Using Hilbert Curves: Consecutive netblocks can be grouped together.

However

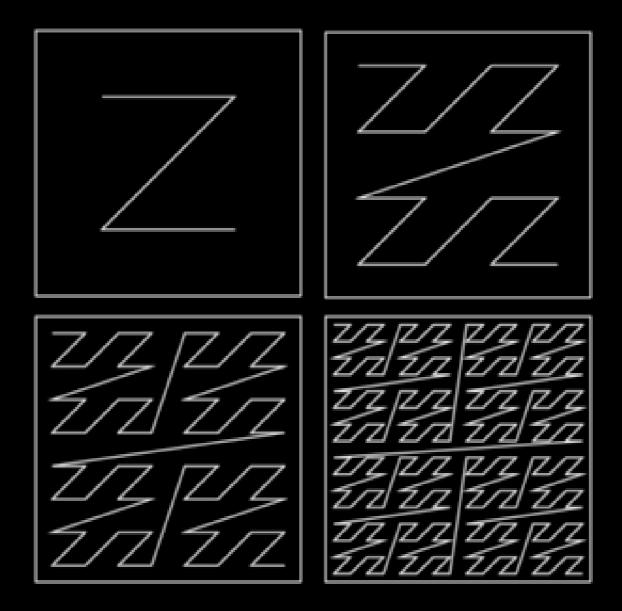
In networking, only those consecutive netblocks that share the same prefix need to be grouped together.

127/8 + 128/8 = 127/7

Using Morton Curves:

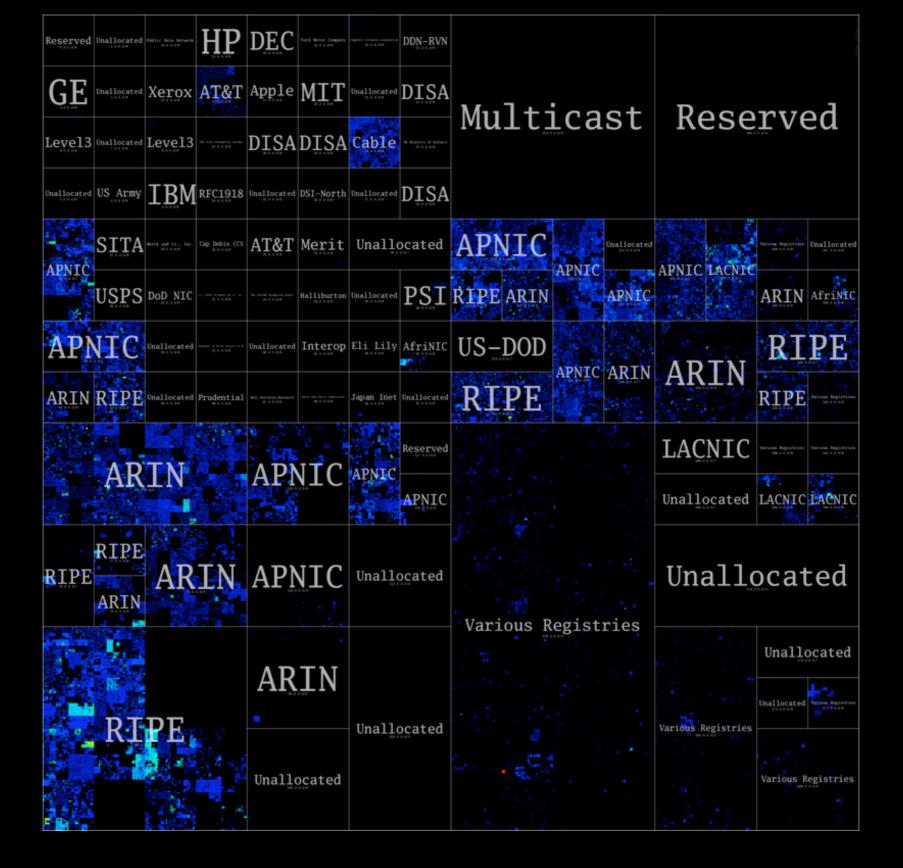
consecutive netblocks that share the prefix can be grouped as one netblock.

Which is tailored to our needs.

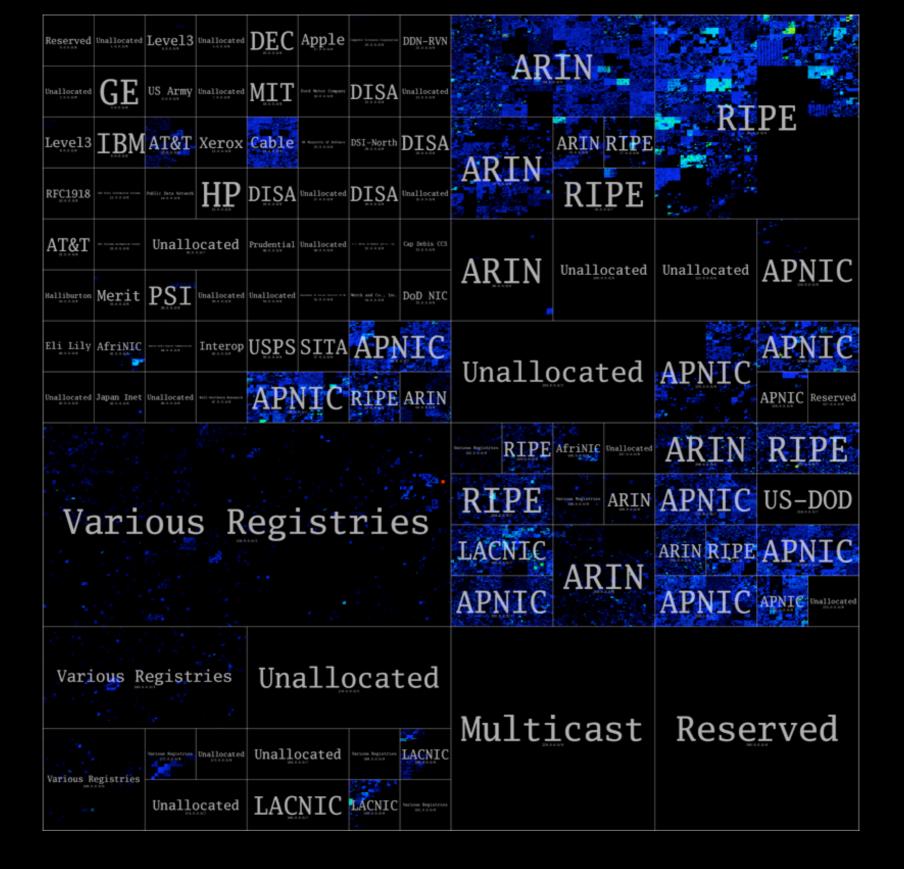


Morton curves, order 1 to 4 Direction is the same with every order

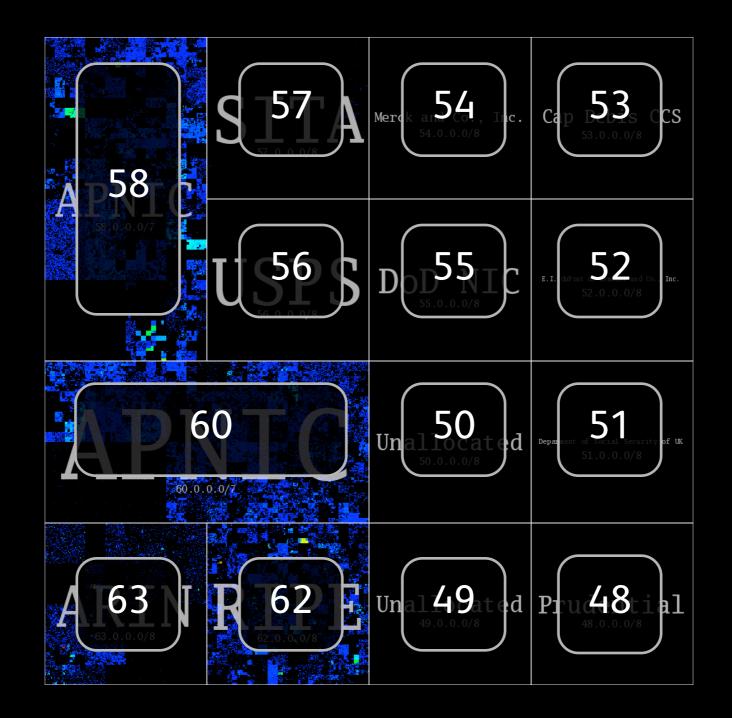
16 points on 2nd order Morton curve



IPv4 Heatmap in Hilbert Order.

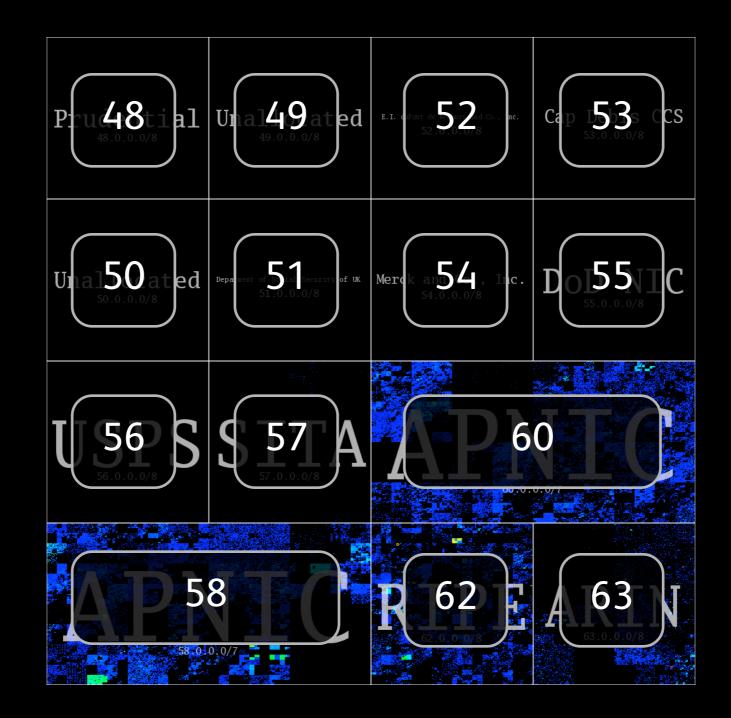


IPv4 Heatmap in Morton Order.



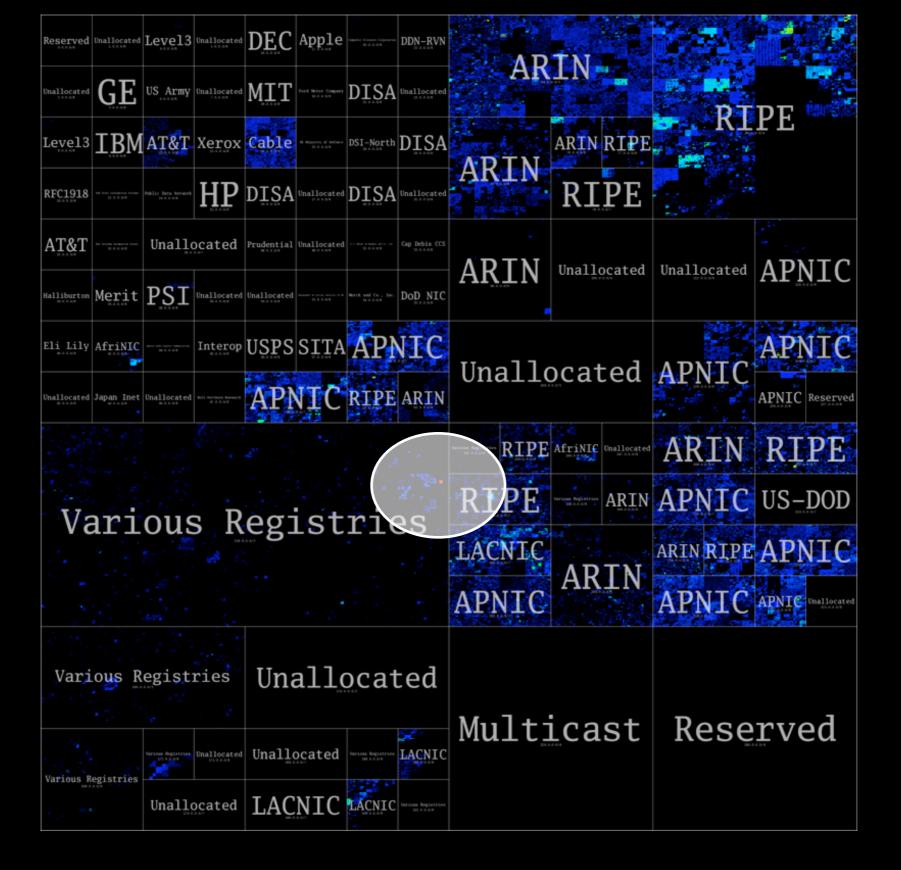
Hilbert

Detail of 48/4

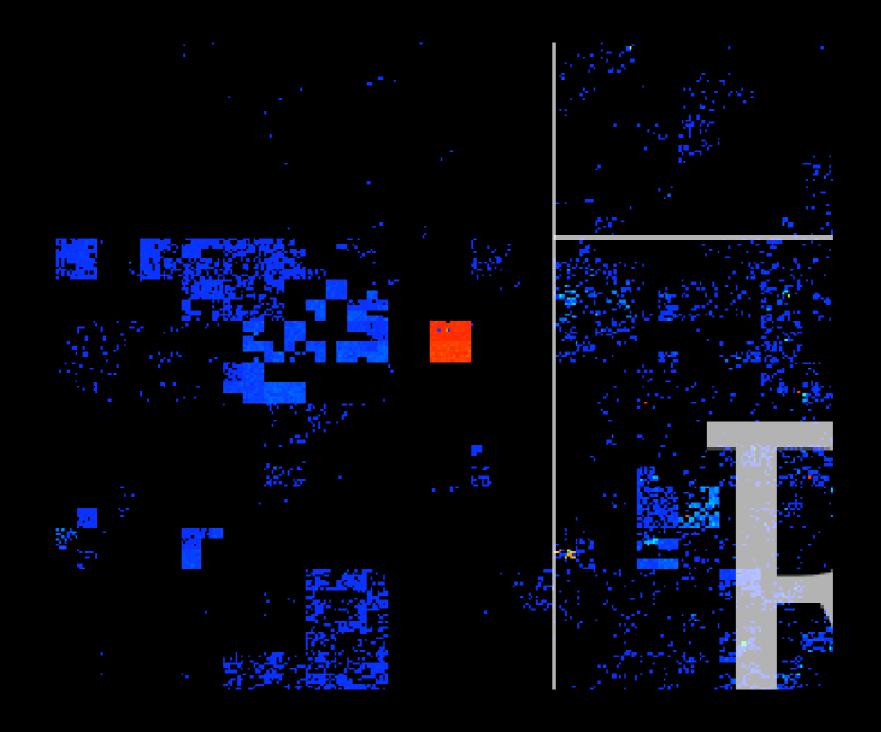


Morton

Detail of 48/4



IPv4 Heatmap in Morton Order. Notice the very red spot.



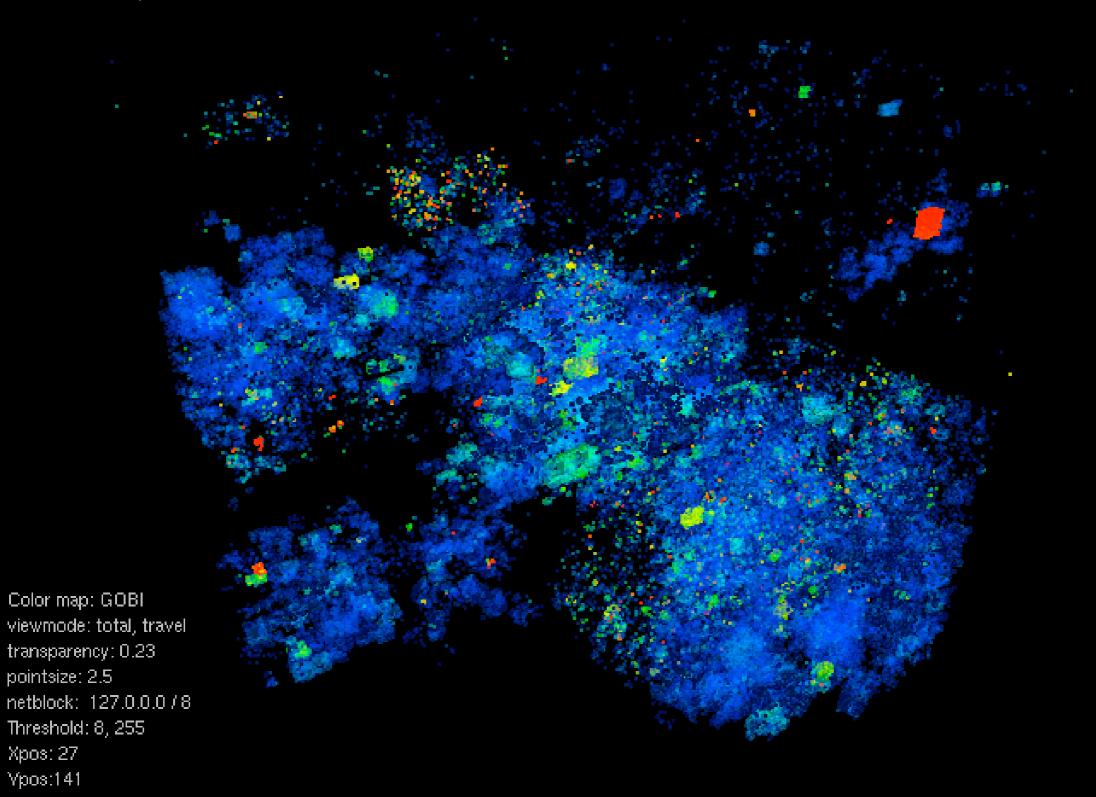
This is a /16 network

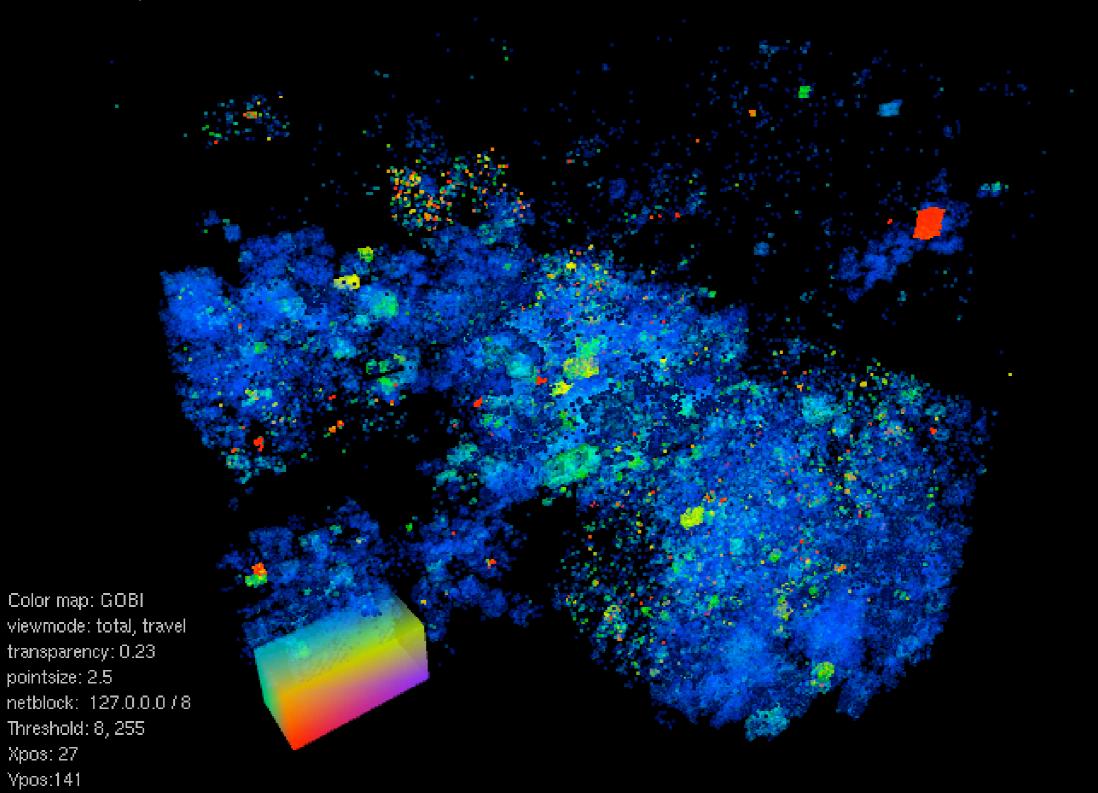
These curves work in three dimensions

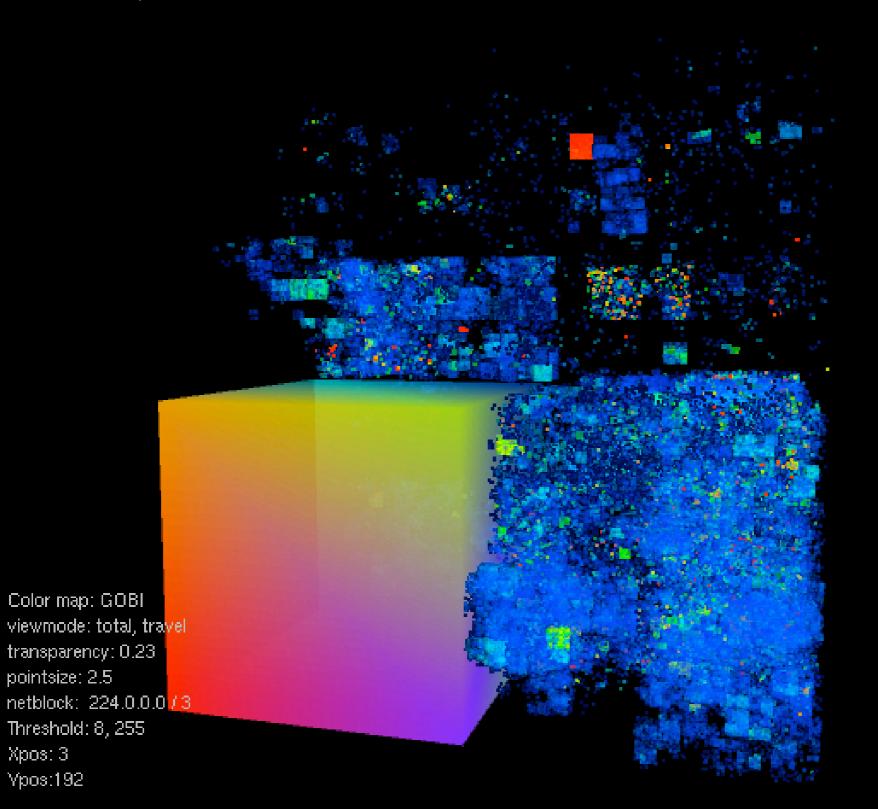
A STREET

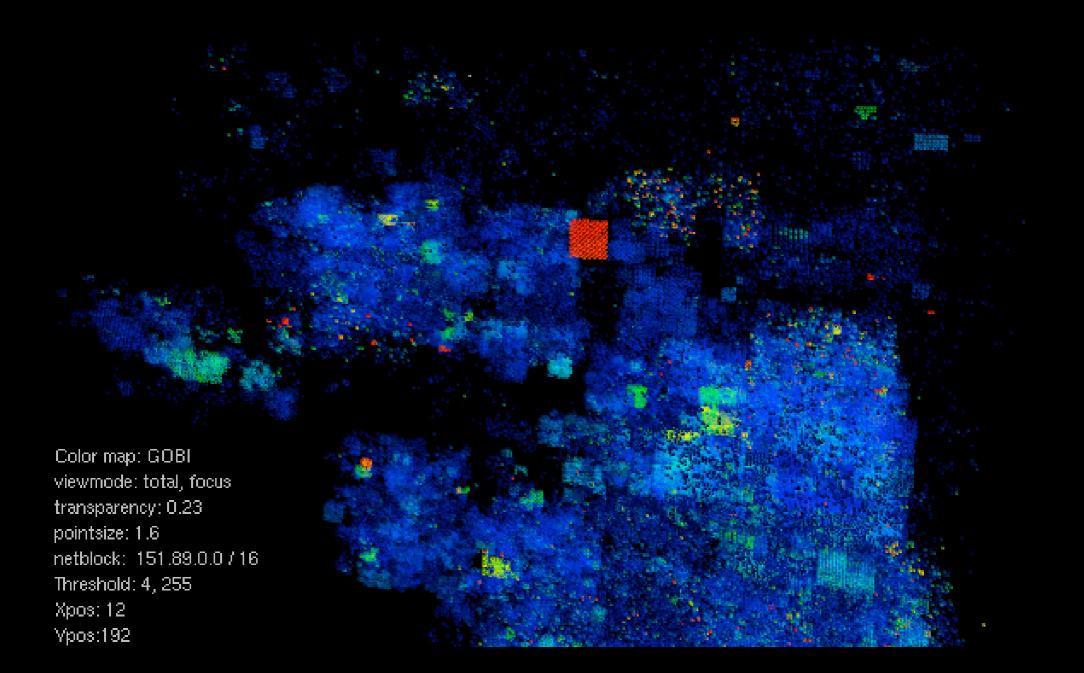
Color map: GOBI viewmode: total, travel transparency: 0.50 pointsize: 1.8 netblock: 10.0.0.078 Threshold: 7, 255 Xpos: 315 Ypos:45

Color map: GOBI viewmode: total, travel transparency: 0.50 pointsize: 2.7 netblock: 10.0.0.078 Threshold: 64, 255 Xpos: 12 Ypos:315











Color map: GOBI viewmode: cube, focus transparency: 0.23 pointsize: 1.6 netblock: 151.89.0.0 / 16 Threshold: 4, 255 Xpos: 12 Ypos:192



Color map: GOBI viewmode: cube, focus transparency: 0.23 pointsize: 4.8 netblock: 151.89.0.0 / 16 Threshold: 4, 255 Xpos: 27 Ypos:204

Questions?