

# nominet

Fun with IPv4 Heatmaps

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Nominet UK



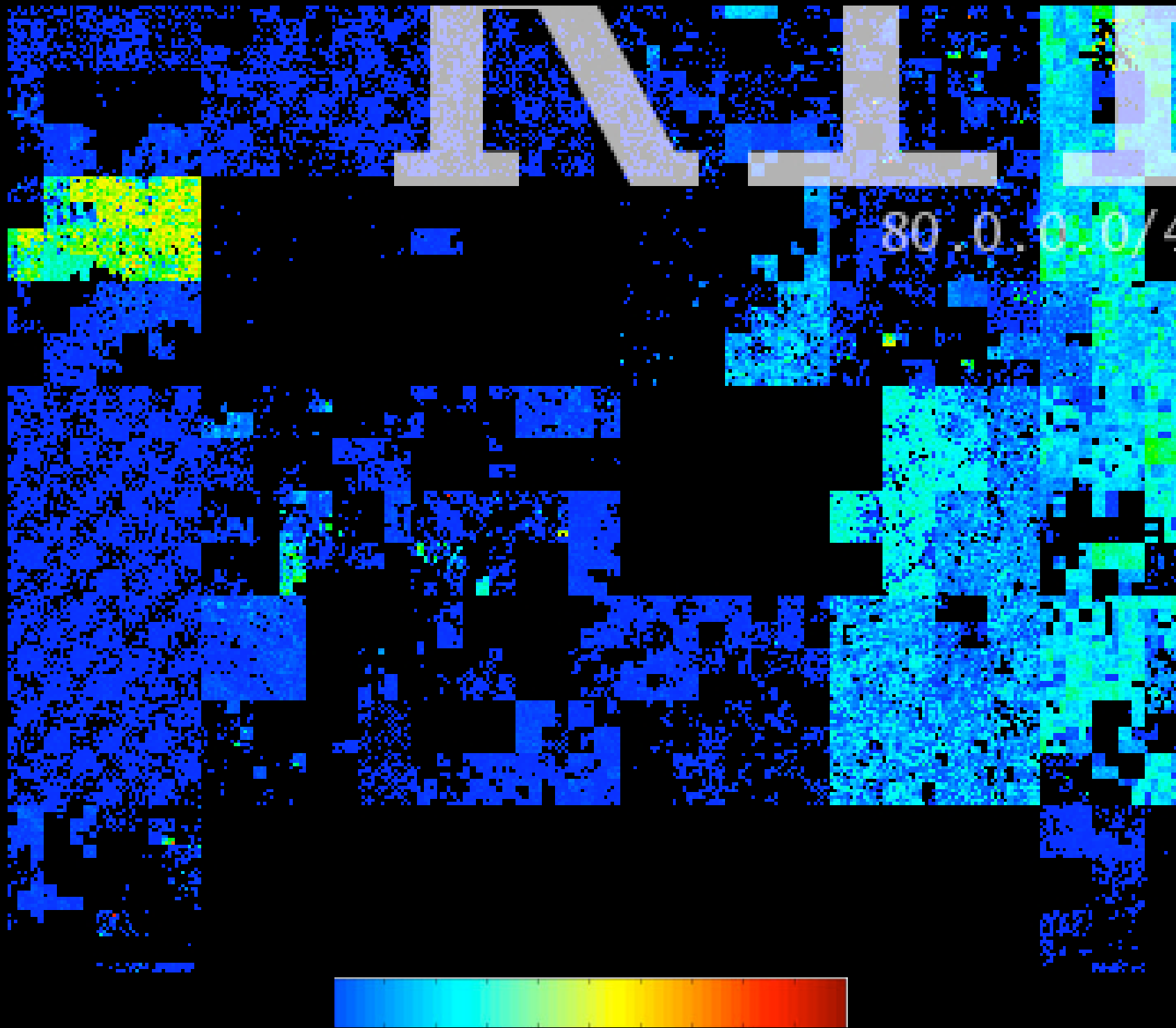


Inspired by XKCD



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

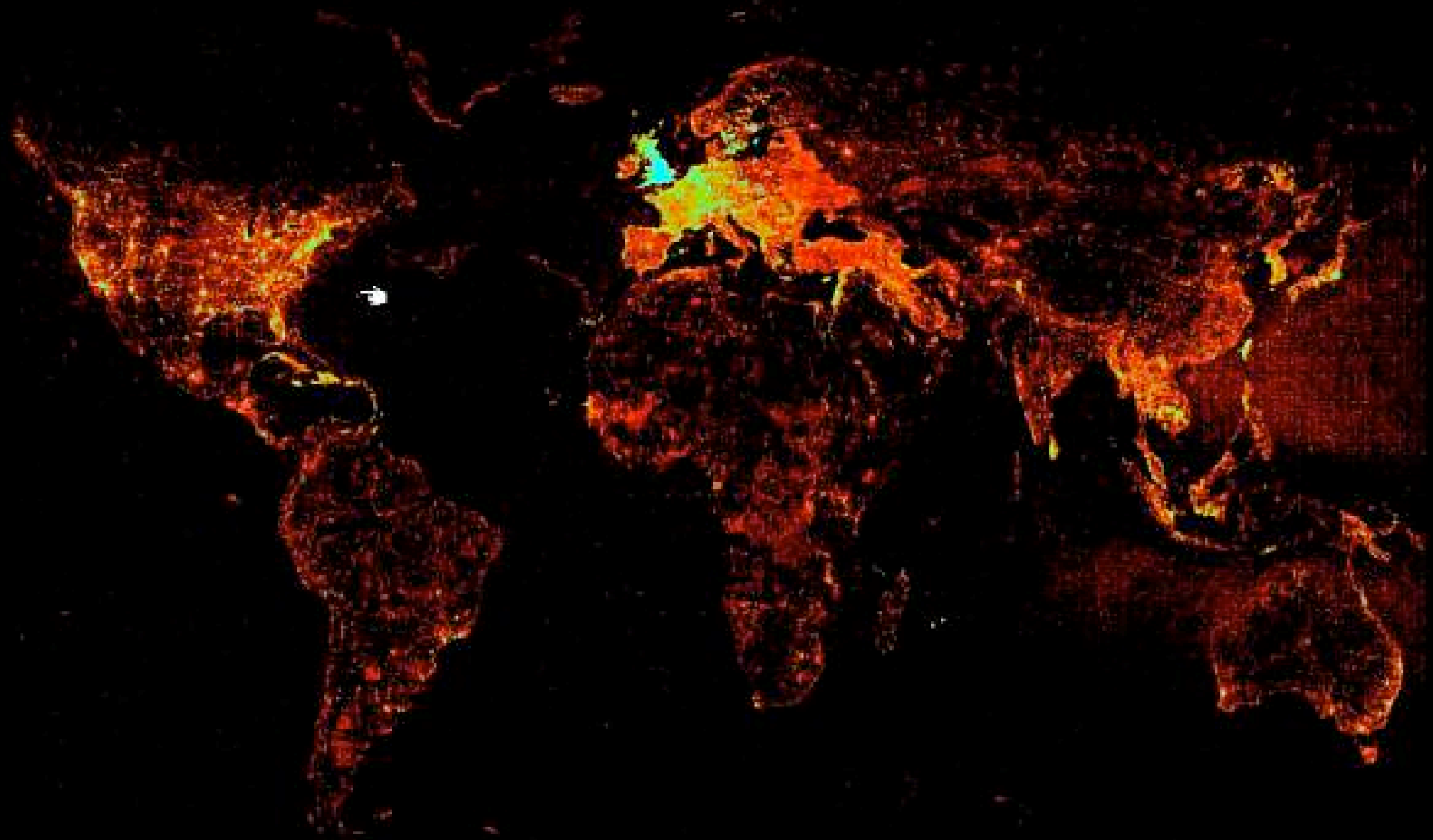




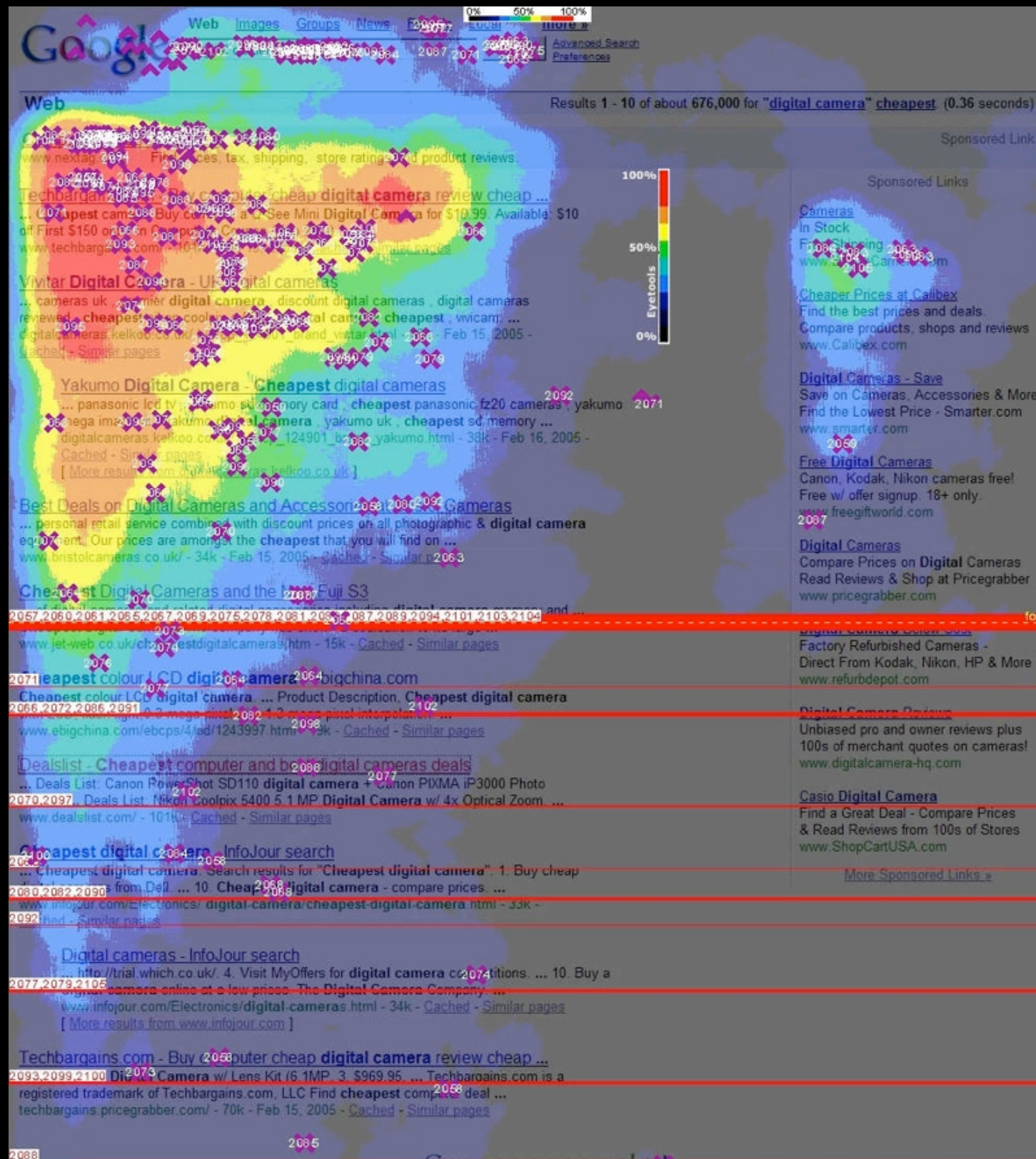
detail of 80.0.0.0/4  
One /24 network per pixel, colored by saturation.



# Examples of Heatmaps



Ed Parsons “the Cathedral and the GPS”  
footprints of google’s KML/GeoRSS database



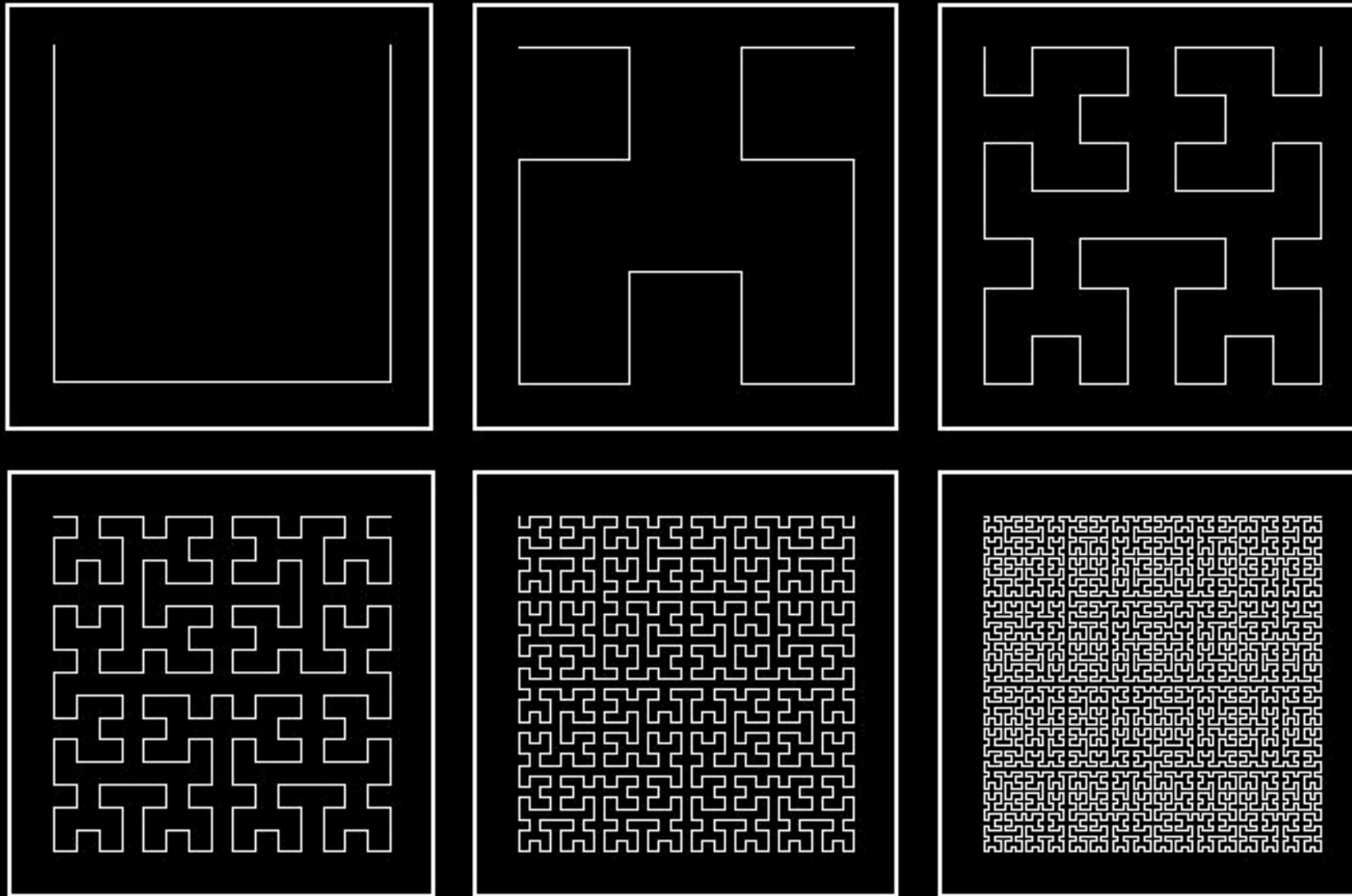
Eyetools heatmaps  
Where do viewers look and click





GeoIQ  
Heatmap layer for Google maps





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 2<sup>nd</sup> 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.

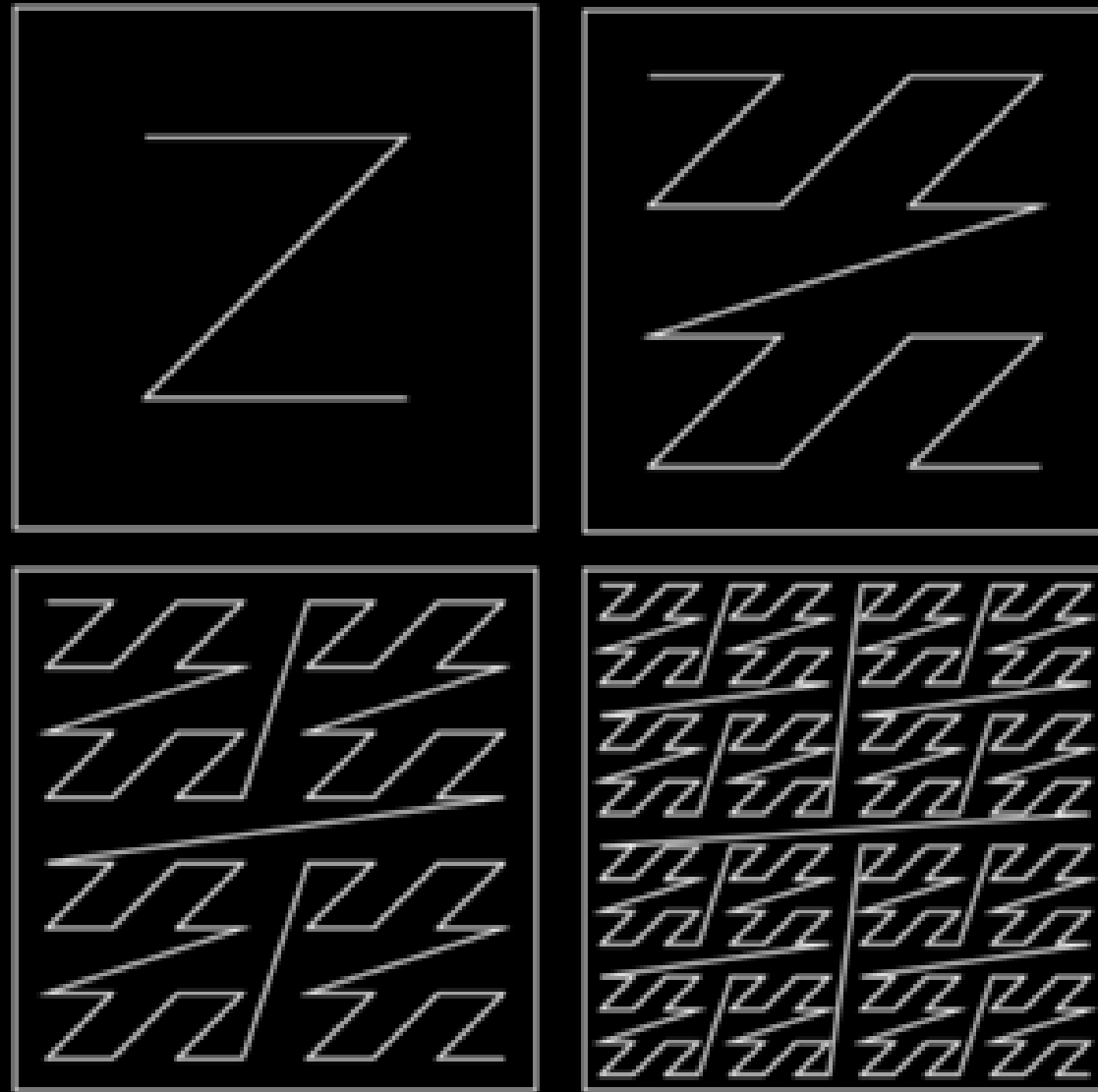
$$127 / 8 + 128 / 8 \neq 127 / 7$$

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

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

16 points on 2<sup>nd</sup> order Morton curve







IPv4 Heatmap in Morton Order.

58 58.0.0.0/7	57 57.0.0.0/8	54 54.0.0.0/8	53 53.0.0.0/8
58 58.0.0.0/7	56 56.0.0.0/8	55 55.0.0.0/8	52 52.0.0.0/8
60 60.0.0.0/7		50 50.0.0.0/8	51 51.0.0.0/8
63 63.0.0.0/8	62 62.0.0.0/8	49 49.0.0.0/8	48 48.0.0.0/8

Hilbert

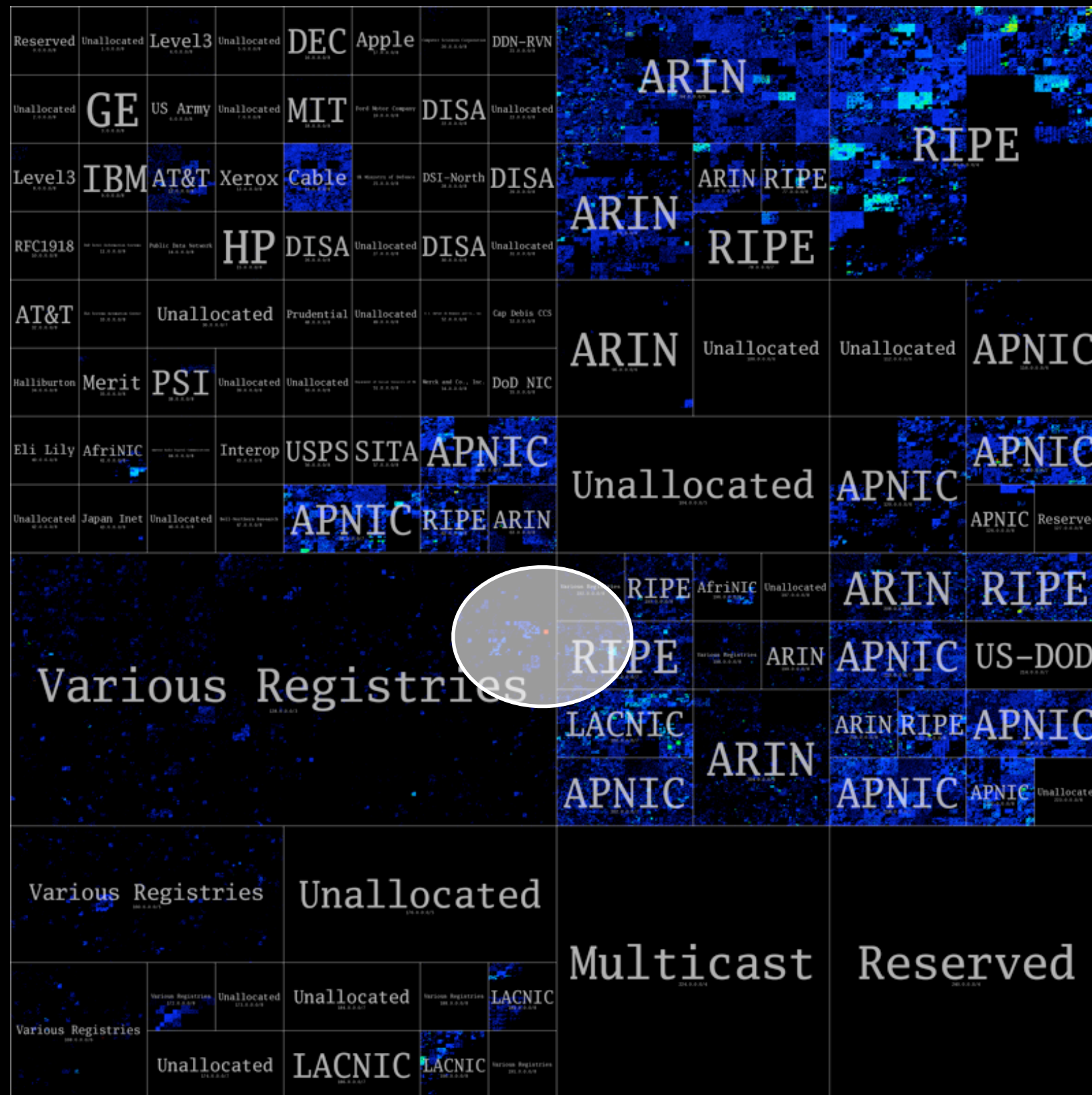
Detail of 48/4

<p>Prudential 48 48.0.0.0/8</p>	<p>Unallocated 49 49.0.0.0/8</p>	<p>E.I. du Pont de Nemours and Co., Inc. 52 52.0.0.0/8</p>	<p>Cap Dbb's CCS 53 53.0.0.0/8</p>
<p>Unallocated 50 50.0.0.0/8</p>	<p>Department of Digital Security of UK 51 51.0.0.0/8</p>	<p>Merck and Co., Inc. 54 54.0.0.0/8</p>	<p>DOB NIC 55 55.0.0.0/8</p>
<p>USPS 56 56.0.0.0/8</p>	<p>SITA 57 57.0.0.0/8</p>	<p>APNIC 60 60.0.0.0/7</p>	
<p>APNIC 58 58.0.0.0/7</p>		<p>RIPE 62 62.0.0.0/8</p>	<p>AREN 63 63.0.0.0/8</p>

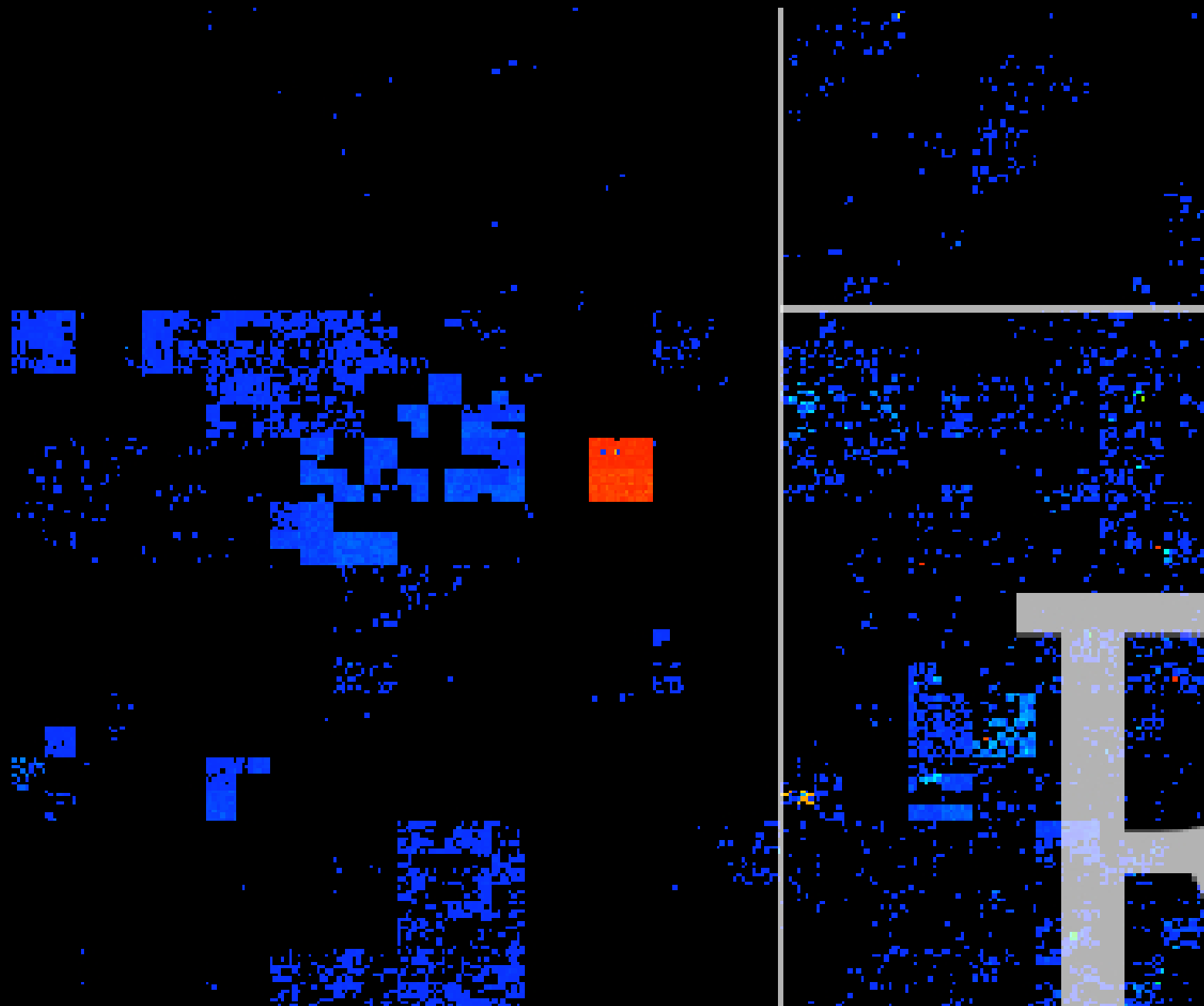
Morton

Detail of 48/4





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

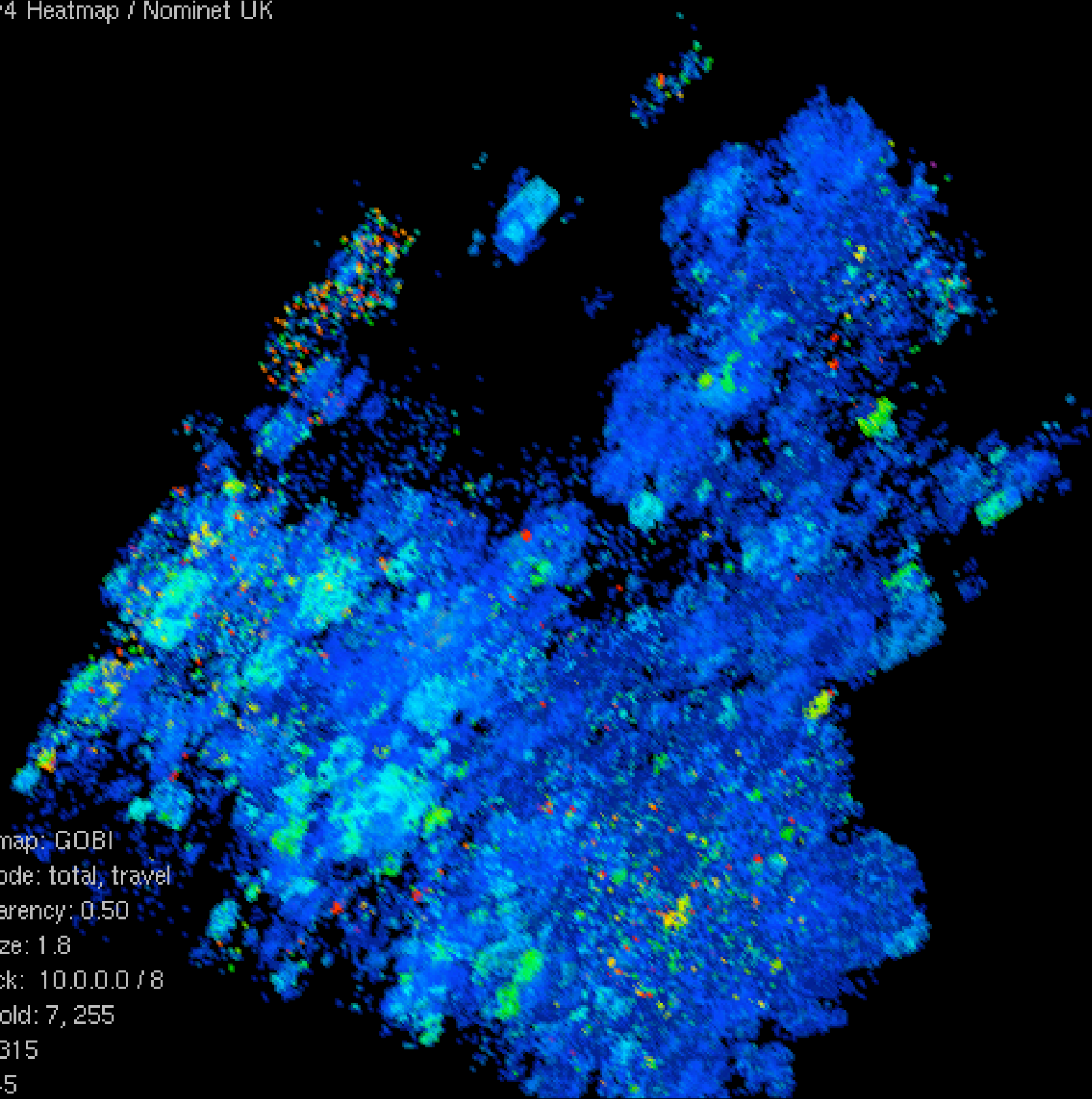


This is a /16 network



These curves work in three dimensions

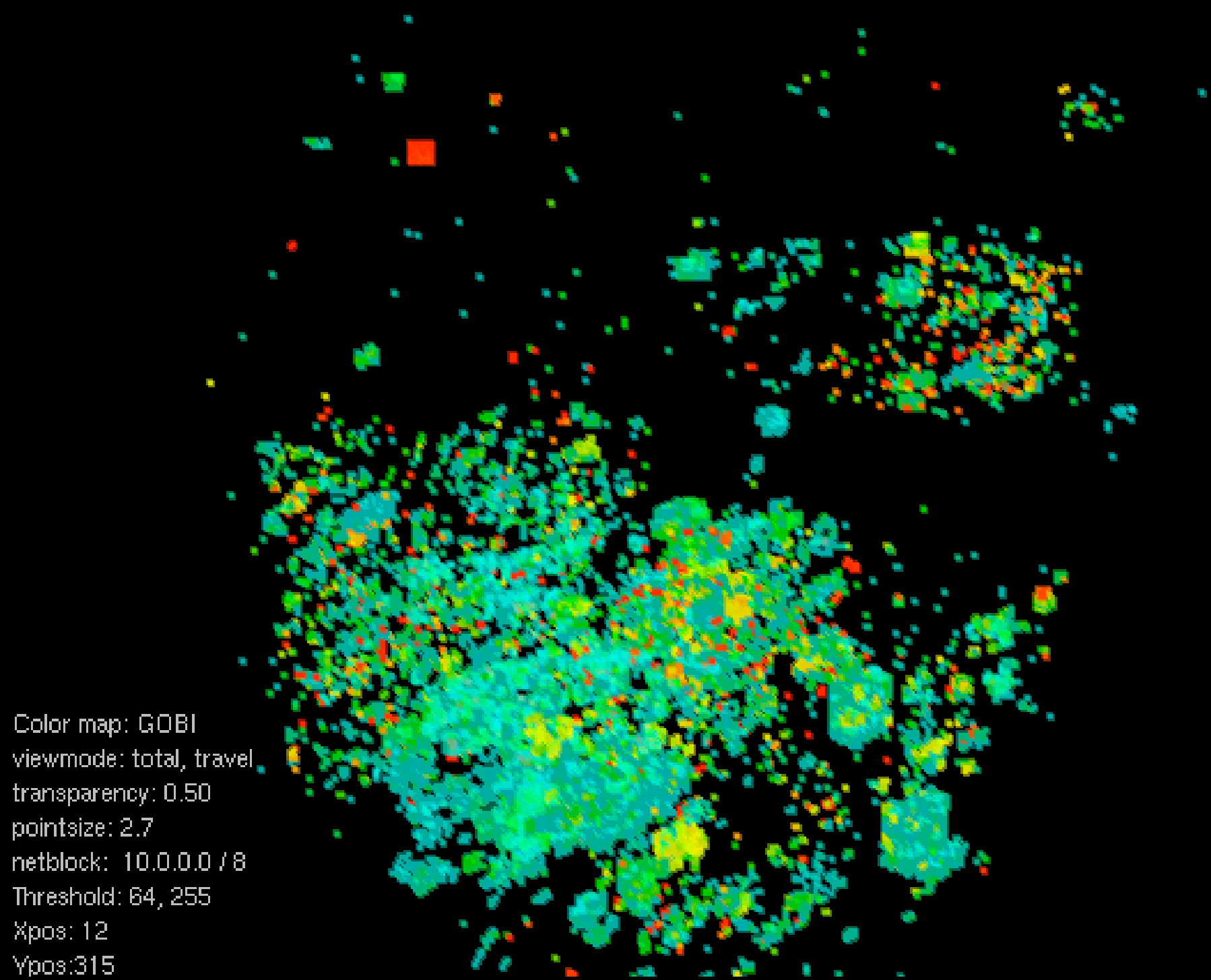
3D IPv4 Heatmap / Nominet UK



Color map: GOBI  
viewmode: total, travel  
transparency: 0.50  
pointsize: 1.8  
netblock: 10.0.0.0 / 8  
Threshold: 7, 255  
Xpos: 315  
Ypos: 45

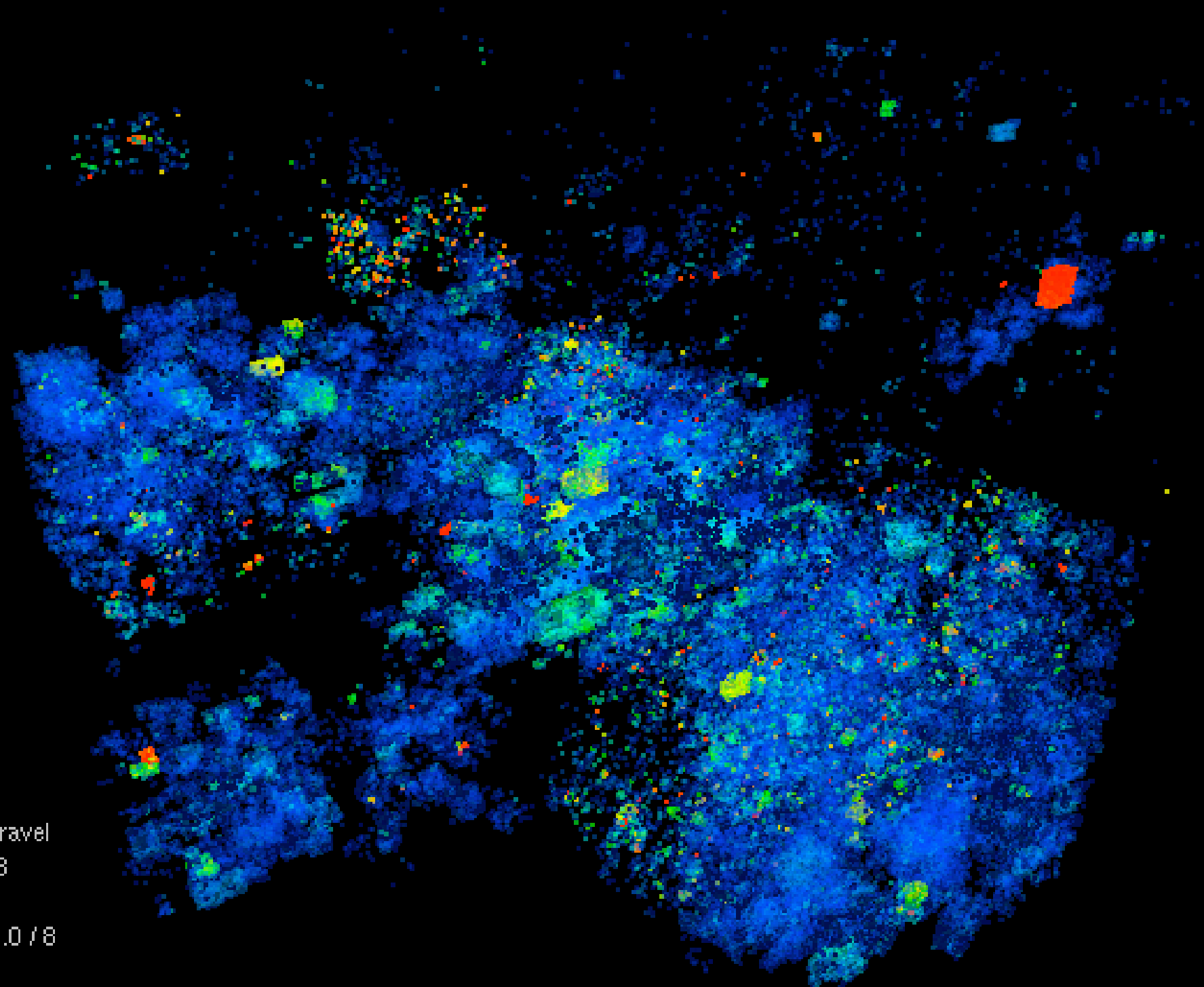


3D IPv4 Heatmap / Nominet UK



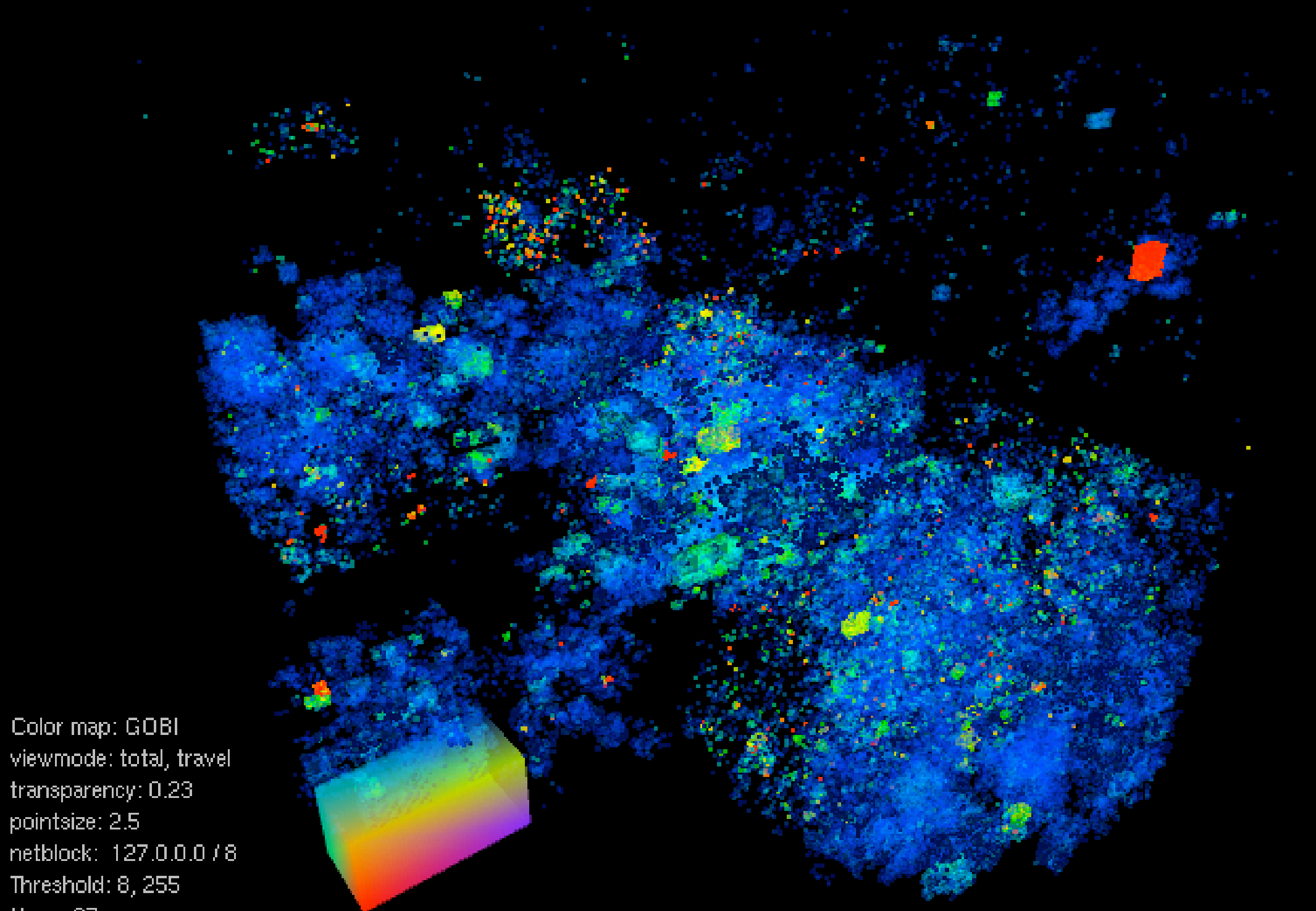
Color map: GOBI  
viewmode: total, travel  
transparency: 0.50  
pointsize: 2.7  
netblock: 10.0.0.0 / 8  
Threshold: 64, 255  
Xpos: 12  
Ypos: 315

3D IPv4 Heatmap / Nominet UK



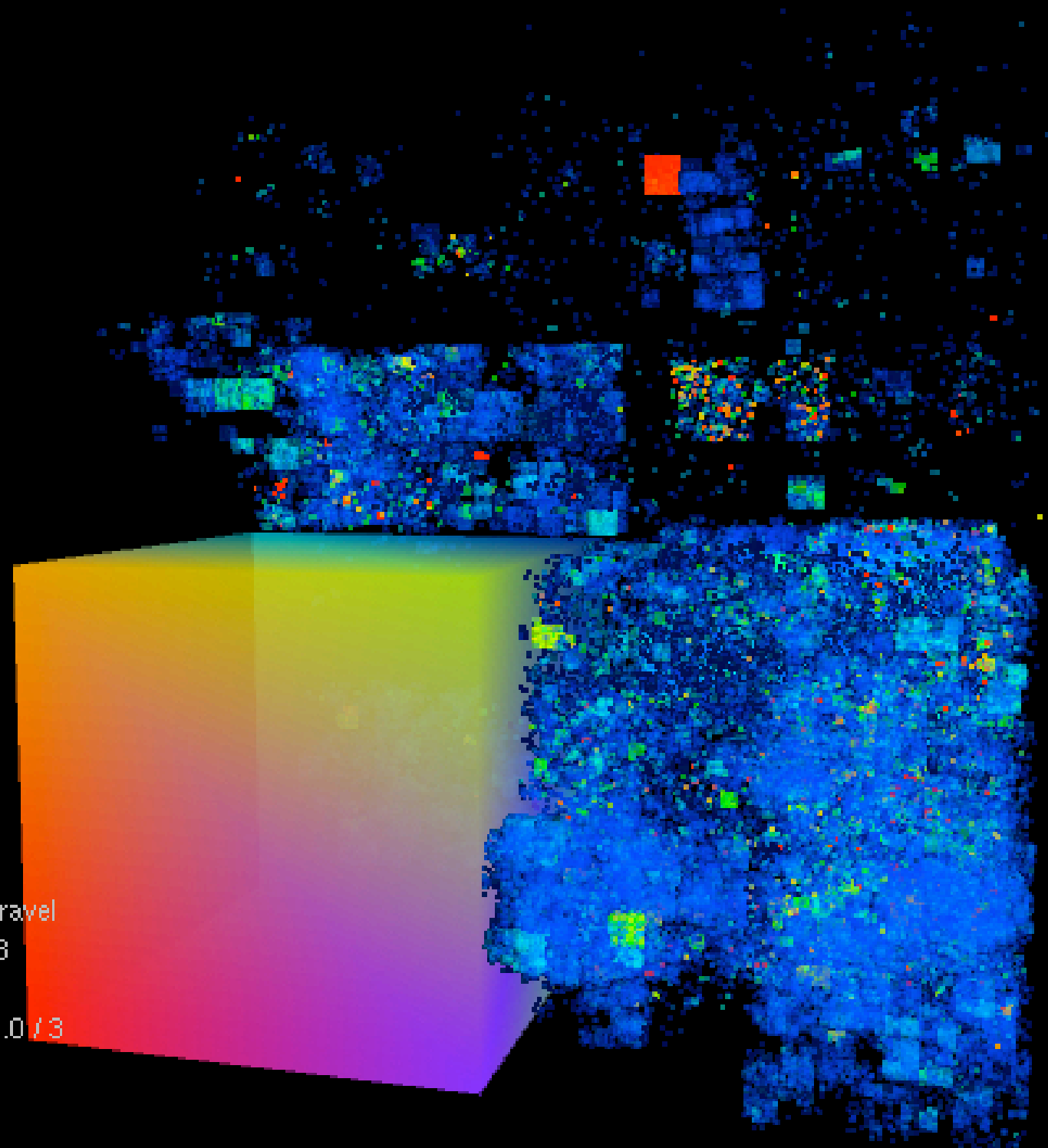
Color map: GOBI  
viewmode: total, travel  
transparency: 0.23  
pointsize: 2.5  
netblock: 127.0.0.0 / 8  
Threshold: 8, 255  
Xpos: 27  
Ypos: 141

3D IPv4 Heatmap / Nominet UK



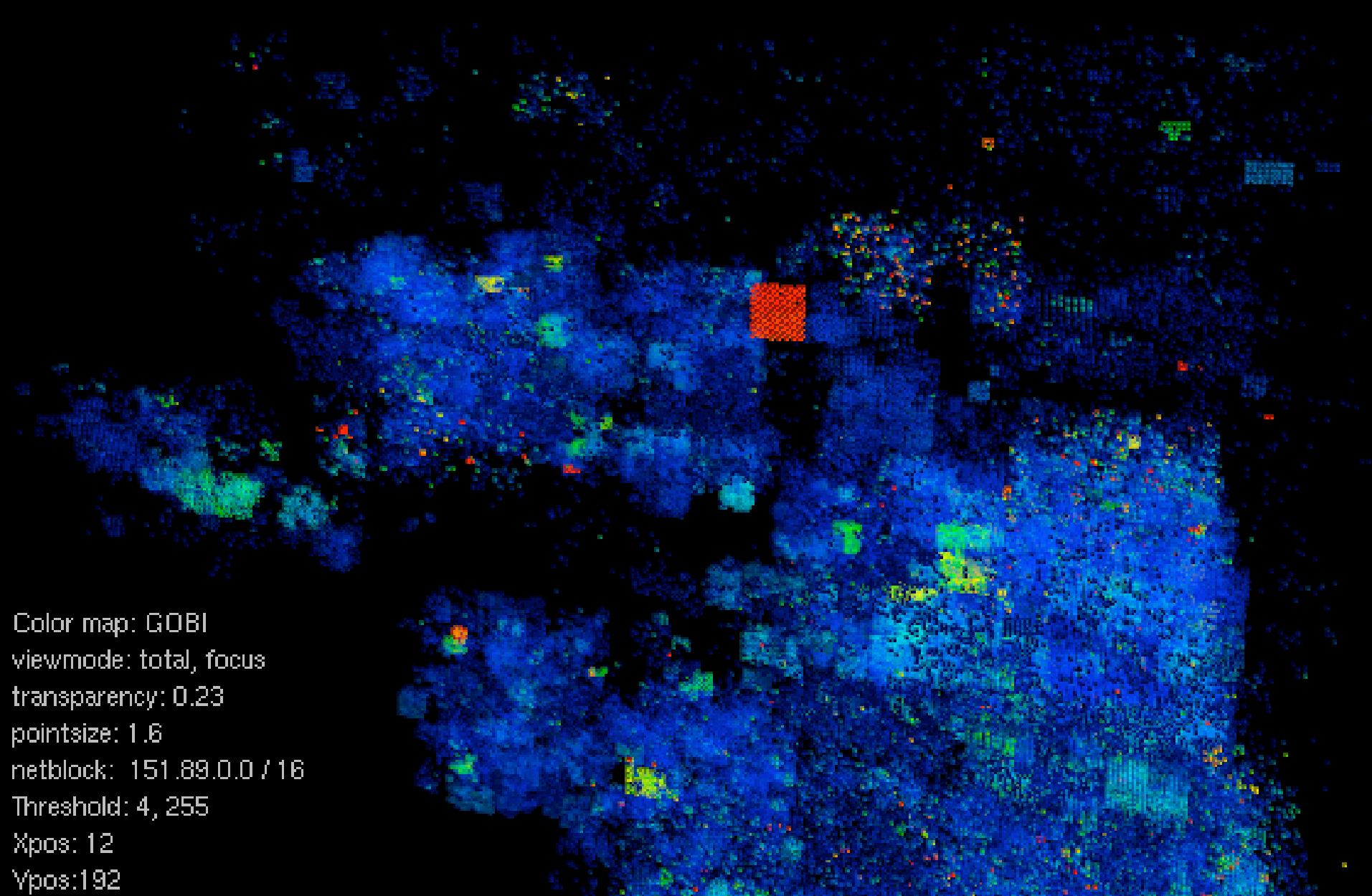
Color map: GOBI  
viewmode: total, travel  
transparency: 0.23  
pointsize: 2.5  
netblock: 127.0.0.0 / 8  
Threshold: 8, 255  
Xpos: 27  
Ypos:141

3D IPv4 Heatmap / Nominet UK



Color map: GOBI  
viewmode: total, travel  
transparency: 0.23  
pointsize: 2.5  
netblock: 224.0.0.0 / 3  
Threshold: 8, 255  
Xpos: 3  
Ypos: 192

3D IPv4 Heatmap / Nominet UK



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



# 3D IPv4 Heatmap / Nominet UK



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



Thanks to  
Duane Wessels  
&  
John Kristoff

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?