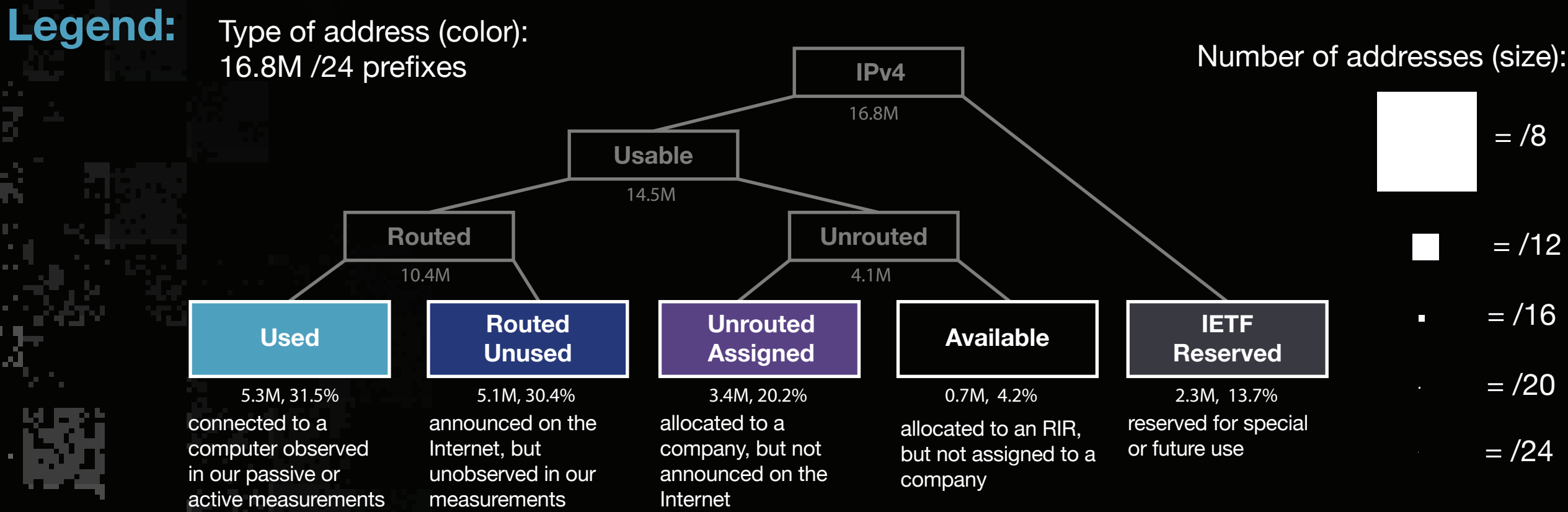
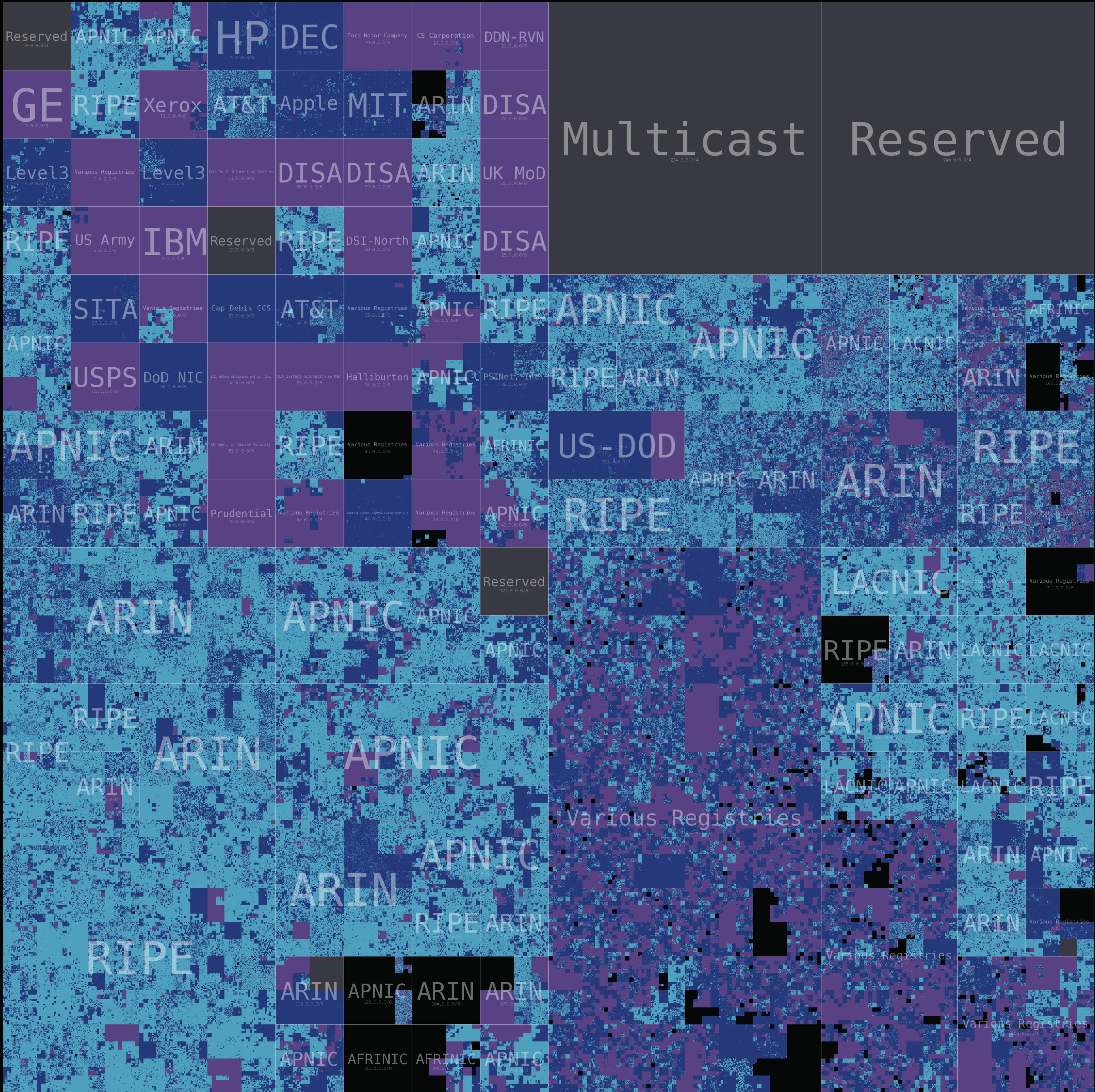


# IPv4 Census 2013

Alberto Dainotti<sup>\*,†</sup>, Karyn Benson<sup>\*,†</sup>, Alistair King<sup>\*,†</sup>, Bradley Huffaker<sup>\*,†</sup>, Eduard Glatz<sup>‡</sup>, Xenofontas Dimitropoulos<sup>\*,†</sup>, Philipp Richter<sup>∞</sup>, Alessandro Finamore<sup>°</sup>, Alex C. Snoeren<sup>†</sup>

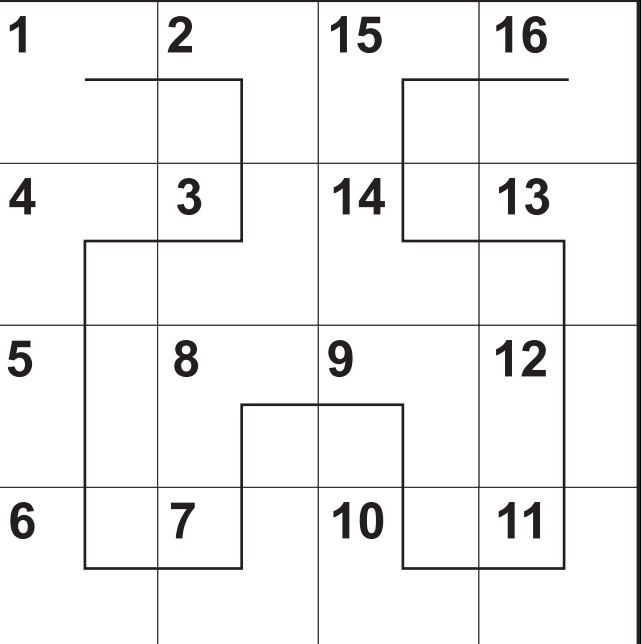
\*CAIDA,<sup>†</sup>UC San Diego, <sup>‡</sup>ETH Zurich, <sup>\*</sup>FORTH, <sup>∞</sup>TU Berlin, <sup>°</sup>Politecnico di Torino | [http://www.caida.org/publications/papers/2015/lost\\_in\\_space](http://www.caida.org/publications/papers/2015/lost_in_space)

Poster Design: Johanna Fleischman and Bradley Huffaker



## Hilbert Graph:

The Hilbert curve is a fractal space-filling curve that preserves locality in a 2D structure. The black line in this graph represents a second order Hilbert curve.



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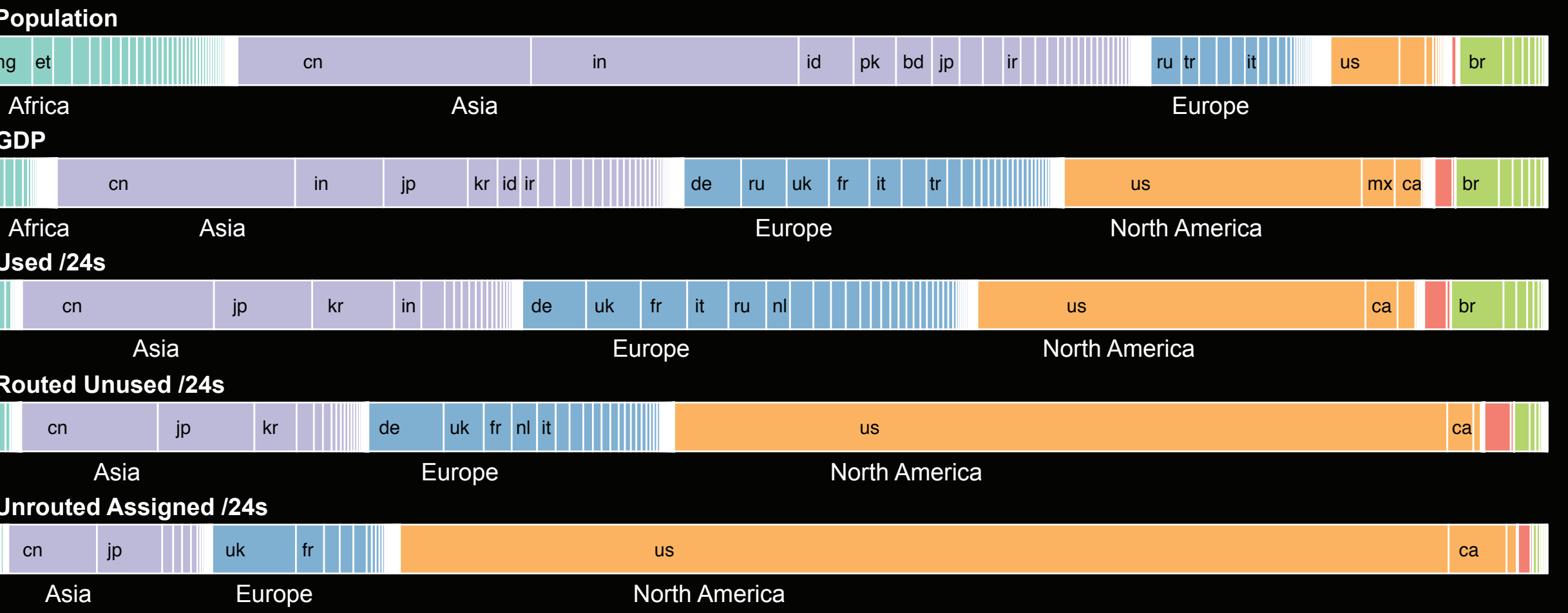


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## IPv4 Address Space Utilization:

Using a space-filling continuous fractal Hilbert curve representation to visualize IPv4 address space utilization is a technique pioneered by ISI [1]. We integrated their active measurement approach with additional sources of active measurements as well as inferences from passive measurements. The visualization on the left illustrates IPv4 address space utilization using a Hilbert curve of order 12, where each pixel represents a /24 block (256 contiguous addresses). The dataset resulting from this study is available through the DHS PREDICT repository [2].

[1] John Heidemann, Yuri Pradkin, Ramesh Govindan, Christos Papadopoulos, Genevieve Bartlett, and Joseph Bannister, "Census and survey of the visible internet", Proceedings of the 8th ACM SIGCOMM IMC 2008  
[2] <https://www.predict.org/>



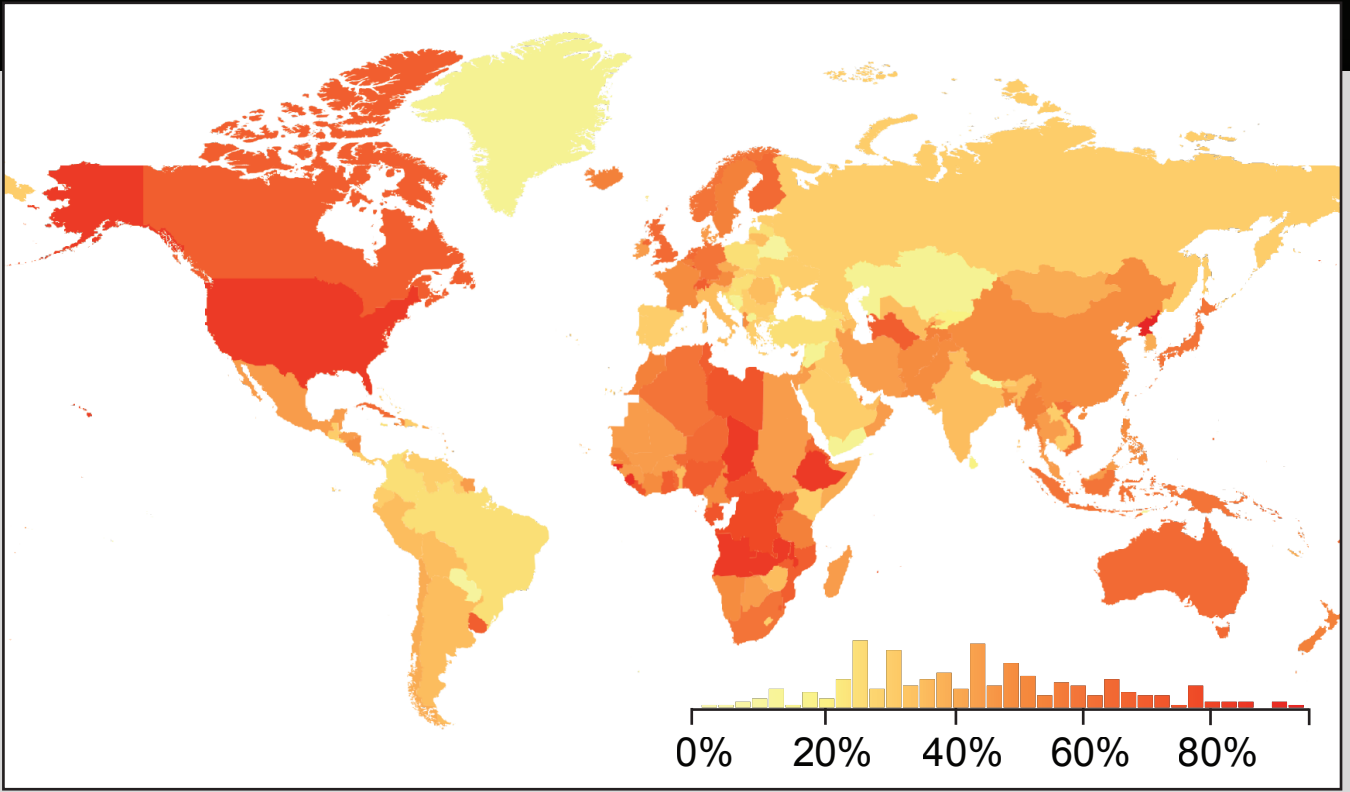
## Country Inequality:

The visualization above compares per-country address space utilization with population and GDP. The width of a country (and continent) represents its relative size within a dataset. For example, the top bar shows the percentage that each country contributes to the global population, with China (cn) contributing the most (1.36B, 18.9%). Comparing bars reveals correlations between datasets. There is not a strong correlation

between population (top bar) and number of used /24 blocks of a country, in large part due to high IPv4 address usage by the United States. However, there is a strong correlation between the GDP (2nd from top) and number of used /24 blocks of a country (3rd bar). Not only does the U.S. dominate /24 block usage, it also represents a significant portion of both the routed unused and unrouted assigned space, with 49.8% and 67.5% respectively.

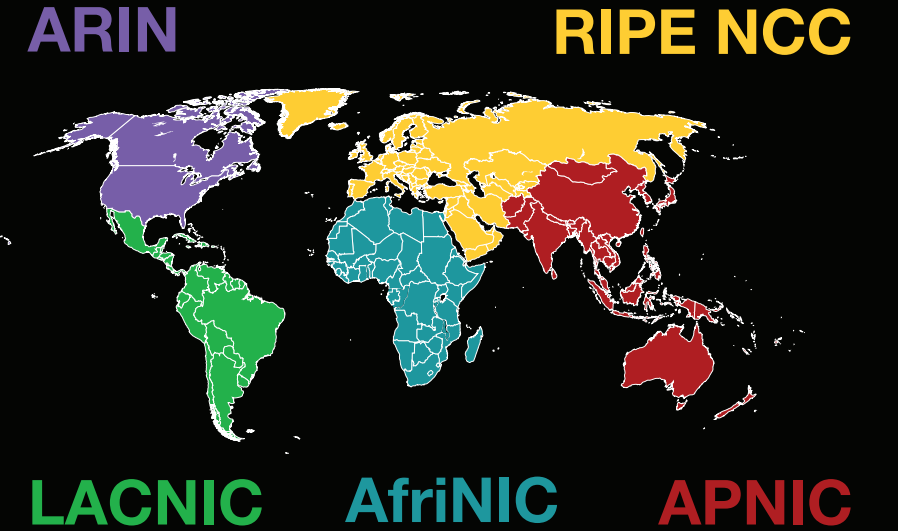
## Map of Unused Address Space:

This geographic map represents the *Unused Space Ratio* as a per-country percentage of unused space (routed unused + unrouted assigned) out of the space assigned to organizations in that country. The U.S. is red in this map due to a few large but underutilized allocations, while some African countries are red because they use a small fraction of their assigned space.



## Regional Internet Registries (RIRs):

Regional Internet Registries (RIRs) manage the allocation and assignment of internet resources.



Above: Regional Internet Registries (RIRs) and their corresponding geographical responsibilities.  
Left: Hilbert graph of observably used addresses colored by the RIR currently responsible for that address space.

## Acknowledgments:

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