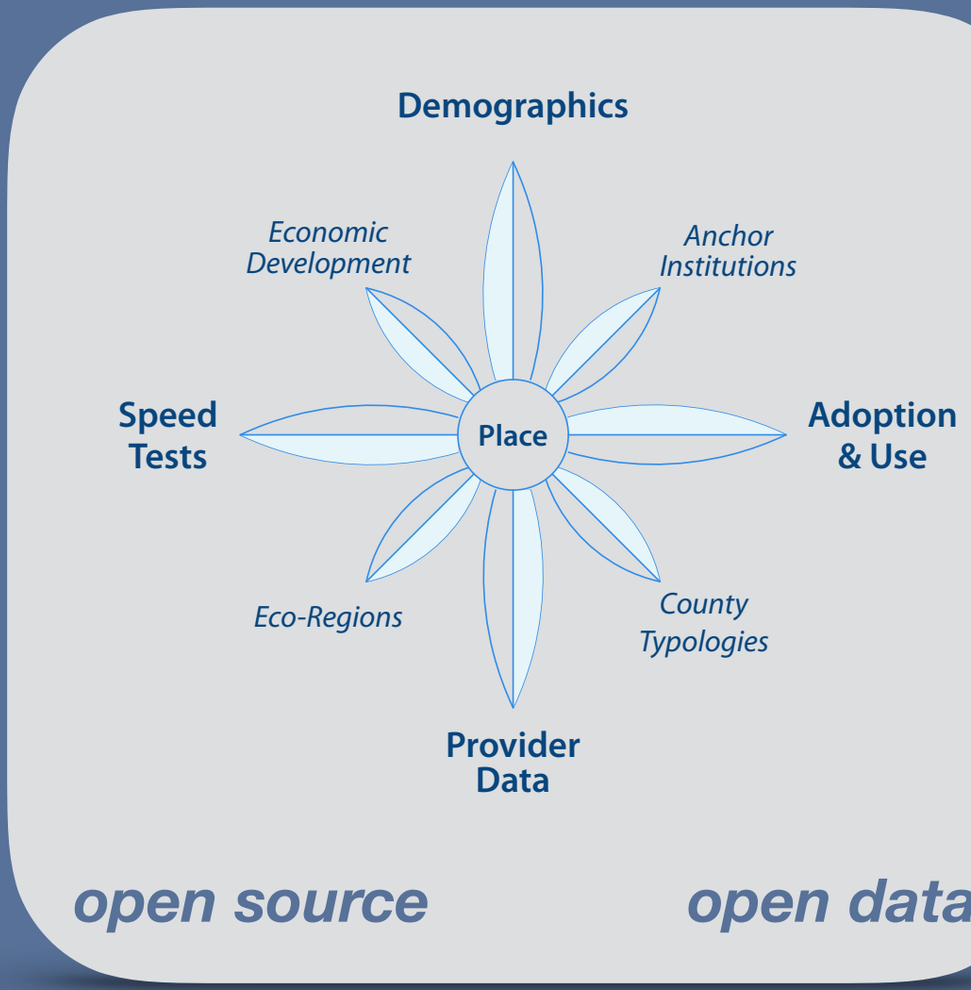

HELPING COMMUNITIES TO WRITE THEIR BROADBAND STORY

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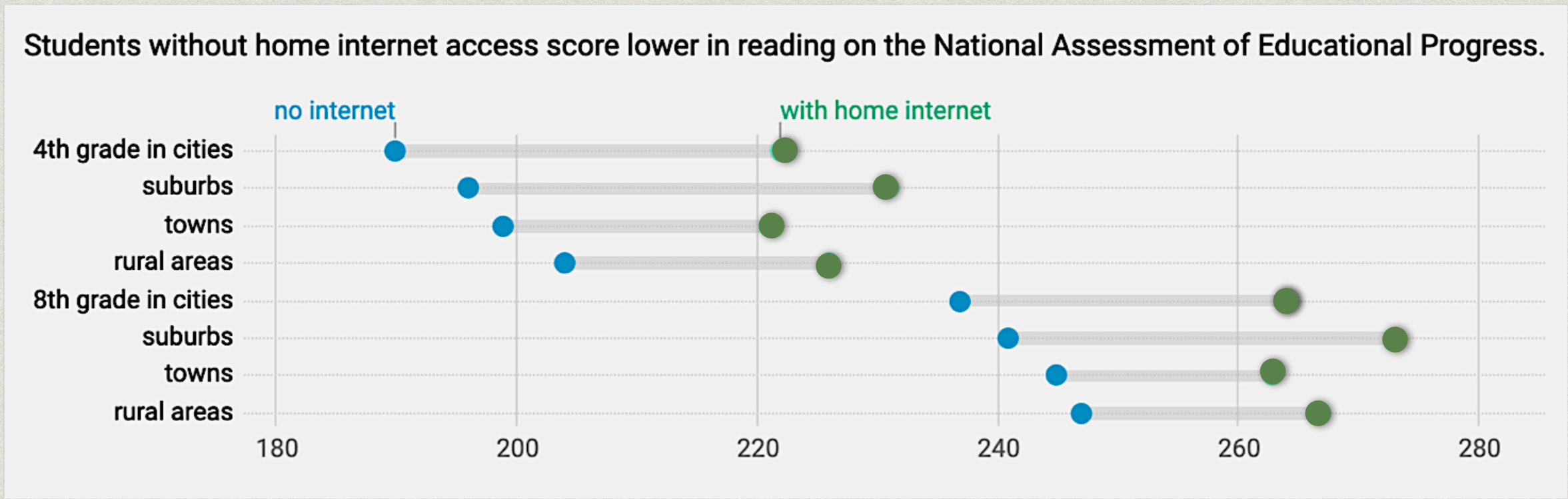
Internet as Infrastructure

AP News: 3 million US students don’t have home internet



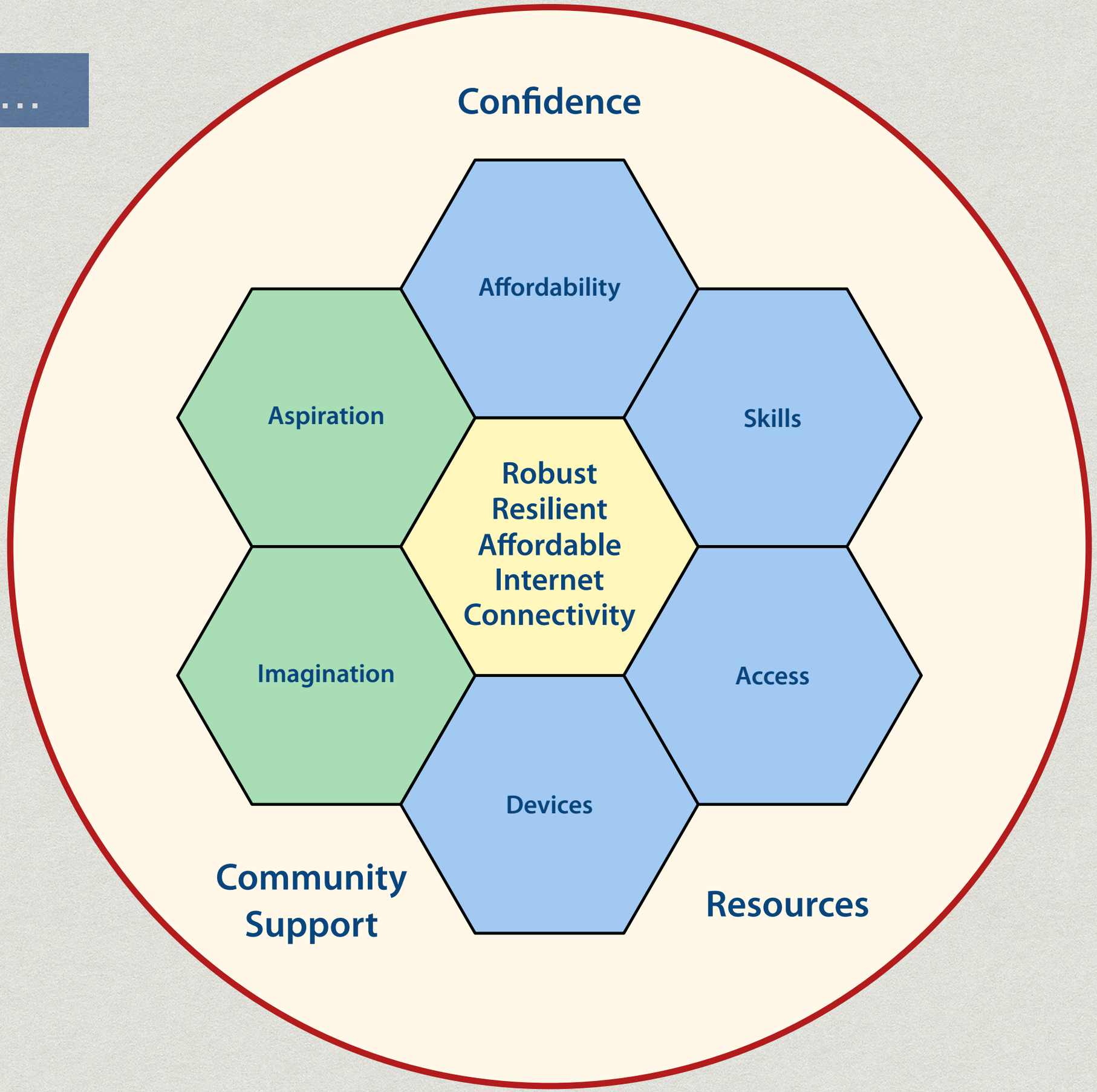
Data: Institute for Education Sciences, Student Access to Digital Learning Resources Outside of the Classroom (2018)

Figure courtesy Sara Trettin, Dept. of Ed.

Median Download Speed (annual) vs. FCC goal of 25Mbs

M–Lab NDT Speed Test Data: 1/1/2012 to 4 July 2019

Infrastructure…

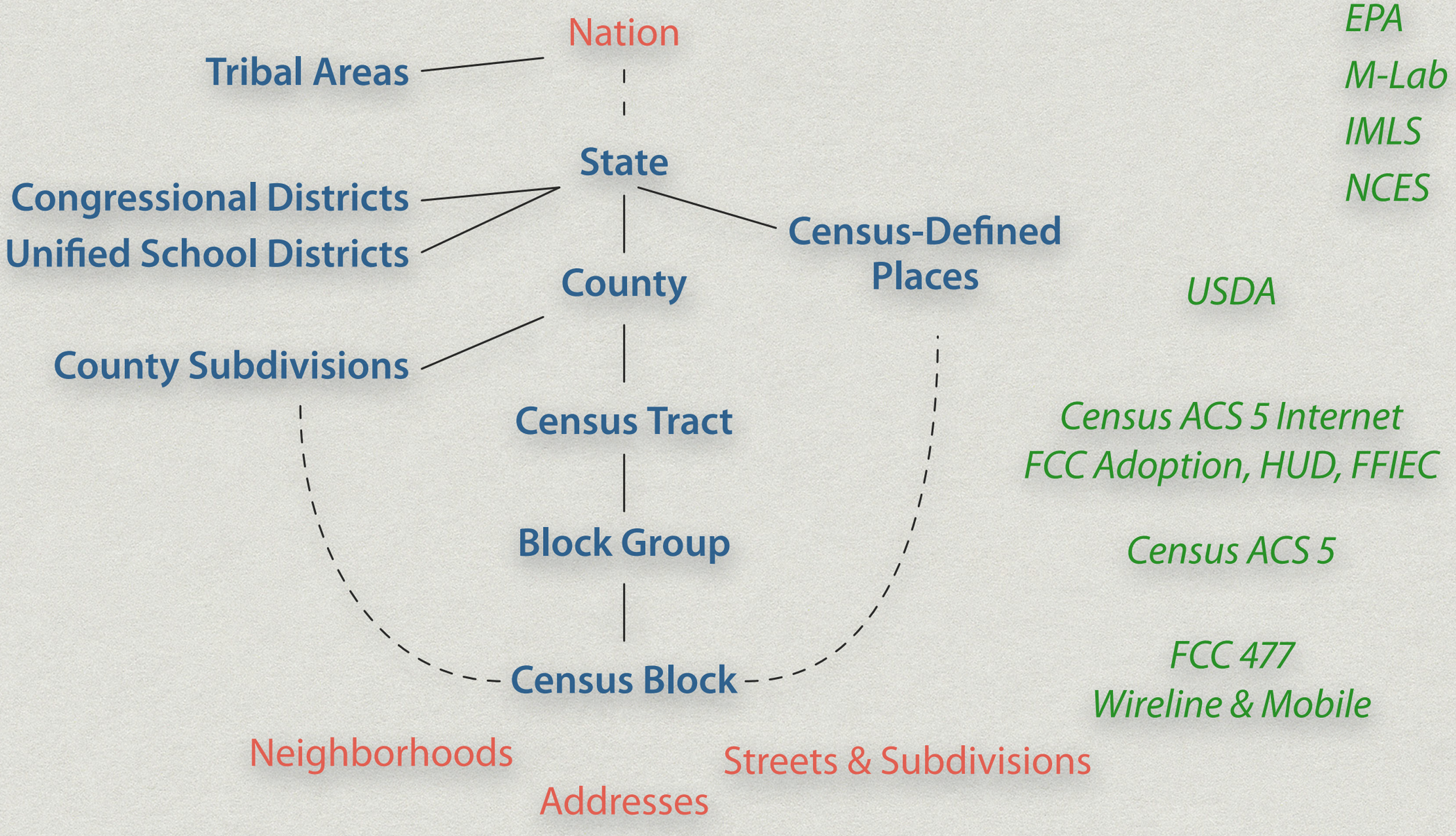


THE I3 CONNECTIVITY EXPLORER

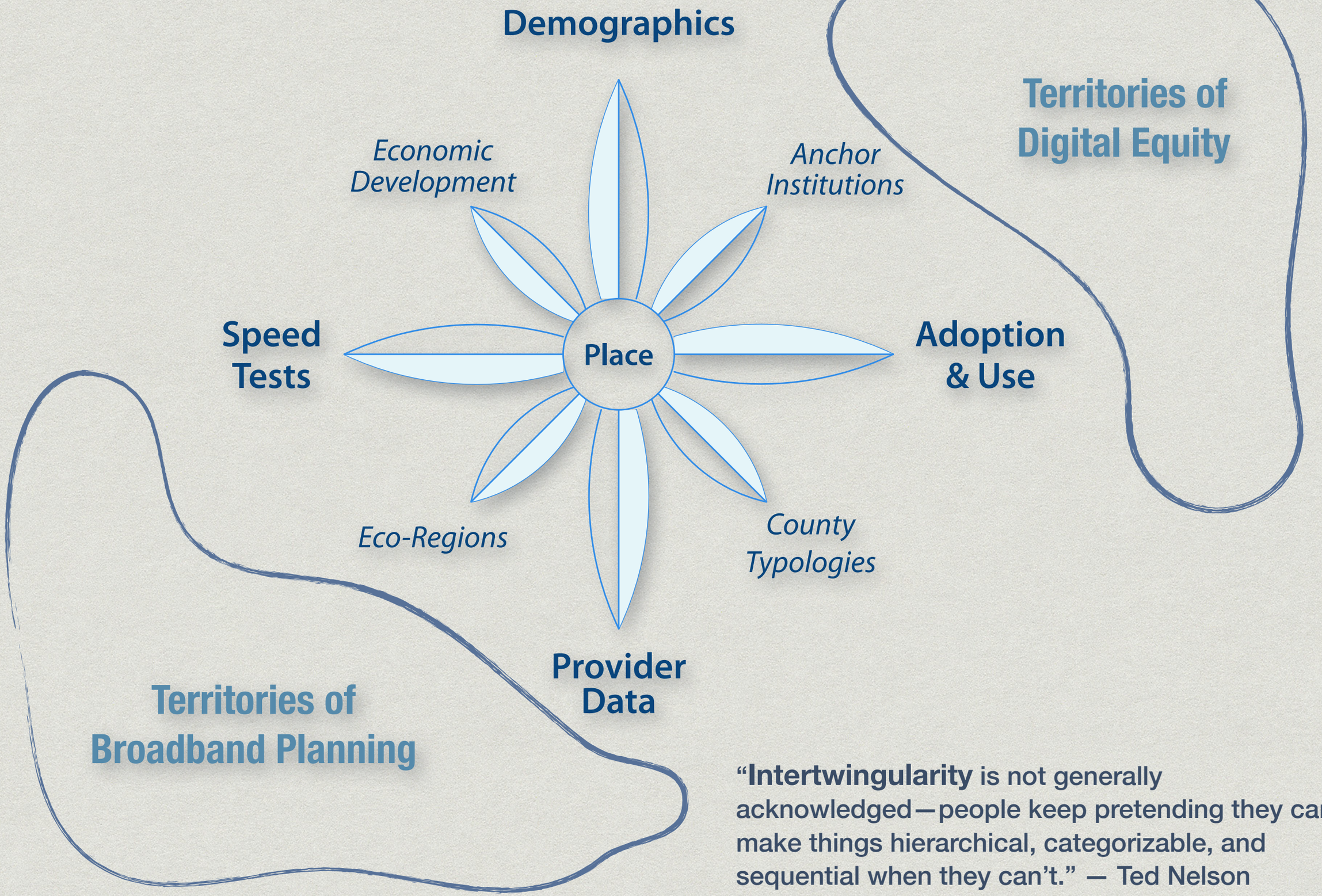
Starting points

- Provide communities with a starting point for effective and informed broadband discussions
- Bring data down from the clouds to where users can
  - get hold of it,
  - understand it, and
  - work with it
- Provide necessary background
- Explore how far one can get with Open Source and Open Data

Geographies



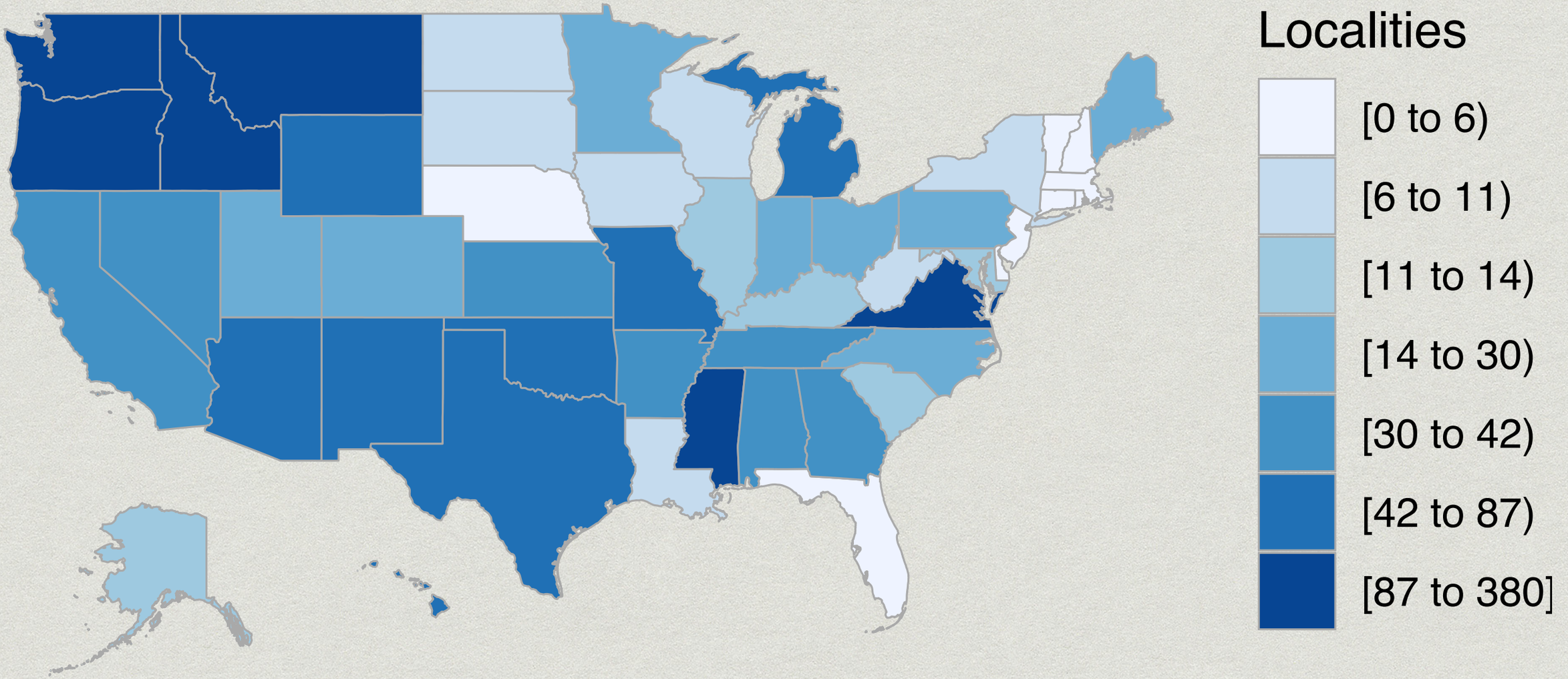
Cardinal Points



"**Intertwingularity** is not generally acknowledged—people keep pretending they can make things hierarchical, categorizable, and sequential when they can't." — Ted Nelson

Status

- In production since July 2018
- 500+ actual users (logged in at least once)
- Map indicates the number of localities viewed
  - 2,256 total, including duplications among users



Data as of 11/12/2019

LET'S TALK DATA

(THE DIRTY SECRET ABOUT DATA IS THAT THE DATA IS ALWAYS DIRTY)

National data, localized

U.S. Census
American Community Survey (ACS)
FCC Block-Level Population Estimates

Demographics

NCES

CRA Qualified Tracts

Opportunity Zones

Economic Development

IMLS

Anchor Institutions

Census ACS Internet

M-Lab NDT

Speed Tests

Place

Adoption & Use

FCC 477 Adoption

Eco-Regions

County Typologies

EPA

USDA

Provider Data

FCC 477 Wireline

FCC 477 Mobile

…Unexplored datasets

National Telecommunications & Information Administration

- Supplement to Census Current Population Survey
- ~52,000 respondents
- 85% response rate
- Asks roughly the same questions every 2 years
- *20 years of responses*

- 50+ Computer and Internet Questions
  - Device types
  - Internet access technologies
  - Locations of use
  - Online activities
  - Reasons for non-use
  - Privacy and security concerns

✓ Trend data is very solid
⚠ Limited to National and State Levels
⚠ Not currently in I3

https://www.ntia.doc.gov/data/digital-nation-data-explorer

Census ACS 5-Year

- Annual outreach to 3.5M households
  - 5 years, 17.5 M households rolling data
  - 5 years is enough to get statistically valid samples for all areas
  - > 90% response rate most years
  - All 3,142 counties
  - Tribal areas
  - School and Congressional Districts
  - Populations of 20,000 or less
  - Geographic areas down to the tract and block group level
- This year was the first year that we have complete coverage for Computer Usage Data
  - Device Usage
  - Subscriptions
  - Computer and Internet use by various demographic categories

✓ Gold Standard

😕 Does not include: AS, GU, MP, VI

⚠️ These are estimates

⚠️ Data lags: current data is 2013—2017

https://factfinder.census.gov https://data.census.gov/

See KaNin Reese's talk this afternoon!

FCC 477 Fixed and Mobile

- Reported by providers every 6 months
  - Current Wireline version is dated June 2018, which came out on 9/10/19
  - Block level: business names, technologies, speeds offered
  - For fixed, includes advertised/contracted speeds
  - Measures *presence*, not *coverage*

✓ Easily find the active providers in a community
✓ May indicate where investments are worthwhile
⚠ Lag
⚠ Overstates coverage:
Residential: A block is served if 1 house is or can be served with reasonable effort
⚠ Advertised speeds != Delivered speeds
⚠ Does not include price
⚠ ⚠ Now tied to Census Blocks, but moving to arbitrary shapes!

https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477

Measurement Lab Speed Tests

- Results of NDT tests that try to assess “normal” as opposed to best case usage
- Open database, over 2 Billion tests since 2009
- Tests run voluntarily by users
- Recently includes mobile coverage via Test-IT

✓ **Huge** database of tests that grows every day
⚠️ Means skew toward the fast side
📌 Median seems to be a more reliable indicator

https://www.measurementlab.net

https://www.naco.org/testit

Community Anchor Institutions

- National Center for Educational Statistics (NCES)
  - Geolocations and survey data for
    - Public Schools
    - Private Schools
    - Post-Secondary Schools
- Institute for Museum and Library Services (IMLS)
  - Annual outlet survey, contains geolocation information

✓ Details on both individual institutions and school/library systems
⚠ Lags
⚠ USAC E-Rate data is online, but “messy”

https://nces.ed.gov

https://www.imls.gov/research-evaluation/data-collection/public-libraries-survey

Supporting Data Sets

- FCC Population Estimates at the Census Block Level (Block)
  - Annual predictions
- USDA County Typologies (County)
  - Urban/Metro, plus primary industries
- EPA Eco-Regions (Polygons)
  - Helps to locate your geography, and with build-out costs
  - SHLB report, 2018
- FFIEC/CRA-Qualified Distressed or Underserved Tracts (Tract)
  - Community Reinvestment Act (CRA) credits to loaning institutions
- HUD Opportunity Zones (Tract)
  - Tax benefits for investors
- ProPublica Congress API (Congressional District)

I3 Connectivity Explorer | Home | Settings | Learn | Resources | Help | I3 Blog | Policies

Ann Arbor, MI | Michigan | Demographics | ACS » Internet | Wireless | Wireline | Speedtests

Ann Arbor

119,303 ± 55
Population

27.9 mi²
Area

4,283 persons/mi²
Population Density

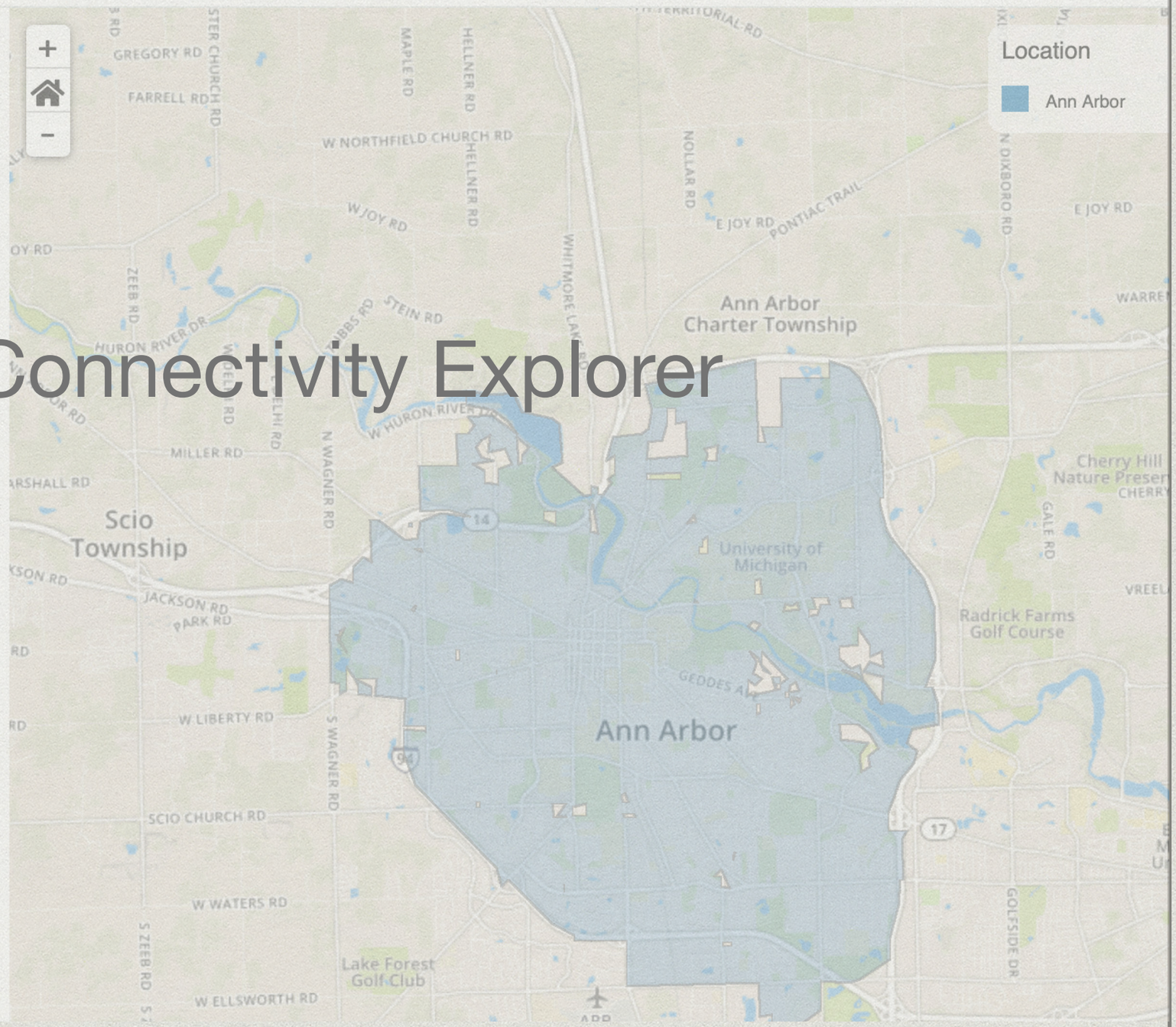
$85,281,818
Annual Economic Benefit of Broadband

$61,247 ± $1,780
Median Household Income

8.57% ± 1.23%
Household Poverty Rate

Eco Regions
8.2 Central Usa Plains

County Info
Washtenaw County
Metro:Federal/State Government



The I3 Connectivity Explorer

Powered by Open Source

Empowered by Open Data

Users and their Stories

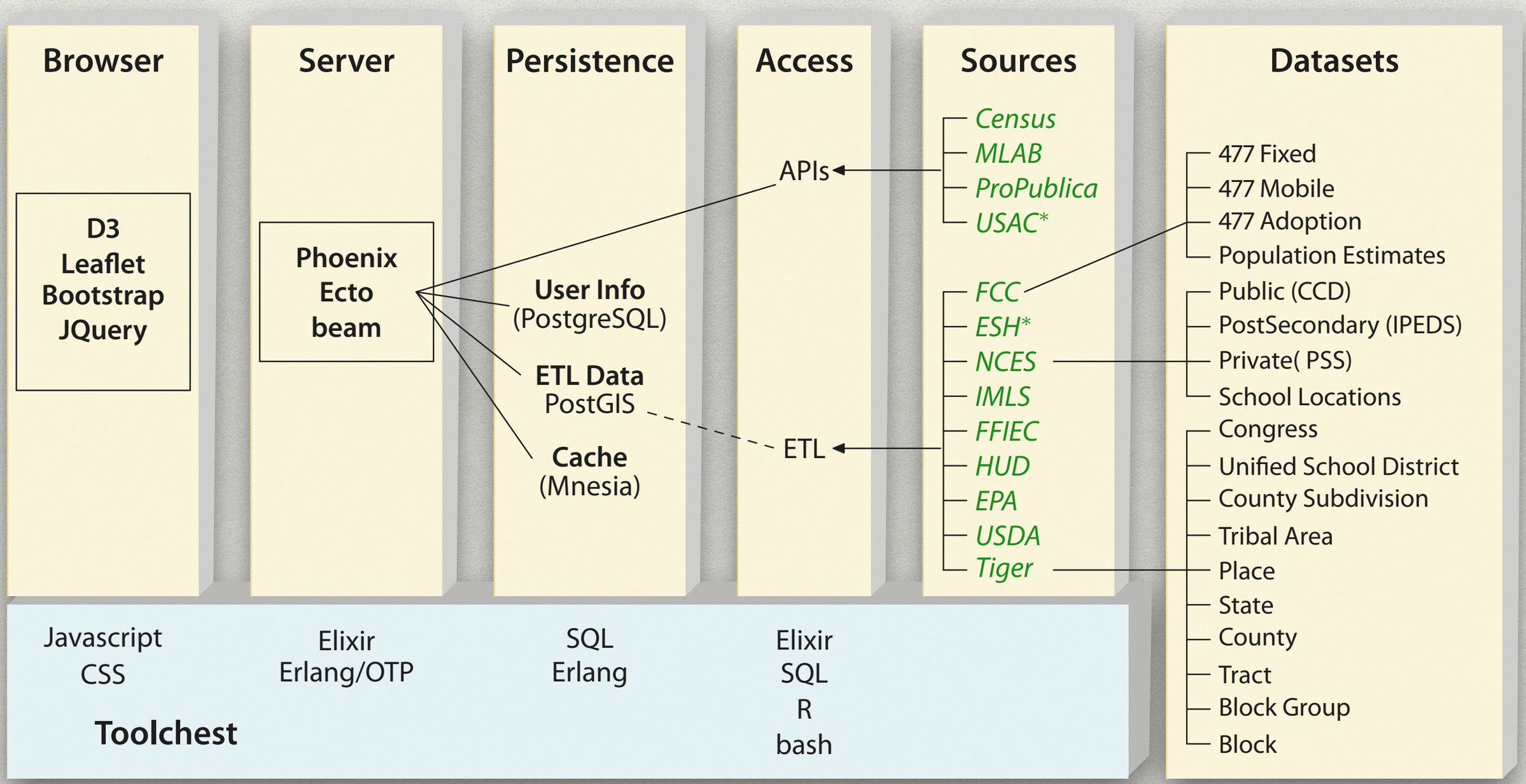
- State of Washington
  - Broadband Planning
- Virginia Department of Education
  - Closing the Homework Gap
- USDA Rural Development
  - Community Broadband Planning
- Tribal Libraries
  - Needs Assessment
- City Councils, School Districts, Communities

ABOUT THE PLATFORM

Tool Chain

- PostgreSQL + PostGIS
  - Geospatial database
  - Heavy use of index tables (e.g. block <-> Census defined place)
- Phoenix + Ecto + Elixir/Erlang
  - Web platform
  - User database
  - Underlying scalable infrastructure
- D3 + Leaflet
  - Visualizations
  - Community Support

System Architecture



Phoenix + Elixir + Ecto

- **Phoenix**: Web application framework (MVC)
  - Connections to PostGIS, HTTP, etc.
  - Templating
  - Channels for persistent/interactive client operations
- **Elixir**: Modern syntax, pipelines, macros, clearer data structures all compile to the **beam** and interoperate across the Erlang environment
  - Initiated in 2010
  - Growing collection of libraries
  - One can call Erlang functions directly. I do so for **mnesia**, **crypto**, and other low-lying system work.
- **Ecto**: DB wrapper, though I use a lot of raw SQL for Spatial Queries
  - Management of DB schema updates

Erlang/OTP

- Developed in the late 80's by Ericsson as a fully distributed, functional language and environment to control telephone switches.
- Over 20 years as an Open Source Development
- Language + environment is carefully thought out for distributed programming
  - Supervision trees, message passing, releases, distributed storage, and hot-code upgrades….
  - Telephony (soft realtime and .9999) forces strong constraints on a programming environment!
  - Erlang had microservices before microservices and supervision trees way before Kubernetes.
- **beam** virtual machine is the execution platform
- But the syntax looks a lot like prolog() :- darn()!

FORUM

- What data sets am I missing?
- What other visualizations do you suggest?
- Do you want to help out? This project could use
  - UX Design
  - Database Engineering
  - Platform Development
  - Translation into Spanish or other languages….
  - ….

I3 Connectivity Explorer

- https://i3connect.org/

The Center for Internet as Infrastructure, LLC

- https://internet-is-infrastructure.org/

Internet as Infrastructure

Fortune Courtesy: Lu Torres, Photo Courtesy: Erin McDuff