

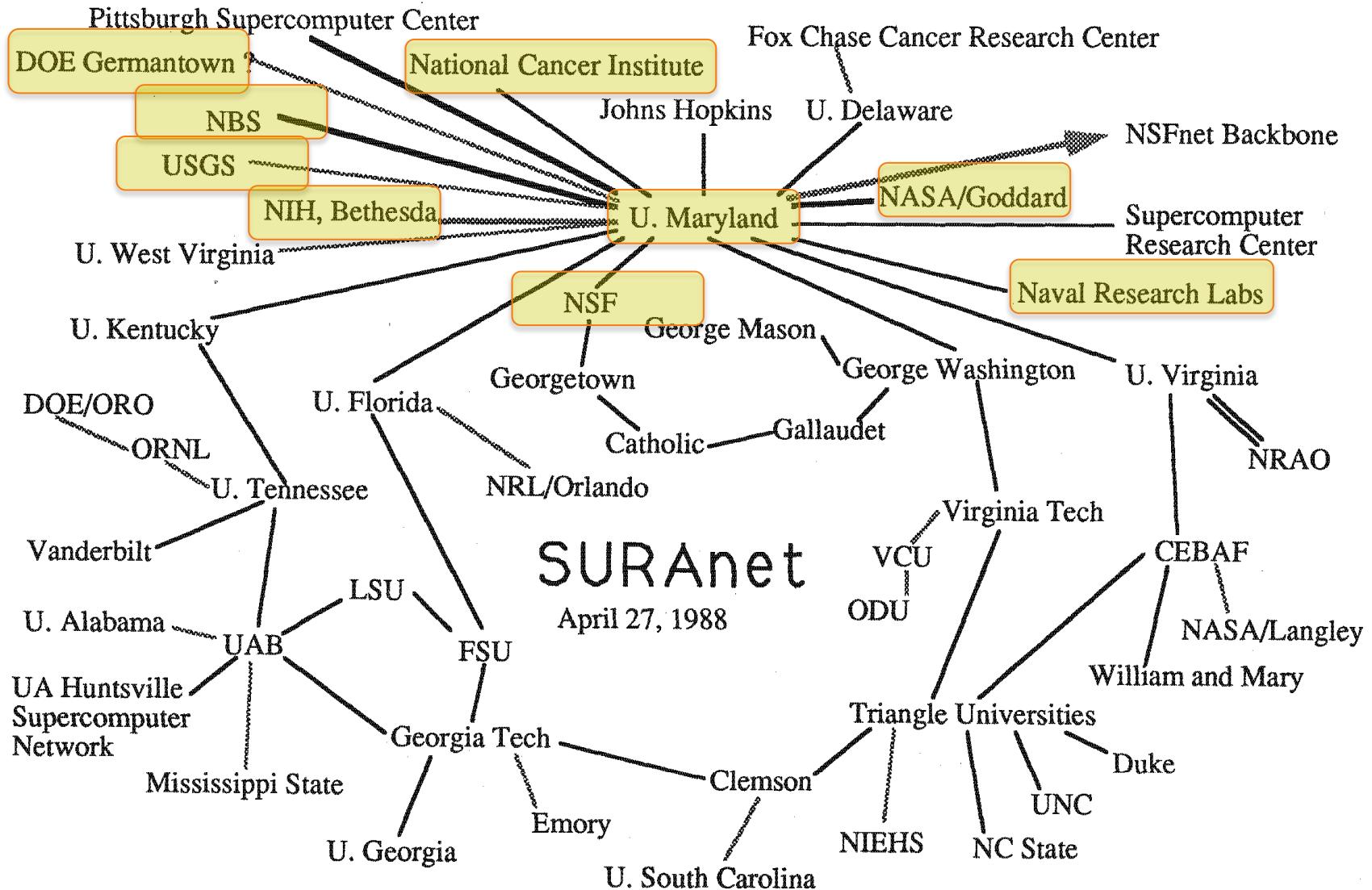
Networking to the MAX

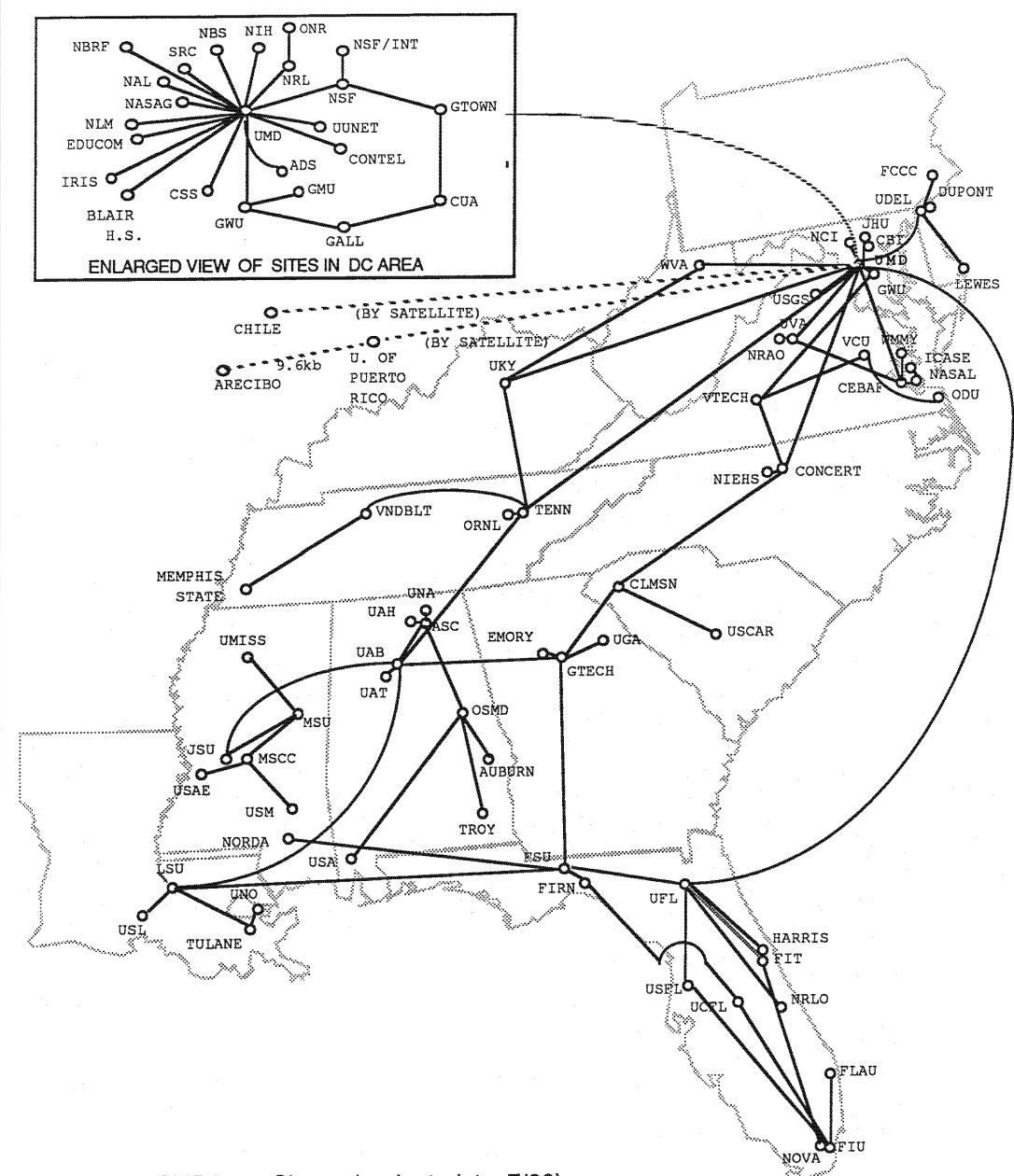


Glenn.Ricart@us-ignite.org

April 5, 2017







1983

1984

1985

1986

1987

1988

1989

1990

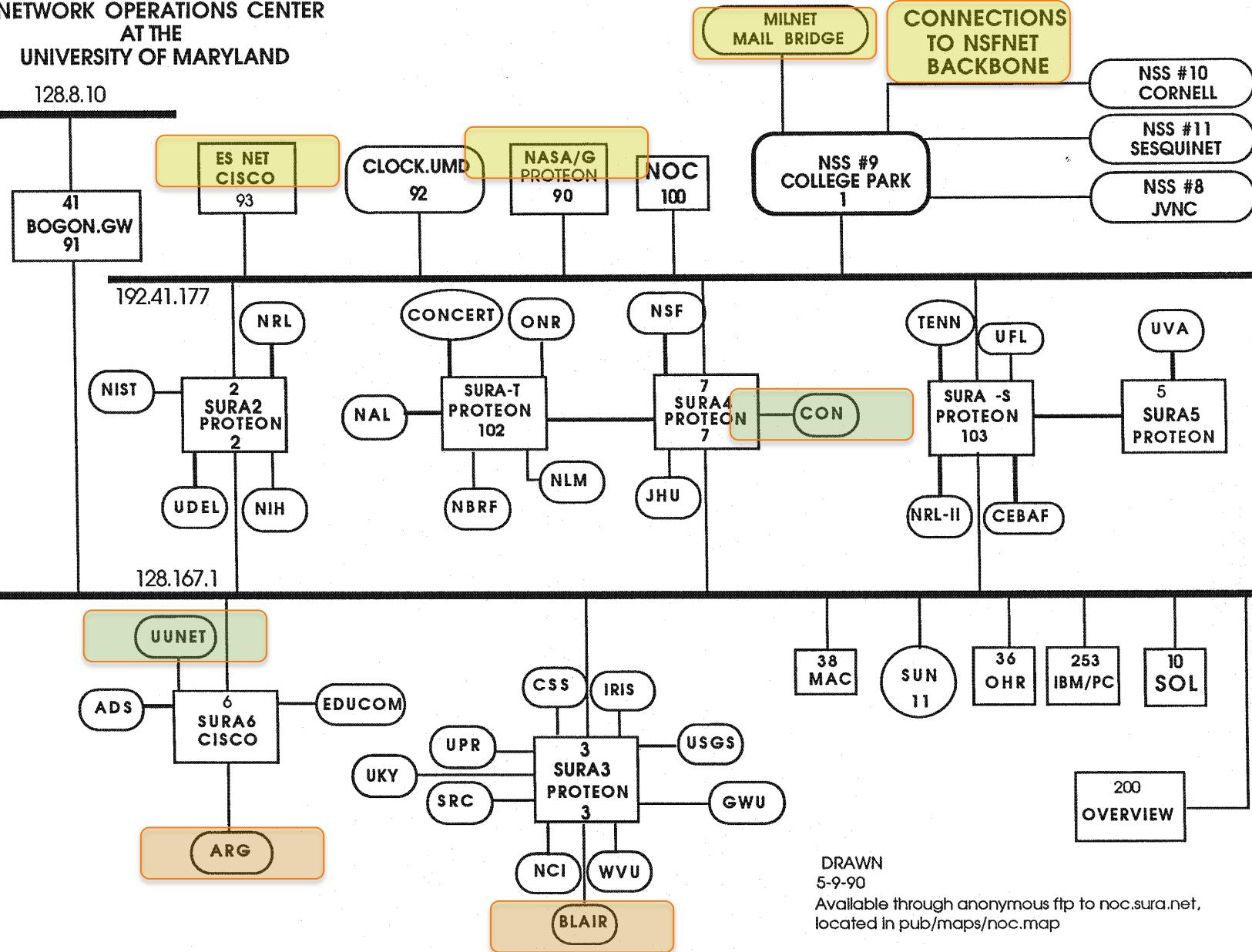
1991

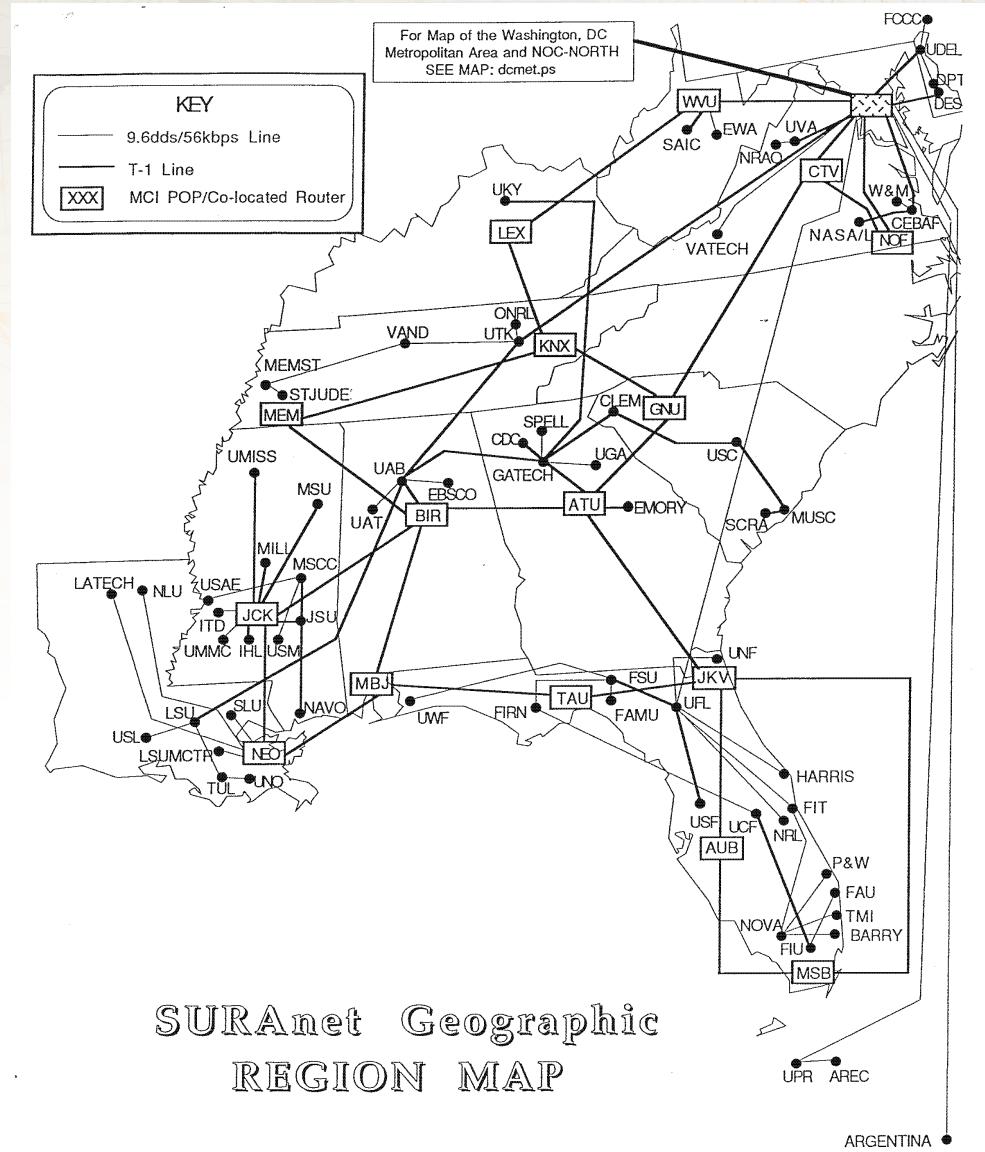
1992 Ignite

Available through anonymous ftp to poc.sura.net,
locate in pub/maps/geo.map
Drawn May 29, 1990

NETWORK OPERATIONS CENTER
AT THE
UNIVERSITY OF MARYLAND

128.8.10





1983
6/92

1984

1985

1986

1987

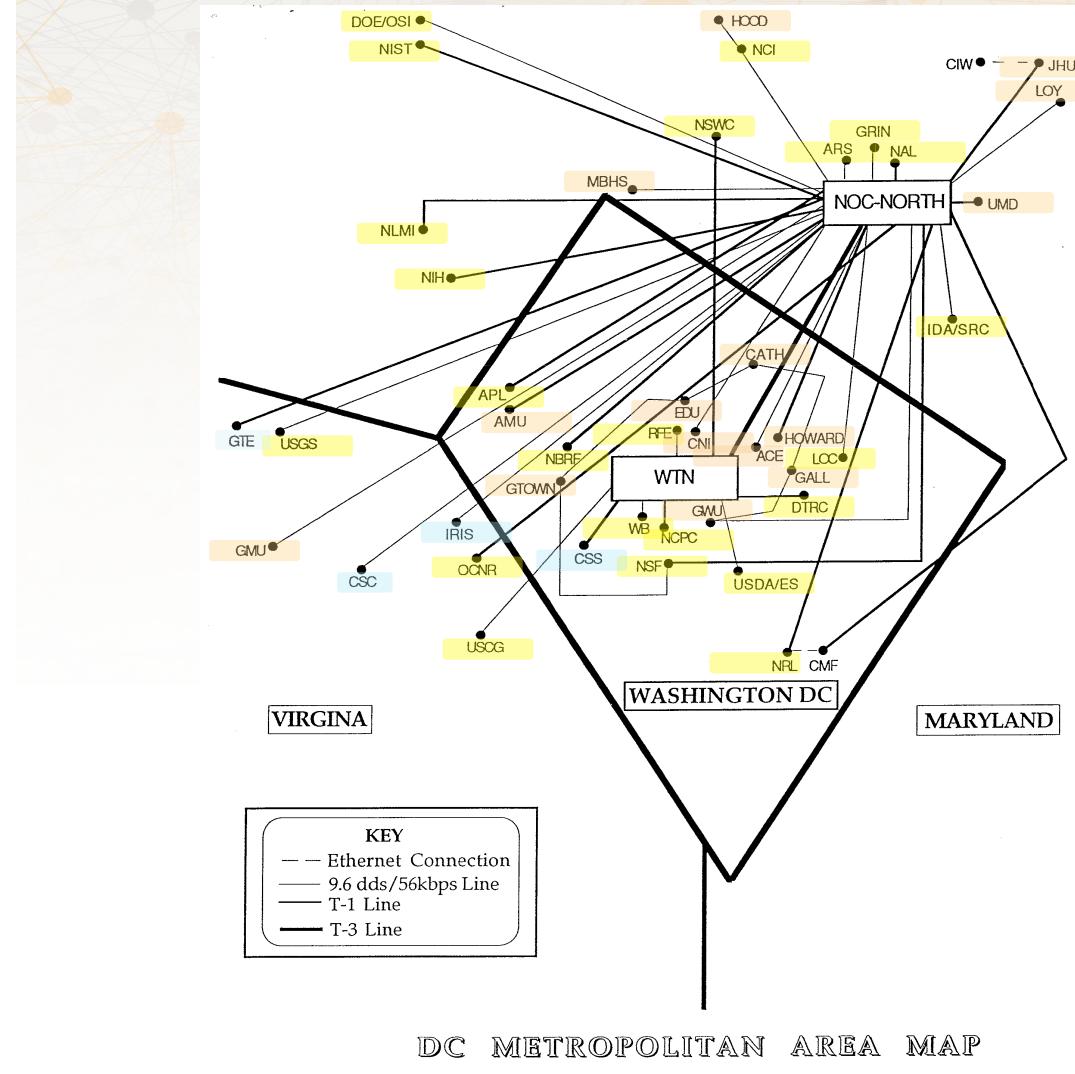
1988

1989

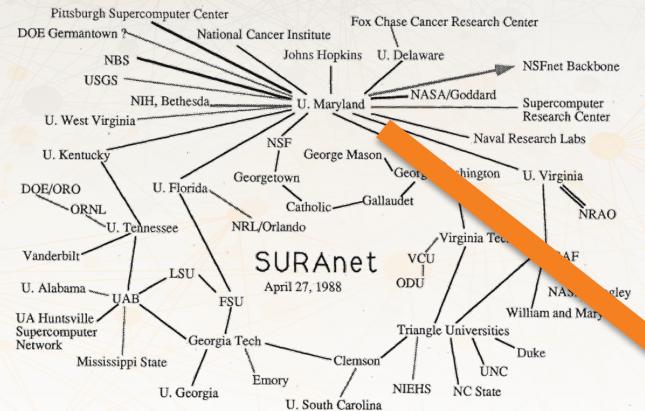
1990

1991

1992

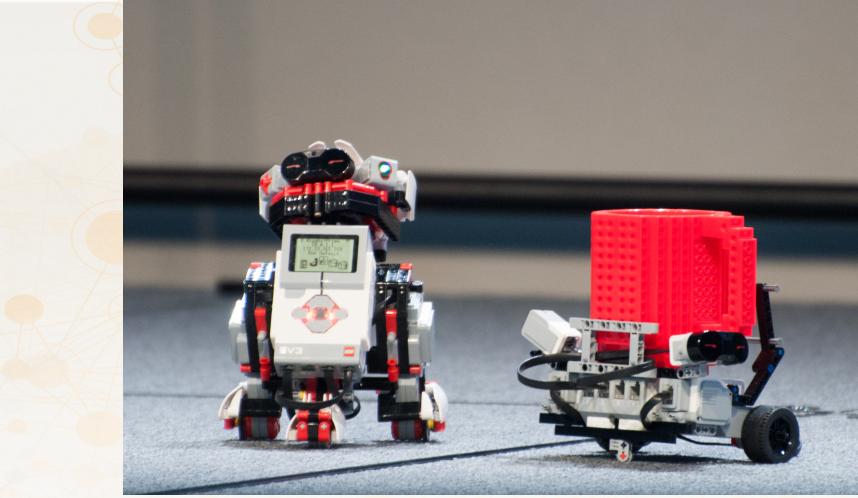


ignite

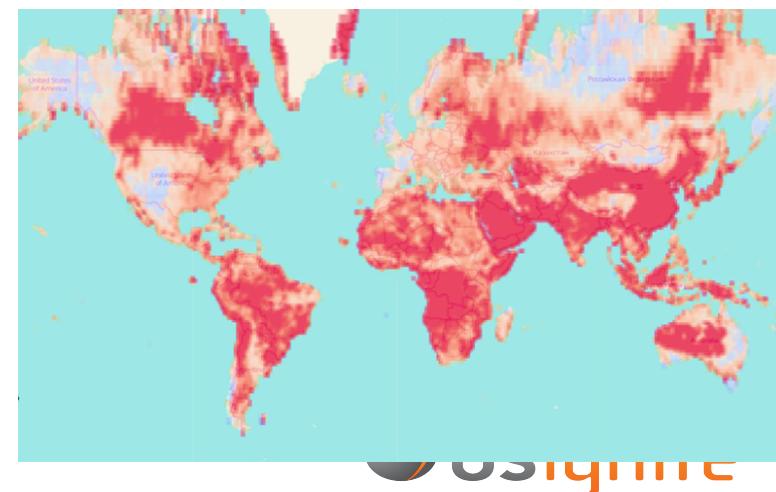
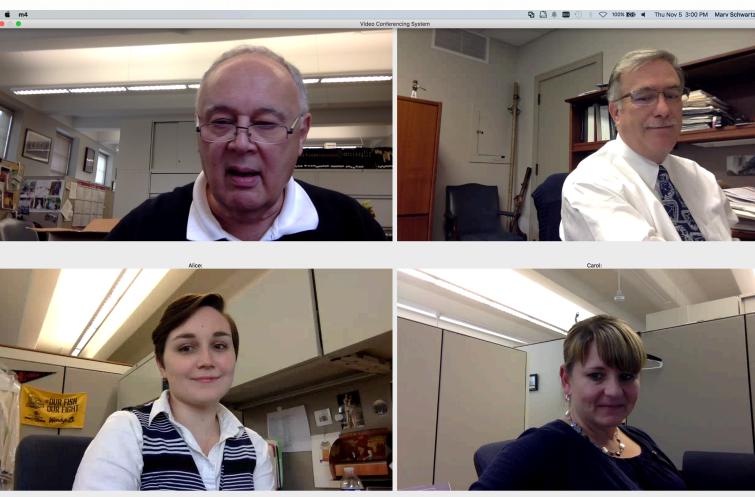
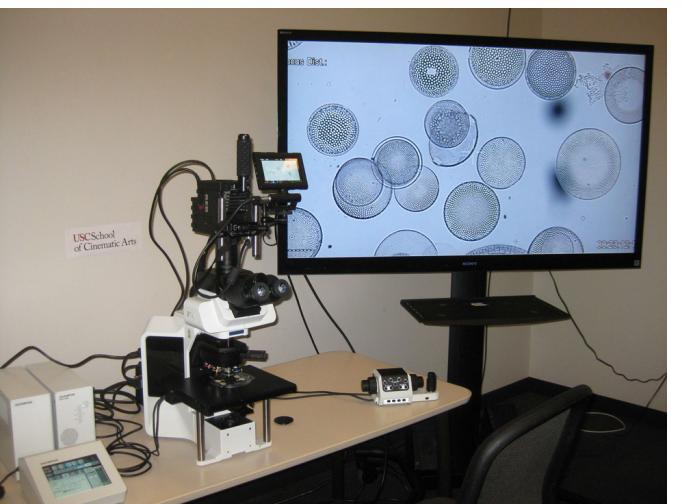


Drawn 4/27/88 by GR from map by J. Hahn



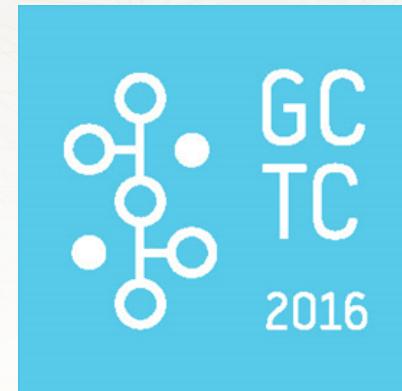


Next-gen applications and services leveraging advanced networking technologies
to build the foundation for smart and connected communities





 **usignite**
SMARTGIGABIT
COMMUNITY



 **CloudLab**
Outreach

**Platforms for
Advanced
Wireless
Research (PAWR)**



with



In partnership with

NIST



with



with



Platforms for Advanced Wireless Research

Industry Consortium

Cash, equipment & material, engineering, marketing, & R&D support

Federal Agencies

(NSF and others)

Grants, experimental spectrum licenses, other support



PAWR
Project
Office



Charter Members

NOKIA Bell Labs

SAMSUNG

KEYSIGHT
TECHNOLOGIES

NATIONAL
INSTRUMENTS™

Sprint

ORACLE

JUNIPER
NETWORKS

COMMSCOPE®

VIAVI

INTERDIGITAL

intel

QUALCOMM®

AT&T

T-Mobile

verizon

ctia™
Everything Wireless

htc

SSC

CARLSON
WIRELESS TECHNOLOGIES

atis

TIA
ADVANCING GLOBAL COMMUNICATIONS

ERICSSON

Anritsu

FiberTower

CROWN
CASTLE

usignite

Platforms for Advanced Wireless Research



PAWR Project Office



Northeastern

**PAWR Platforms
(Cities)**

Proposer's Day April 27
Washington, DC

1-2 selected in 2017
1 each in 2018 and 2019

**University/Industry
research**

Platforms available for research in 2018

Networking to the MAX



Glenn.Ricart@us-ignite.org

April 5, 2017





“The Cloud” is packing up and moving to your neighborhood

	Issues	Distant Cloud	Local Cloud
Economics	Further economies of scale	Diminishing to negative	Improving and positive
	Costs of power and space	Saves up to 5¢ / server-hour	
	I/O charges		Saves 7-70¢ per 100 Mbps / server-hour
Technical	Network response time	10-80 msec.	1-4 msec.
Architecture		Exploit globality	Exploit locality
Security	DDoS attacks	Vulnerable	Less vulnerable
	Spoofing	From anywhere	Limited local
IoT	Local proxy / security		Yes
	Local proxy / battery life		Better
Resiliency	Vulnerability	Round-trip to cloud	Only local

OUT IN

Stress coloring

Rage rooms

Chip & Joanna

Martha & Snoop

Hillbilly Elegy

Hillbillies

Lies

Leaks

Camp David

Mar-a-Lago

Matcha

Turmeric

All Hadids

Yara Shahidi

Bragging about "Hamilton" tickets

Bragging about "Hello, Dolly!" tickets

Glenn's 2017 In-and-Out List

<u>Out</u>	In
People use the Internet	Devices use the Internet
Exploit massive datacenters	Exploit locality
Move data to the computing	Move computing to the data
Datasets	Data streams
Abundant backbone bandwidth	Abundant access bandwidth
Bandwidth is the main measurement	Response time is the main measurement
“Please wait”	Real-time
Computers model and monitor real world	Computers are integral parts of real world



What would a Metro Internet look like if it were designed to support applications and services for:

- Internet of Things (IoT)?
- Billions of wireless devices?
- Industrial Internet?
- Trustworthy devices?



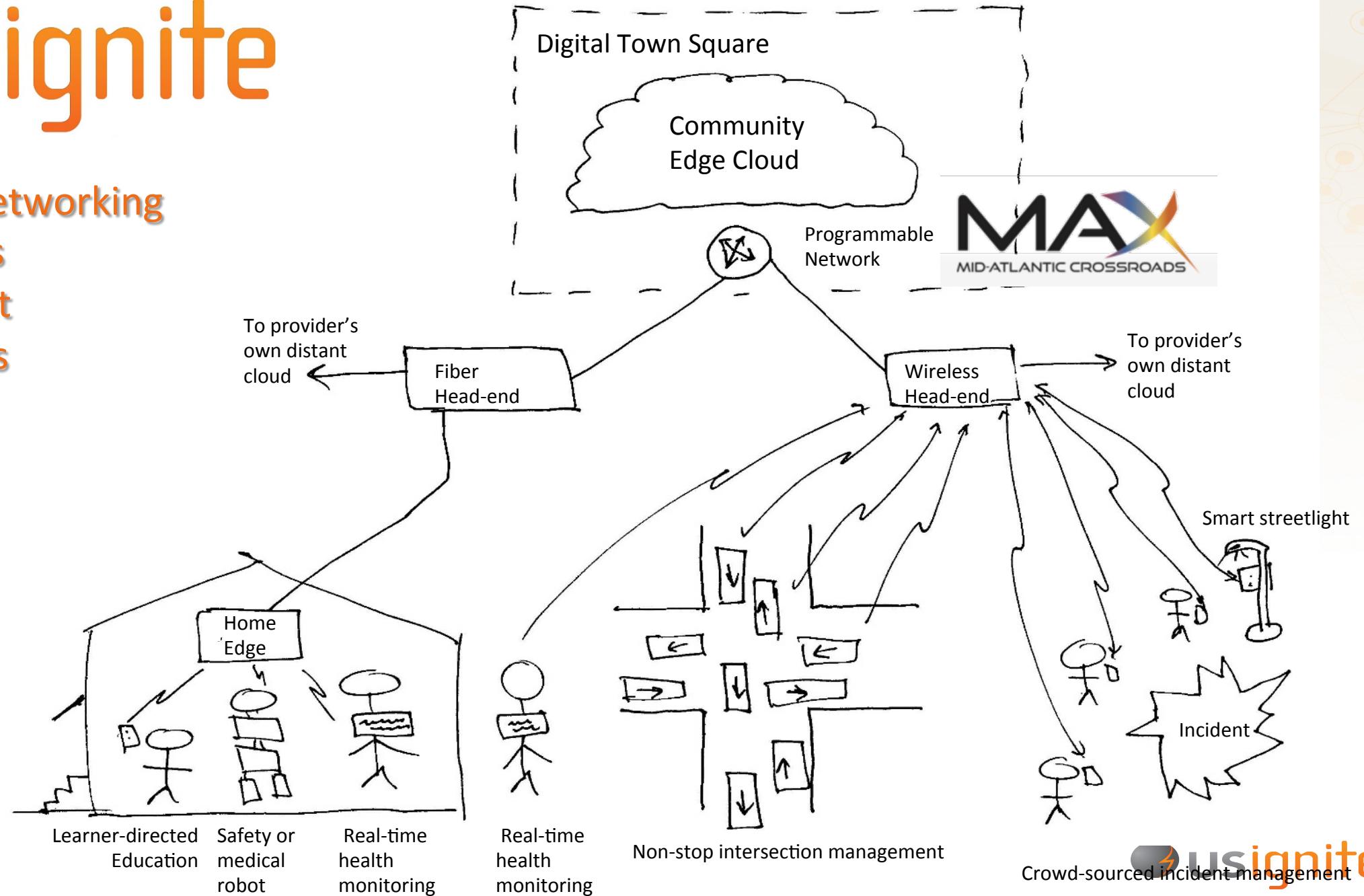
It would be sliceable & edge-centric
with co-optimized gigabit access.

= Locavore



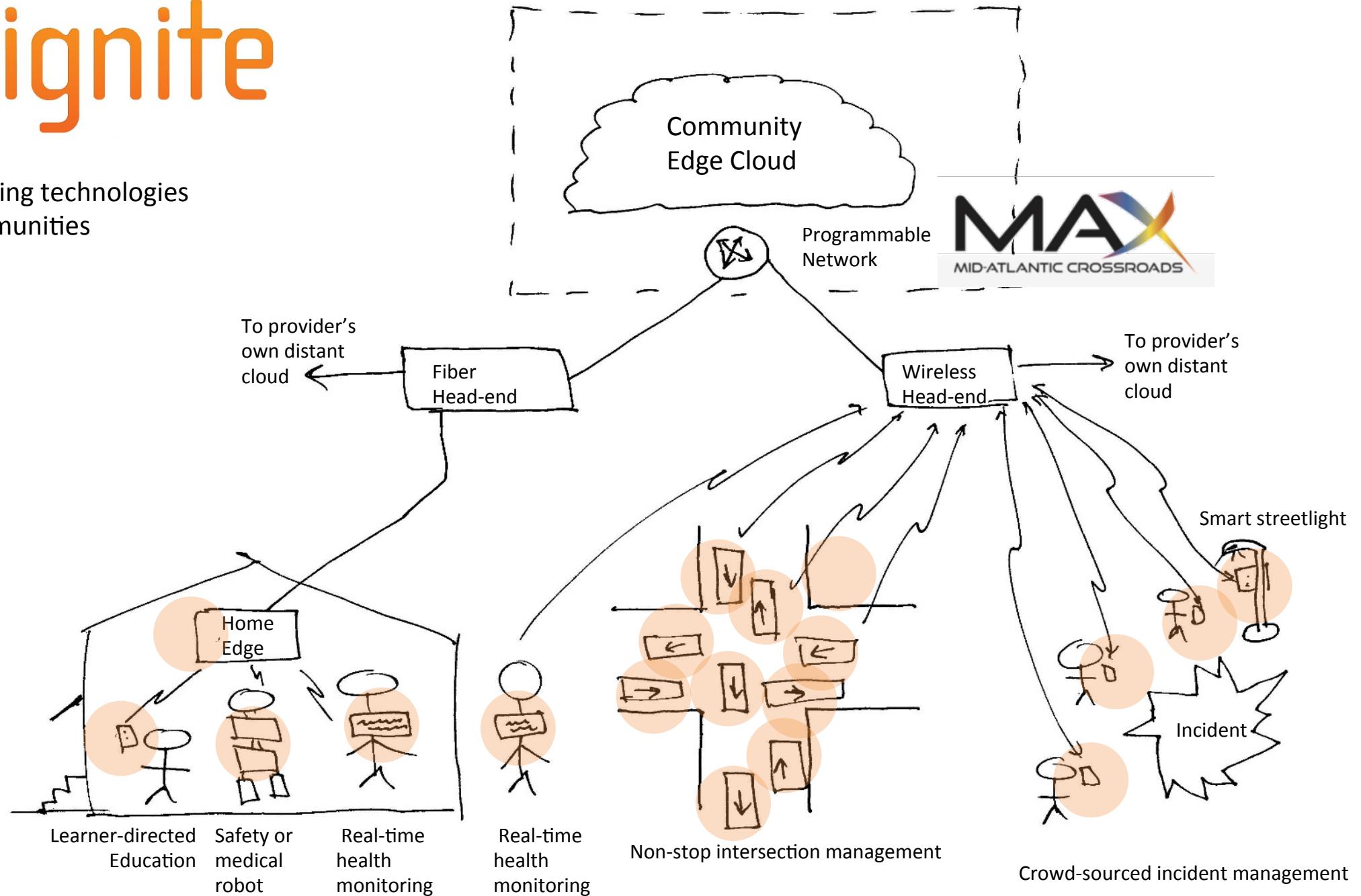


Advanced networking
technologies
enable smart
communities





Advanced networking technologies
enable smart communities

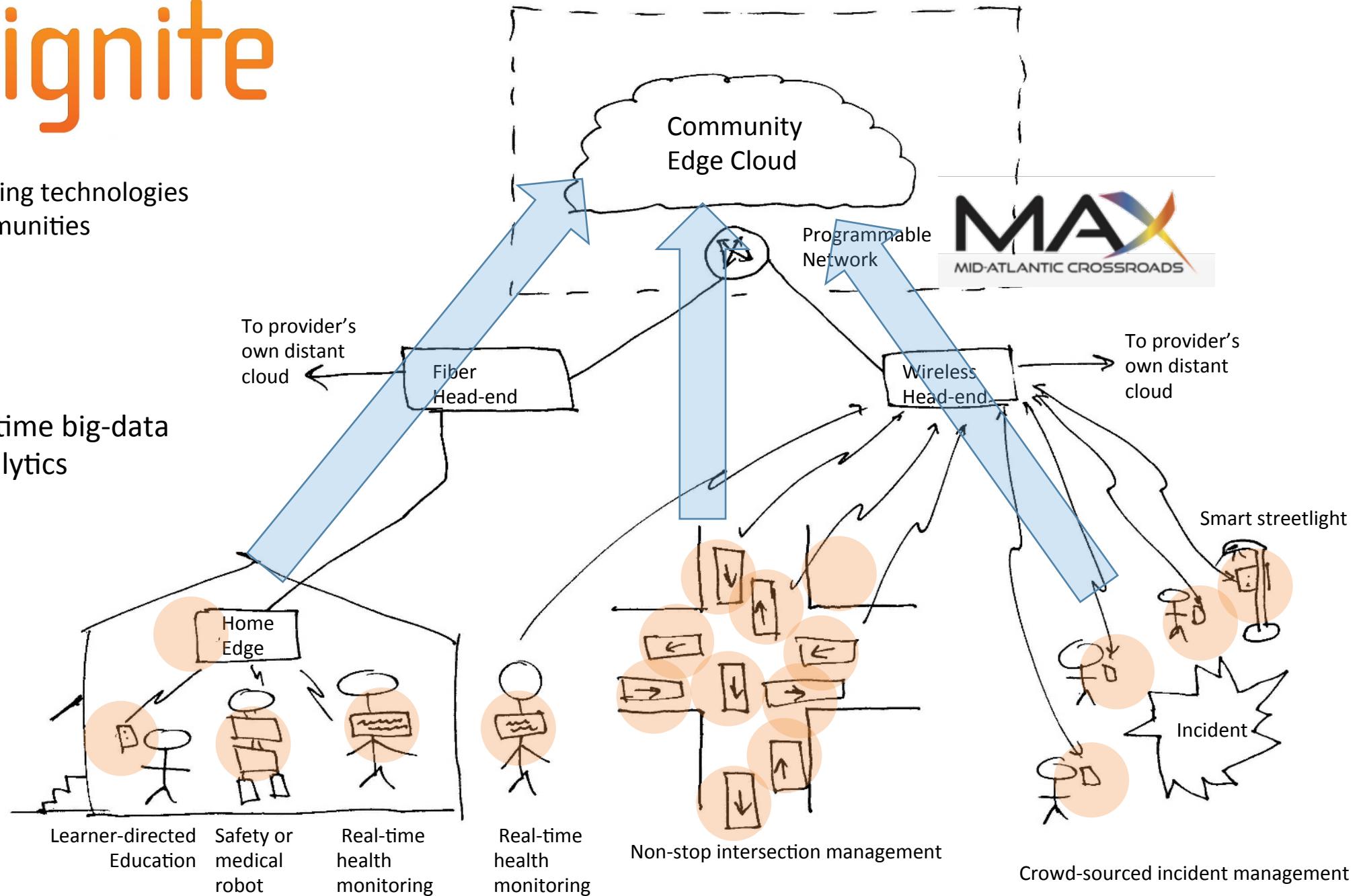




Advanced networking technologies
enable smart communities



Feed real-time big-data
and AI analytics

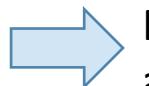




Advanced networking technologies
enable smart communities



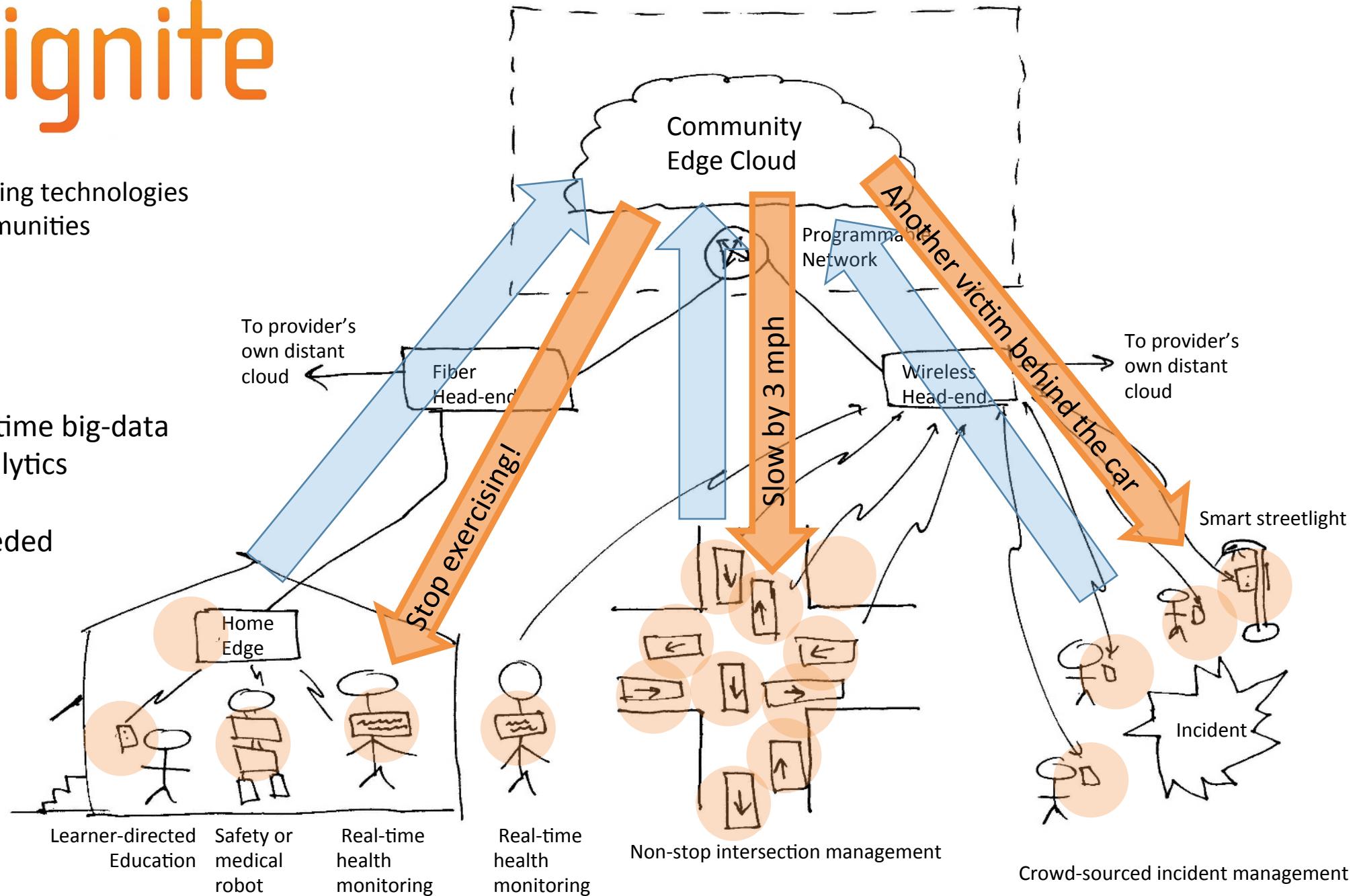
Sensors



Feed real-time big-data
and AI analytics



Action needed





What are the categories of
Killer Apps for Locavore?

Big
Quick
Special Handling





Big = (often) gigabit or greater

Generic	Example
Real-time HD, 4K, or greater video	Wayne State real-time video fusion
Real-time manipulation of a large model	City planning with realistic 3D models and surfaces
Ultra-high resolution images	DICOM medical images being read remotely



Quick = Low latency

Generic	Example
In sync with the real world	Augmented reality
Streaming VR	Feeding low-cost classroom VR headsets
Cyberphysical Systems	Industrial Internet controllers



Special Handling = SDI

Generic	Example
Privacy needed	Putting medical records in a protected slice
QoS per slice	Public safety video communications (FirstNet)
Application distributed between edge clouds	Pollution Visualizer



What are the categories of
Killer Apps for Locavore?

Big
Quick
Special Handling

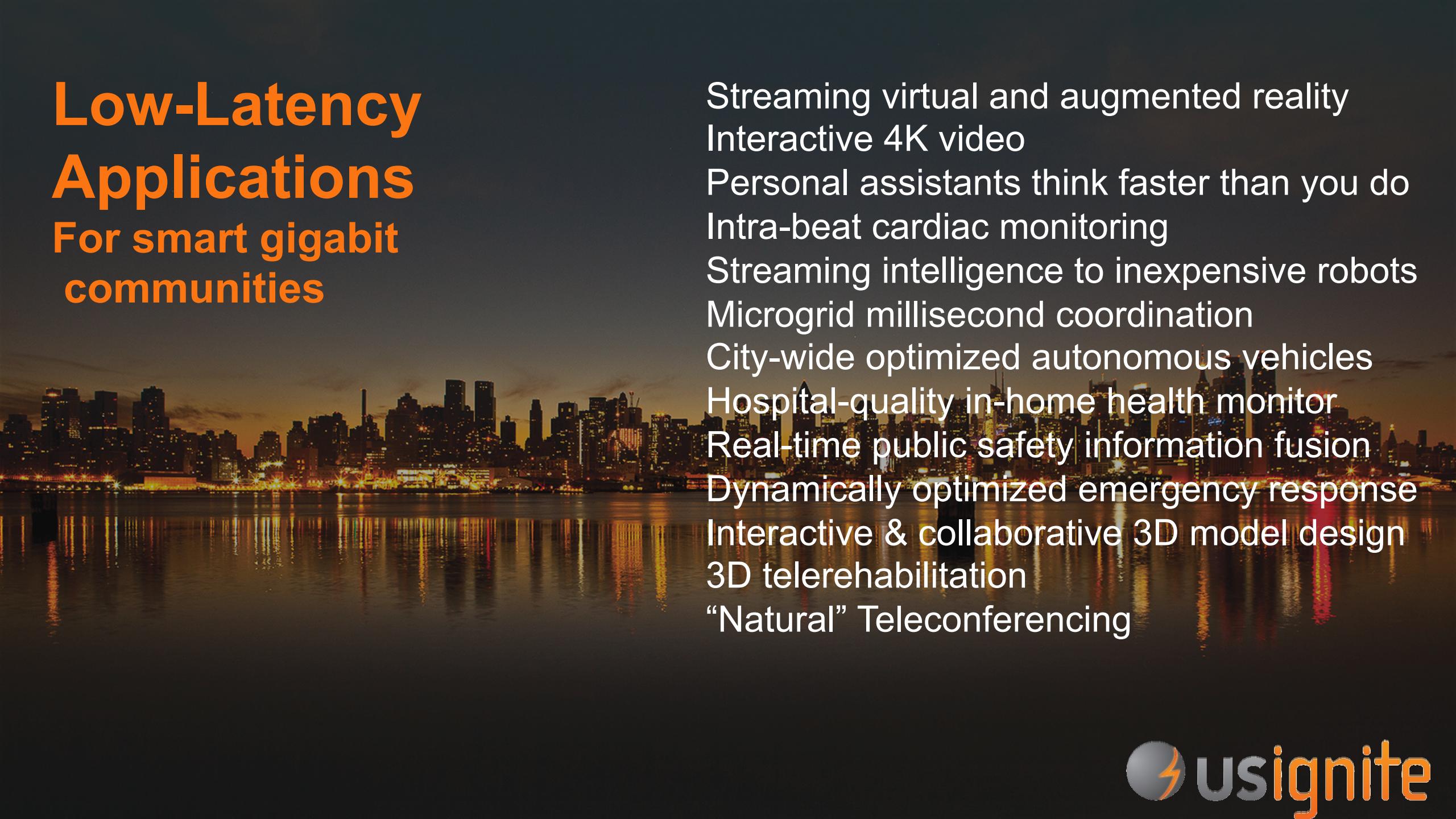




20 Communities
Two apps per year, shared
Advanced gigabit infrastructure
Deep civic involvement
Community leader
Technical leader



Low-Latency Applications For smart gigabit communities



Streaming virtual and augmented reality
Interactive 4K video
Personal assistants think faster than you do
Intra-beat cardiac monitoring
Streaming intelligence to inexpensive robots
Microgrid millisecond coordination
City-wide optimized autonomous vehicles
Hospital-quality in-home health monitor
Real-time public safety information fusion
Dynamically optimized emergency response
Interactive & collaborative 3D model design
3D telerehabilitation
“Natural” Teleconferencing





Recruiting additional communities

Advanced civic infrastructure (gigabit, edge)
Self-supported or sponsored: \$25K/yr.
Access to GENI rack
Participation of University and Civic Orgs
Incent local developers (2 apps / yr.)

1 or 2 additional NSF-sponsored
communities to add diversity; contact us





usignite

APPLICATION **SUMMIT**

Largest smart city conference

June 26-28, 2017

Austin, Texas

Smart city research meeting on Monday

Conference program and demos Tuesday-Wednesday

A wide-angle photograph of a large conference or lecture hall. In the foreground, a man in a suit stands at a podium on a stage, speaking to an audience. The audience consists of many people seated in rows of chairs, facing the stage. The room has a modern design with a dark ceiling featuring a complex truss lighting system. The walls are a light color, and there are several vertical panels of different heights on the left wall. A camera operator is visible on a small platform in the background, and a projector is hanging from the ceiling.

2016:
2100 attendees
220 cities
30 countries



Demos, Trade Show, Posters



SMART CITIES
CONNECT
CONFERENCE & EXPO





 usignite