Global Knowledge®
a skillsoft company

Practical 5G Slicing

Presented by:

Stuart Feeser

Sept 23, 2021

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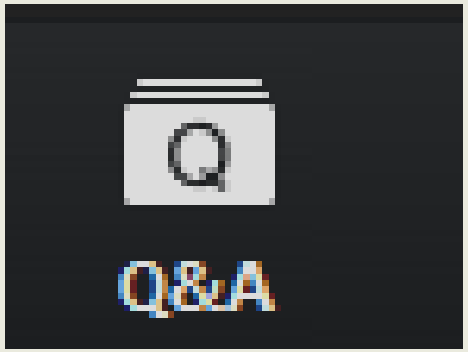
Note: Today's webinar is being recorded.



PRESENTER - STUART R. FEESER, III

Alta3 Research Inc.'s founding President & CEO, Stuart Feeser, has been in the data/telecommunications industry for the past 35 years. For the past 23 years, he has dedicated his company to the thorough understanding of complex systems through researching the latest technology and delivering training and consulting services based on the company's research.

He has written various courses on topics including:

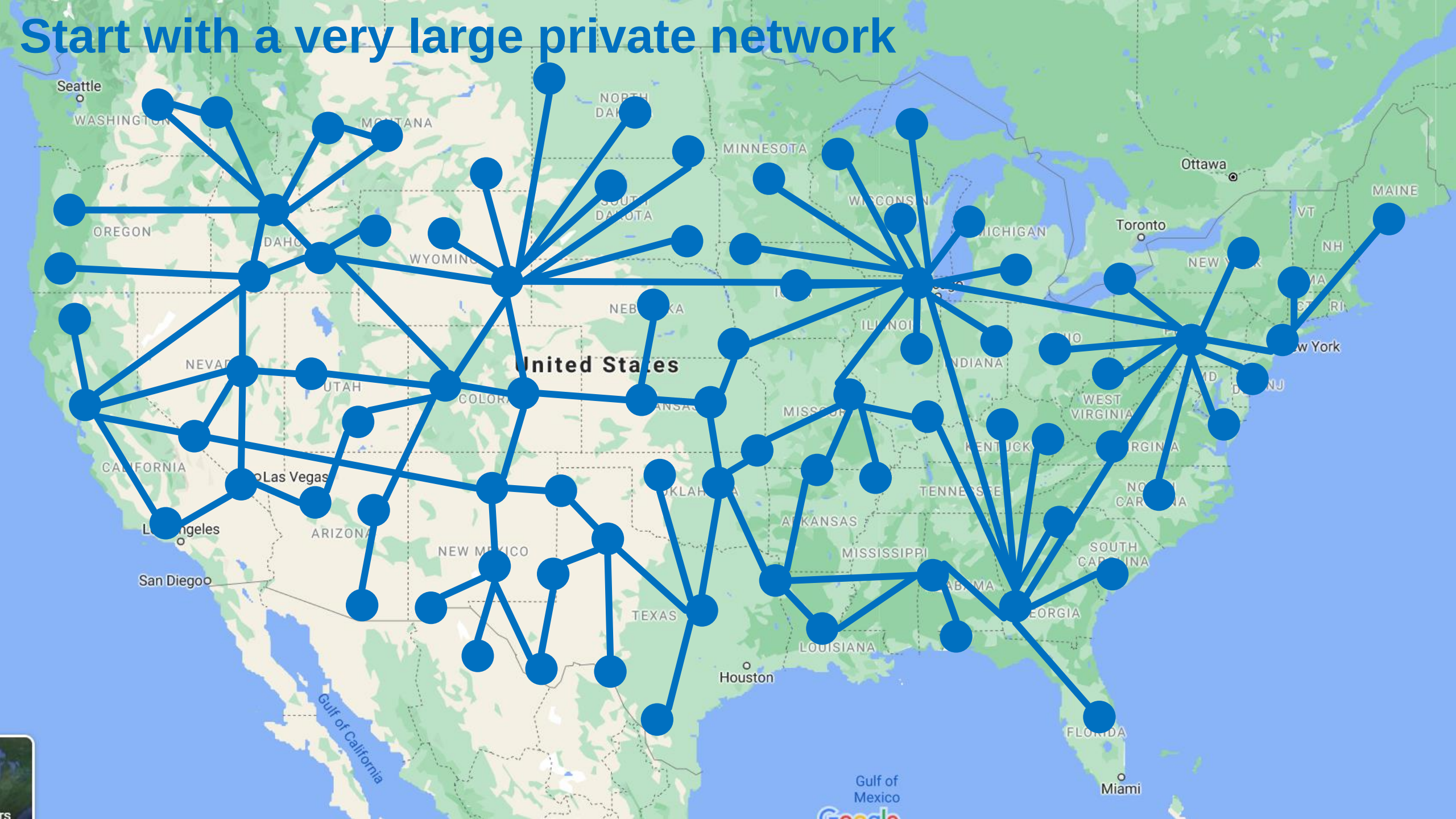
- Kubernetes Administration and Troubleshooting
- Ansible Essentials
- 5G Essentials
- Deploying 5G
- Certified OpenStack Administrator
- SIP Essentials
- VoLTE and the IMS
- SDN/NFV/SD-WAN Testing and Certification
- IPsec and Networking Fundamentals
- Ceph Storage

He co-authored:

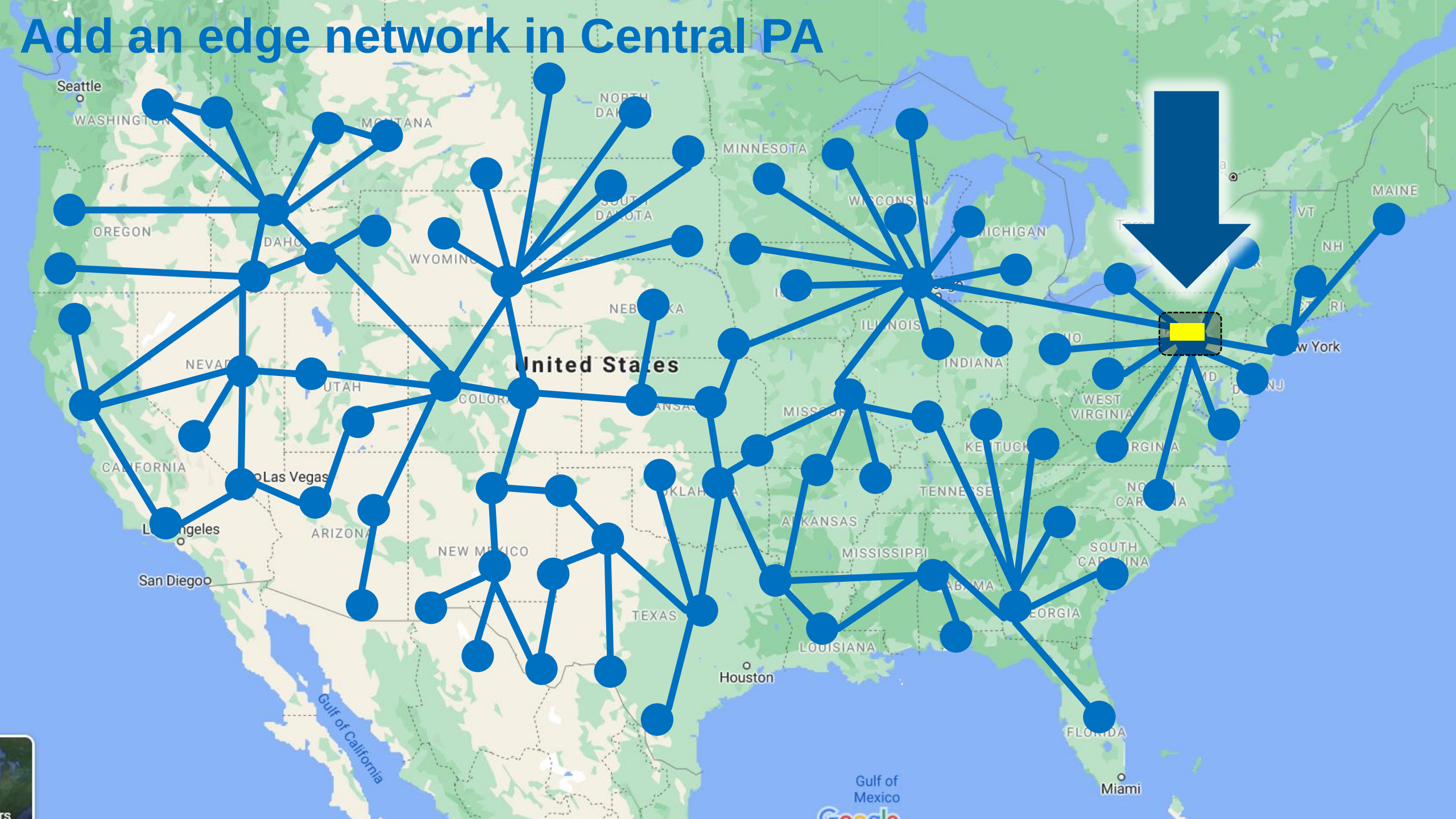
- Python Basics
- APIs and API Design with Python
- Python for Network Automation
- Network Automation Using Python and Ansible

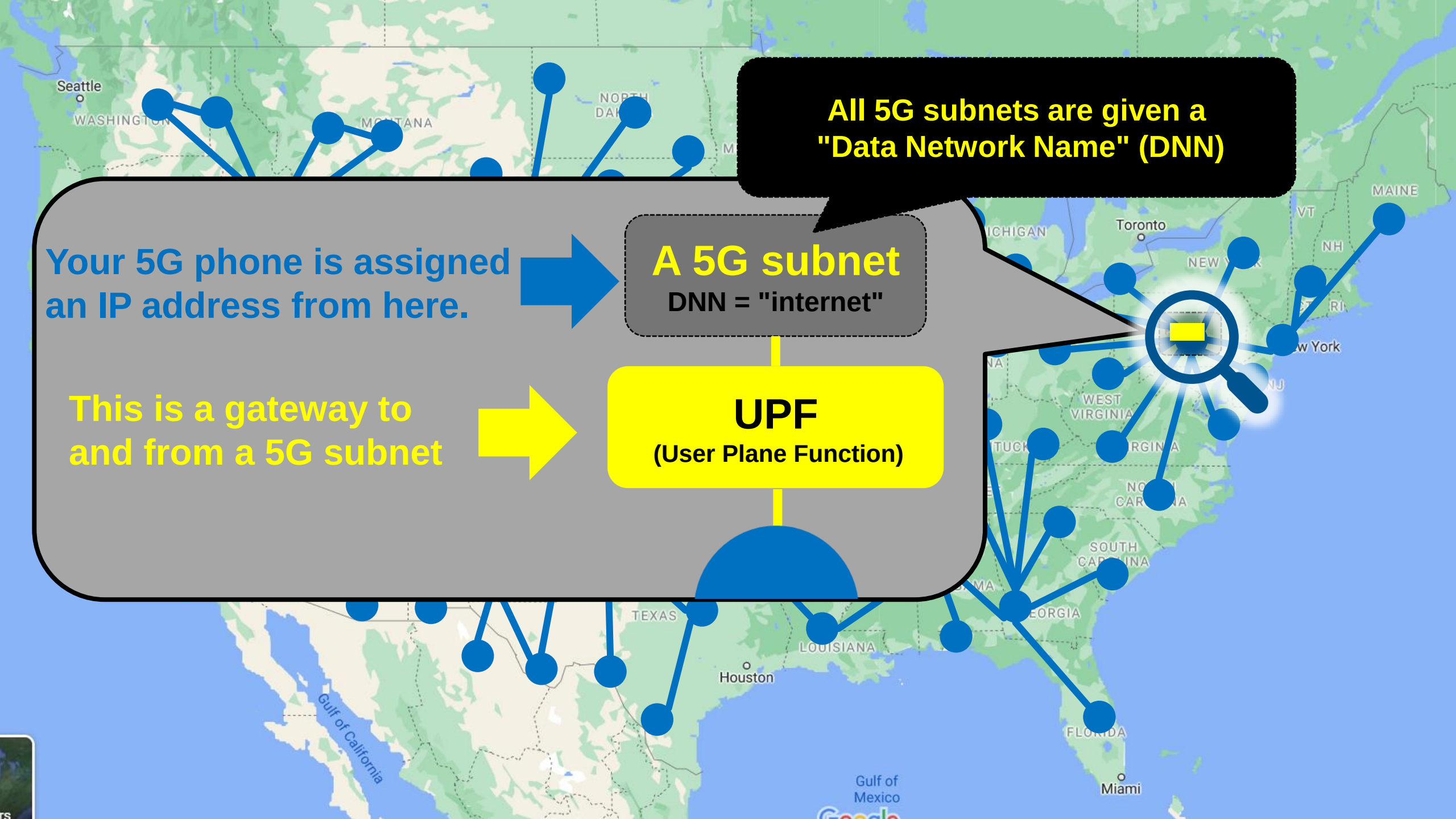
5G Slicing

Start with a very large private network

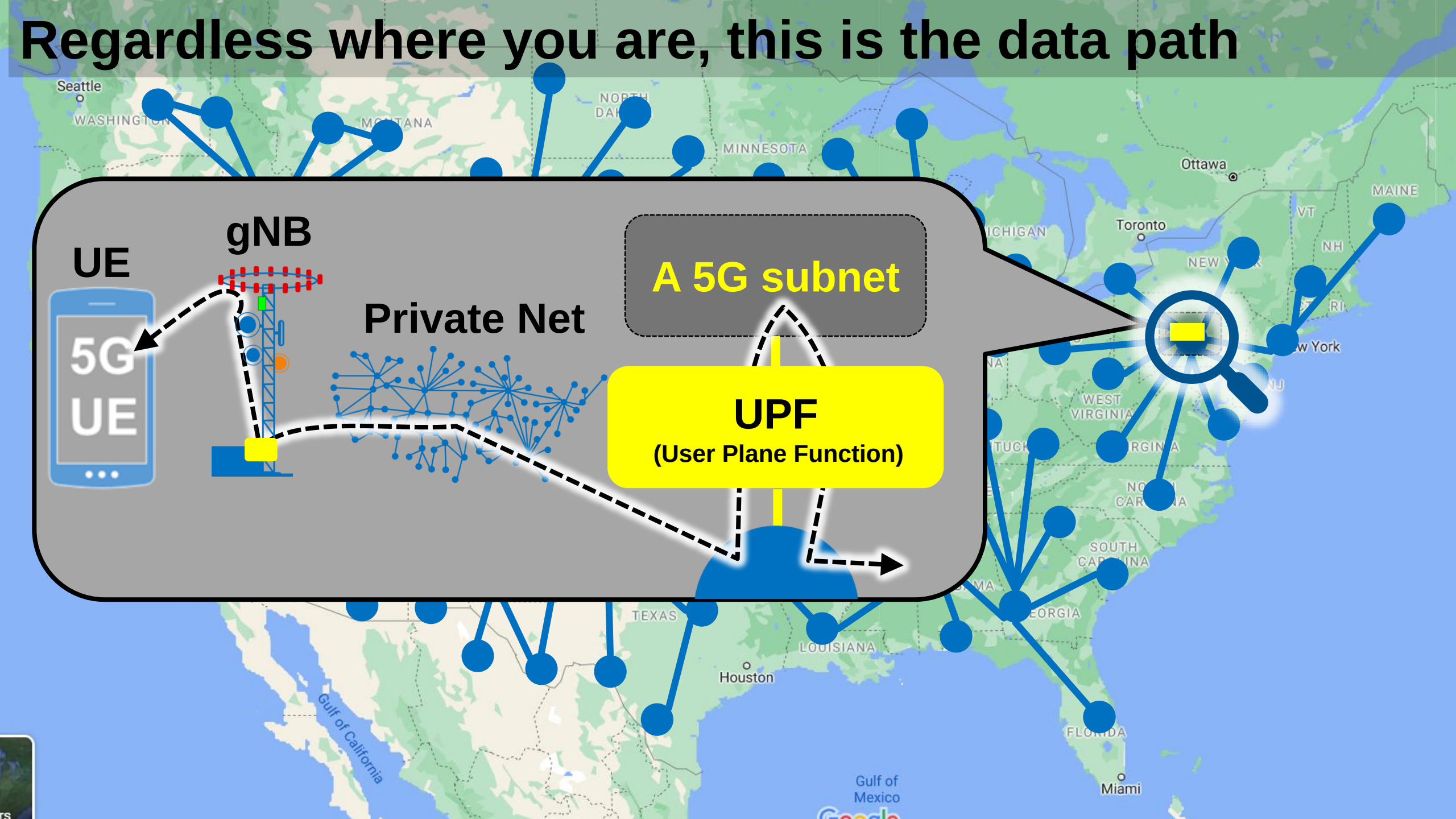


Add an edge network in Central PA

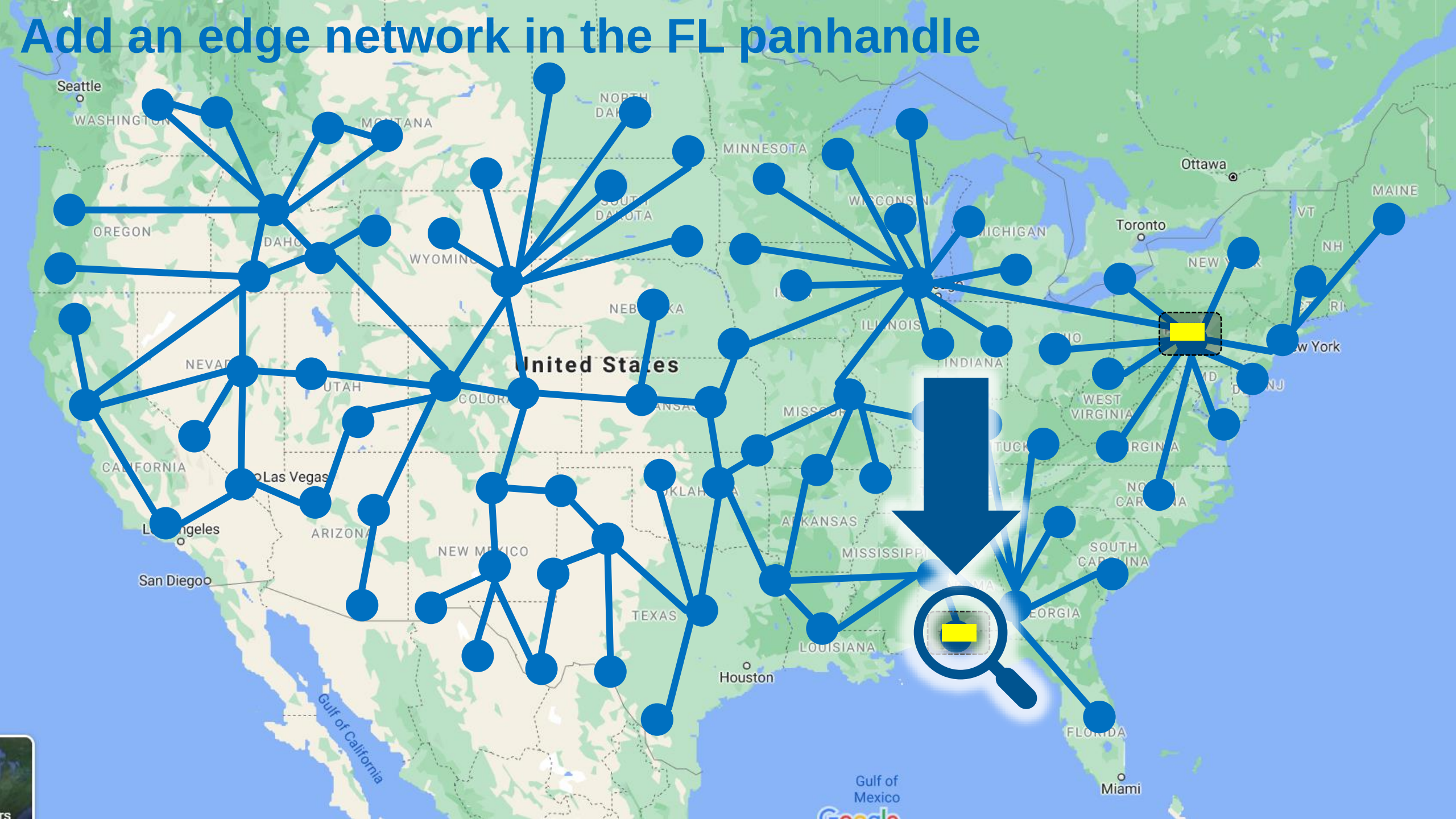



All 5G subnets are given a "Data Network Name" (DNN)
Your 5G phone is assigned an IP address from here.
A 5G subnet
DNN = "internet"
This is a gateway to and from a 5G subnet
UPF
(User Plane Function)
Seattle
WASHINGTON
MONTANA
Toronto
MAINE
VT
NH
WEST VIRGINIA
TEXAS
LOUISIANA
Houston
Gulf of California
Gulf of Mexico
FLORIDA
Miami

Regardless where you are, this is the data path

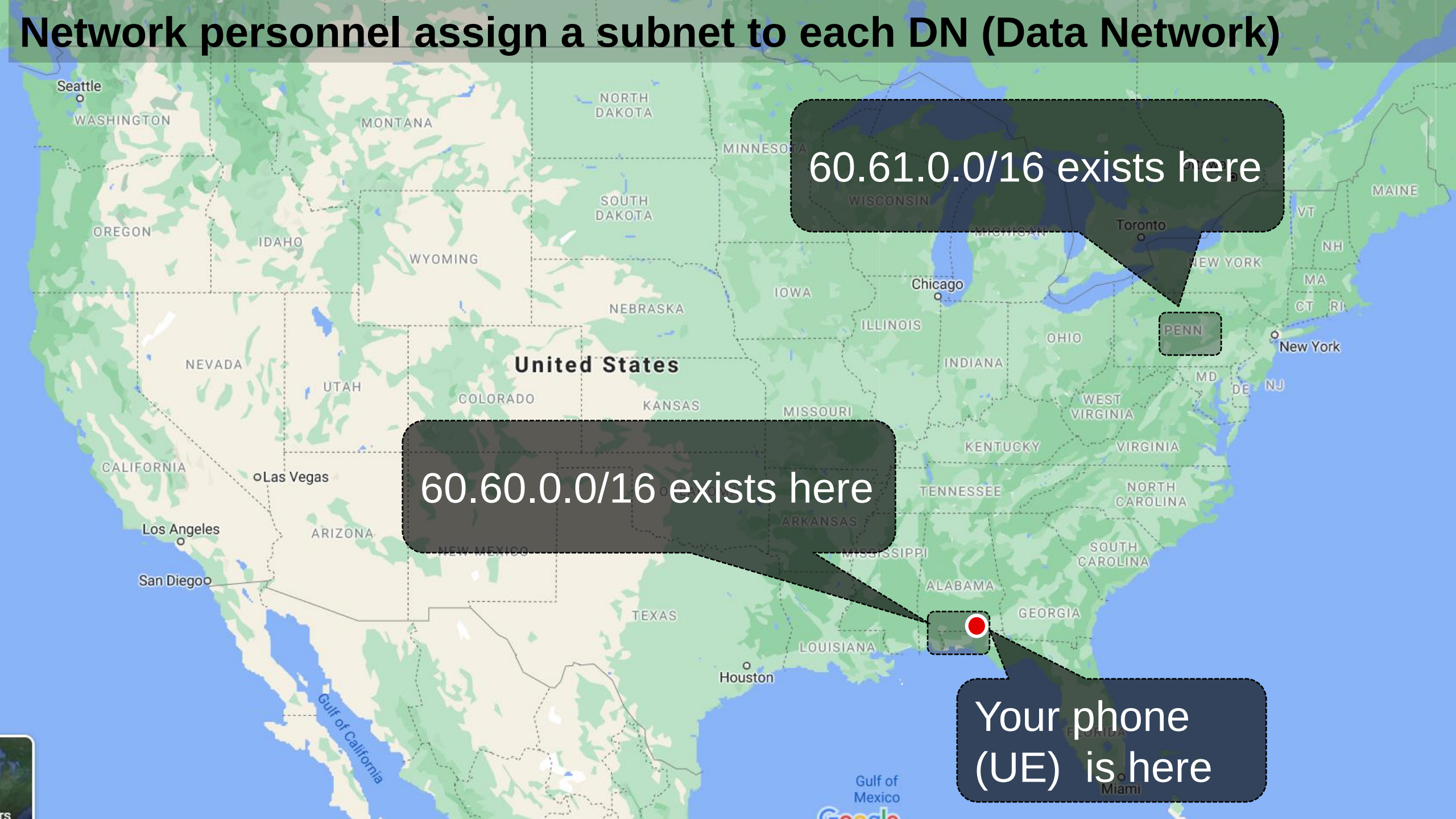


Add an edge network in the FL panhandle

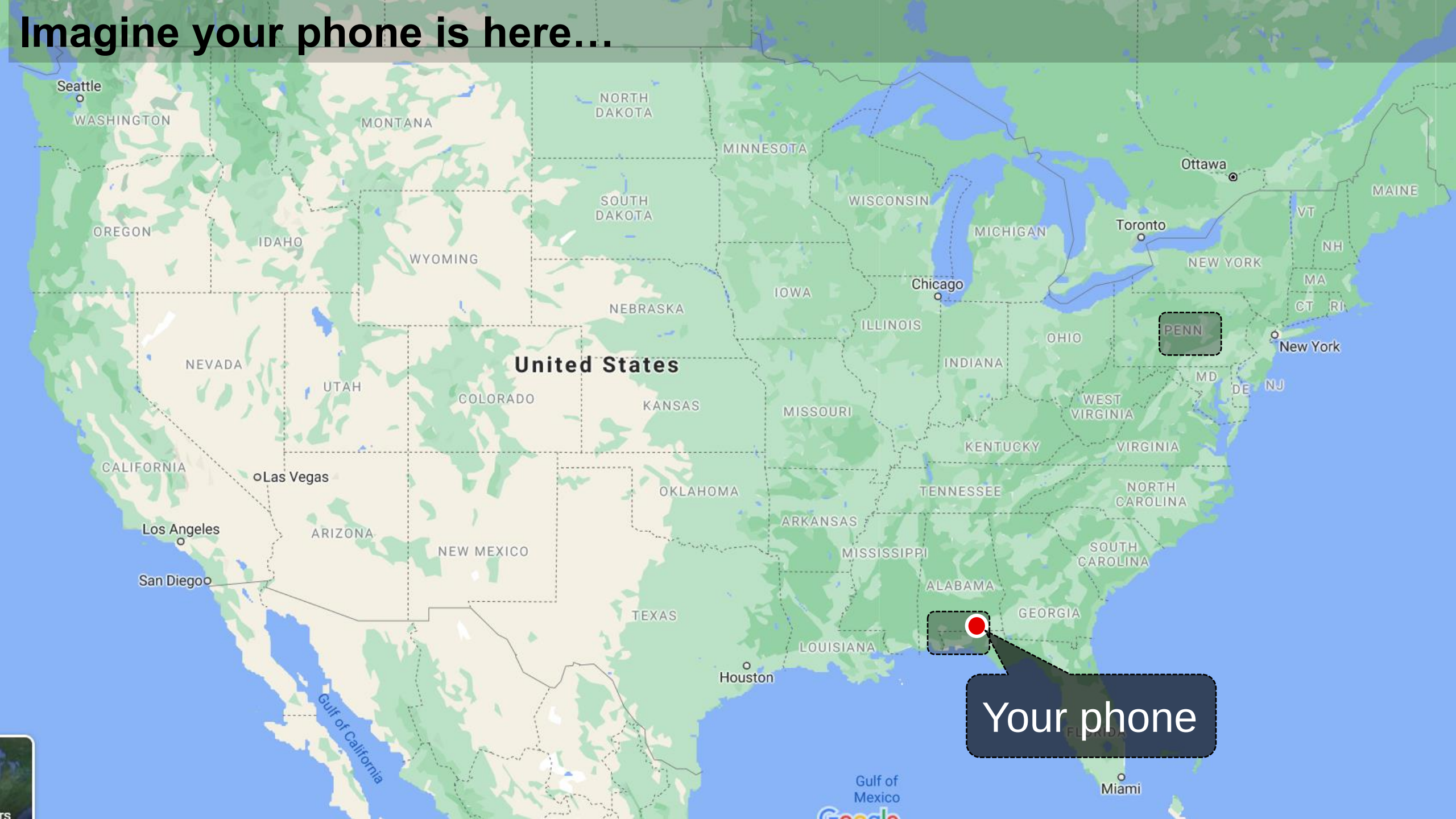



Before you ask, YES, there would be more than "two" UPFs.
Ottawa
Toronto
United States
San Diego
Gulf of California
Gulf of Mexico
Miami

Network personnel assign a subnet to each DN (Data Network)



Imagine your phone is here…



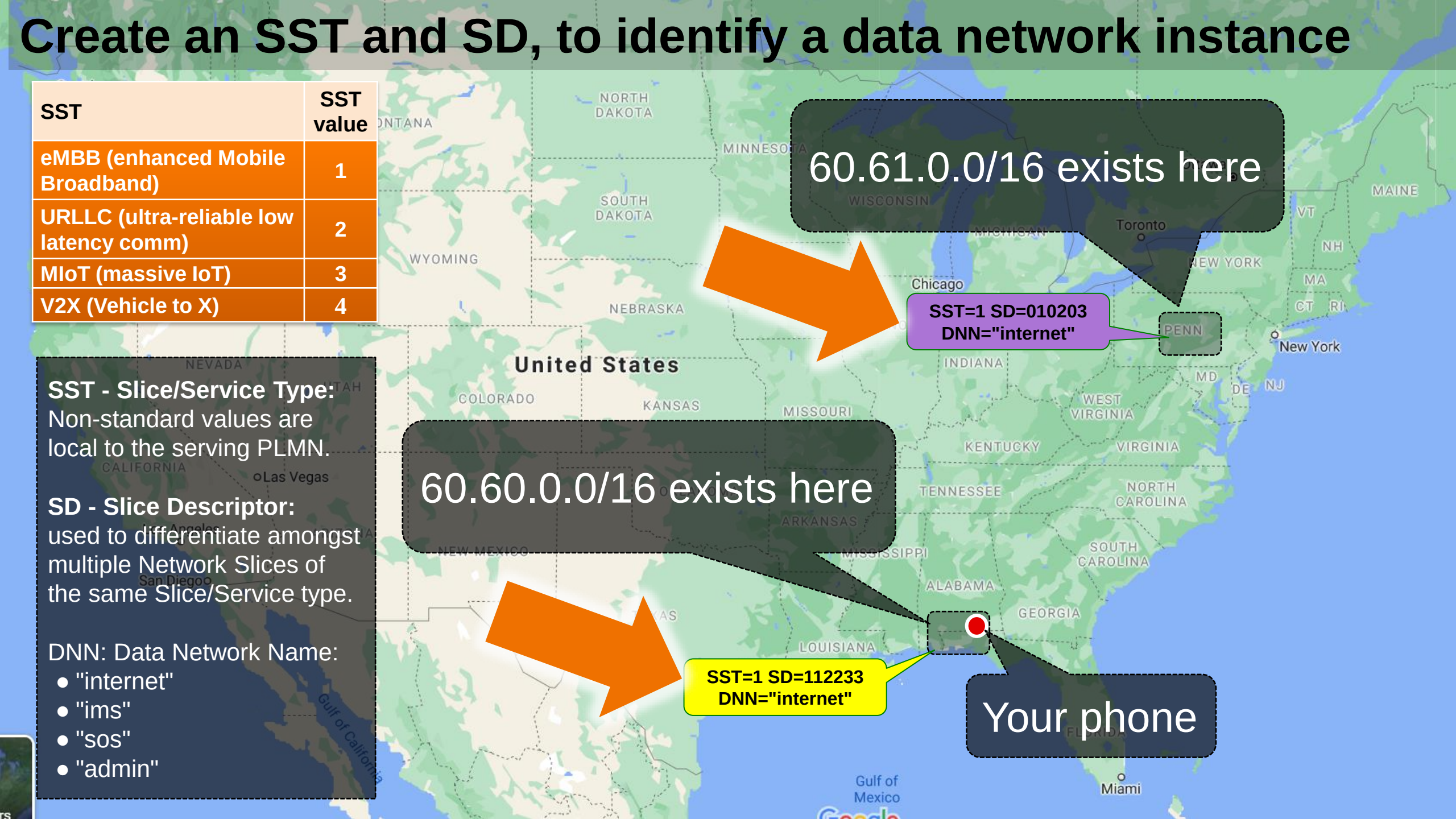
Create an SST and SD, to identify a data network instance

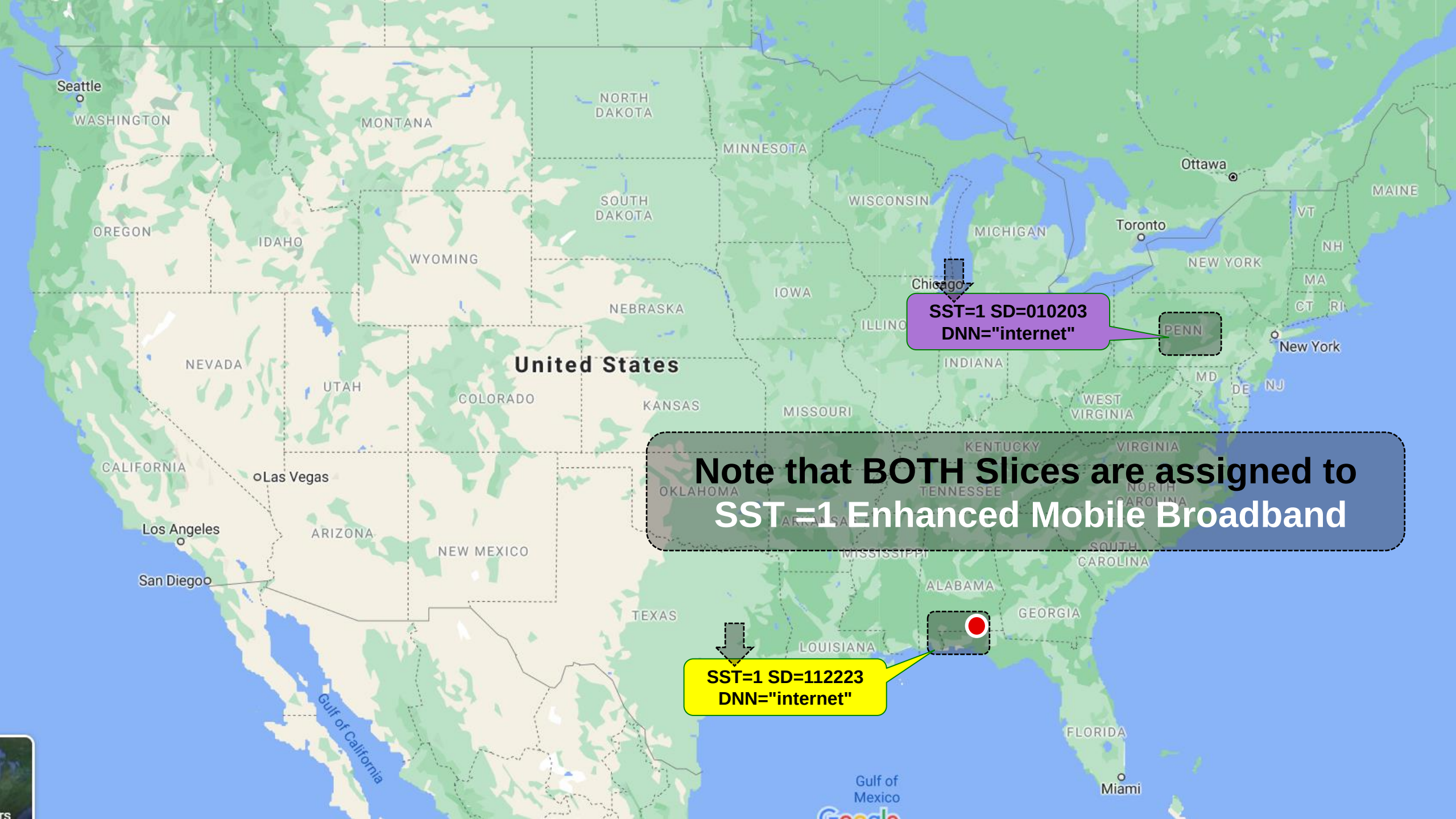
SST	SST value
eMBB (enhanced Mobile Broadband)	1
URLLC (ultra-reliable low latency comm)	2
MIoT (massive IoT)	3
V2X (Vehicle to X)	4

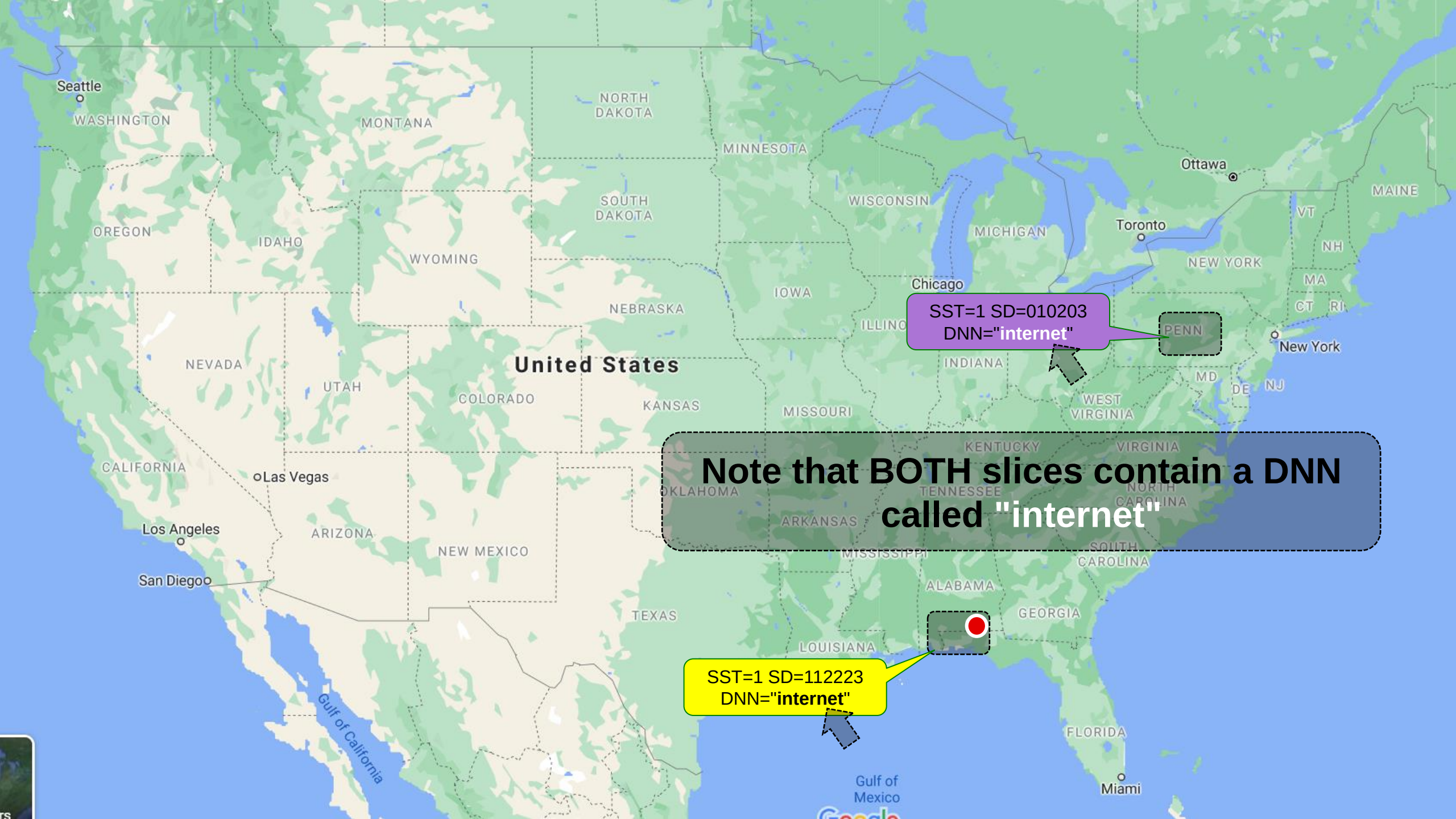
SST - Slice/Service Type:
Non-standard values are local to the serving PLMN.

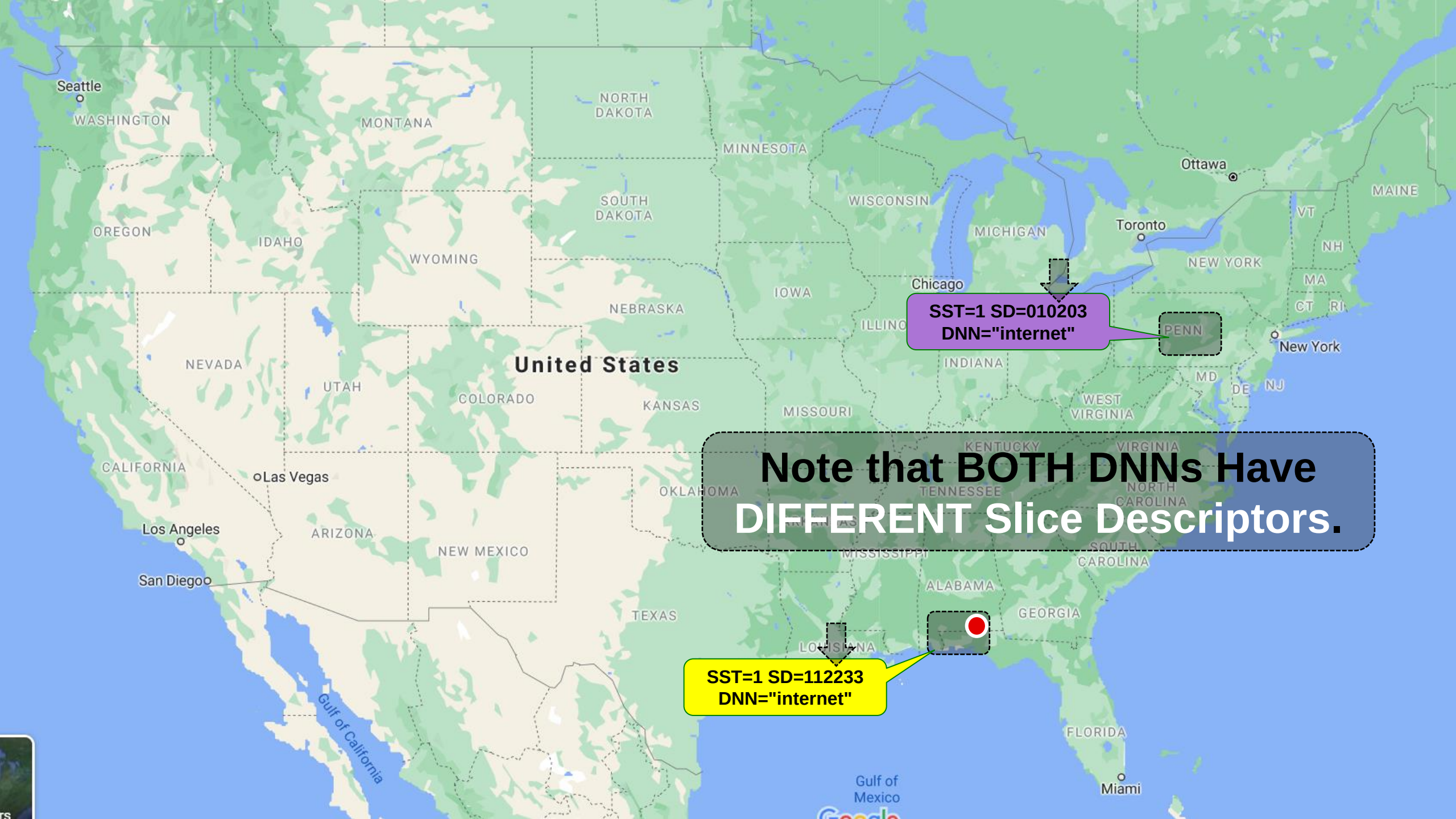
SD - Slice Descriptor:
used to differentiate amongst multiple Network Slices of the same Slice/Service type.

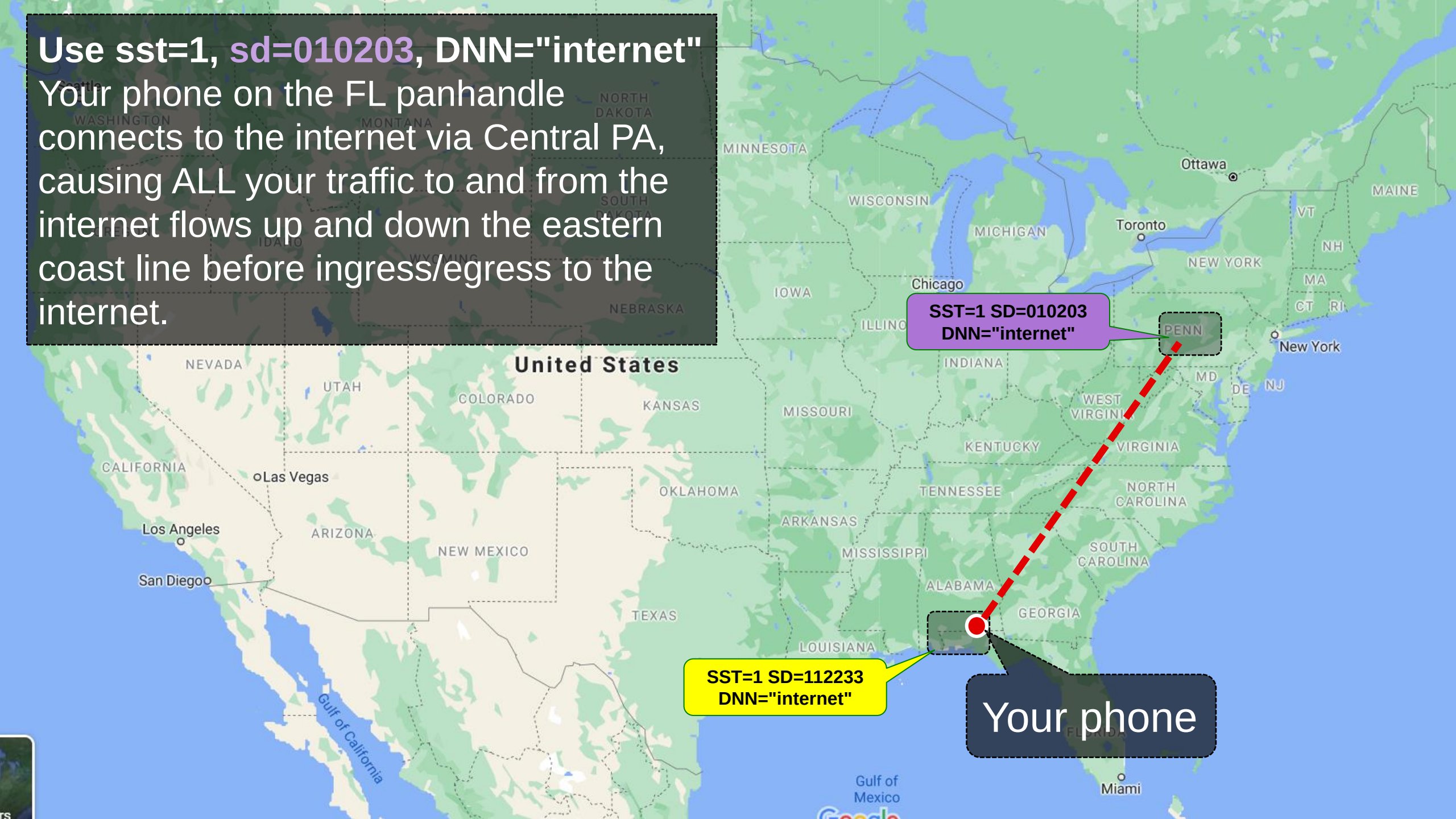
DNN: Data Network Name:
- "internet"
- "ims"
- "sos"
- "admin"



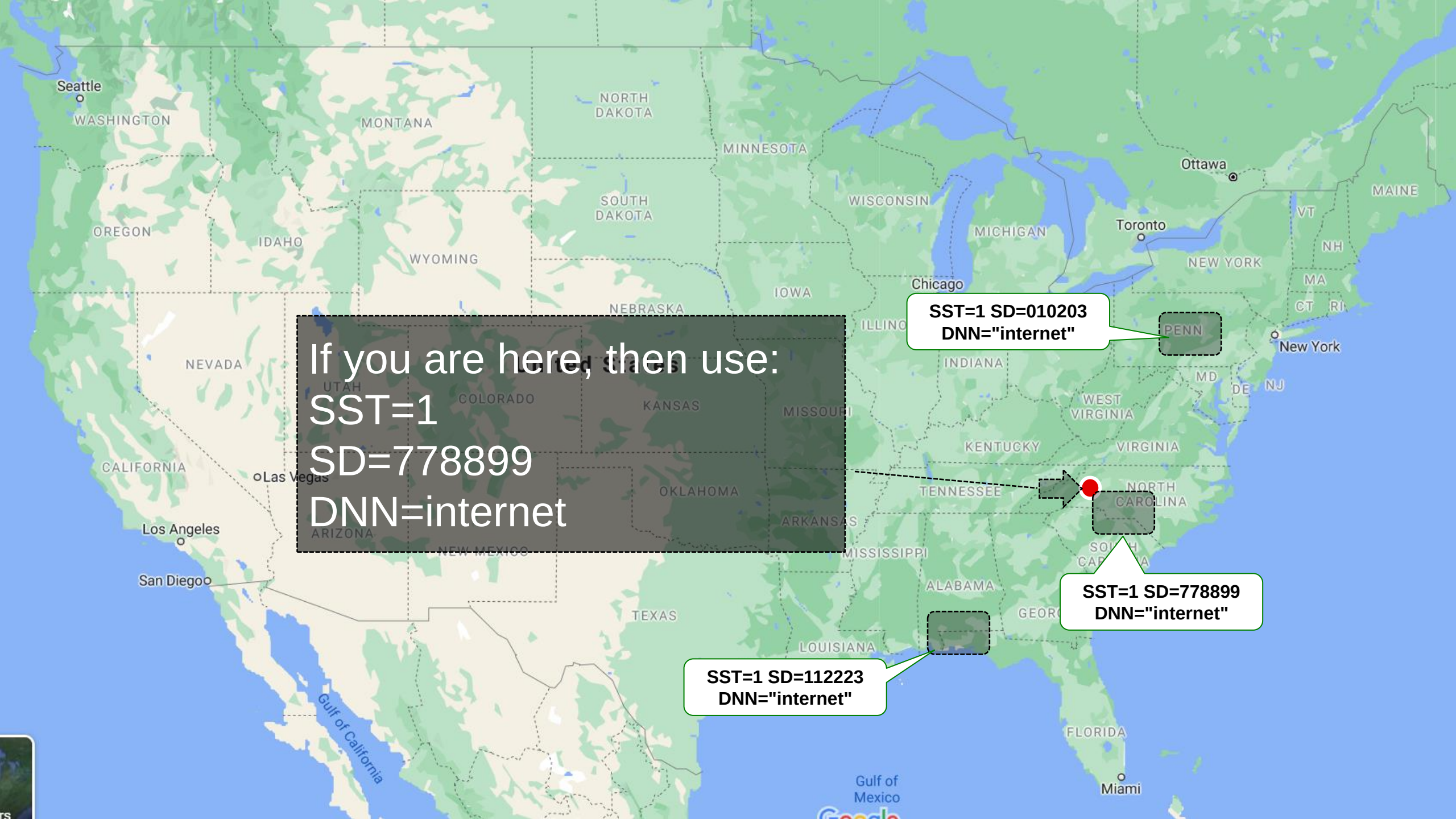

SST=1 SD=010203
DNN="internet"
Note that BOTH Slices are assigned to
SST =1 Enhanced Mobile Broadband
SST=1 SD=112223
DNN="internet"
Seattle
WASHINGTON
OREGON
IDAHO
MONTANA
WYOMING
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
MINNESOTA
IOWA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
Chicago
Ottawa
Toronto
NEW YORK
PENN
New York
MAINE
VT
NH
MA
CT
RI
MD
DE
NJ
WEST VIRGINIA
KENTUCKY
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
Miami
LOUISIANA
TEXAS
OKLAHOMA
KANSAS
MISSOURI
COLORADO
UTAH
NEVADA
ARIZONA
NEW MEXICO
CALIFORNIA
Las Vegas
Los Angeles
San Diego
United States
Gulf of California
Gulf of Mexico


SST=1 SD=010203
DNN="internet"
SST=1 SD=112223
DNN="internet"
Note that BOTH slices contain a DNN called "internet"
Seattle
WASHINGTON
OREGON
IDAHO
MONTANA
WYOMING
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
MINNESOTA
IOWA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
PENN
NEW YORK
MAINE
VT
NH
MA
CT
RI
NJ
DE
MD
WEST VIRGINIA
VIRGINIA
KENTUCKY
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
FLORIDA
ALABAMA
MISSISSIPPI
LOUISIANA
ARKANSAS
MISSOURI
KANSAS
COLORADO
UTAH
NEVADA
CALIFORNIA
ARIZONA
NEW MEXICO
TEXAS
OKLAHOMA
United States
Ottawa
Toronto
Chicago
New York
Miami
Las Vegas
Los Angeles
San Diego
Gulf of California
Gulf of Mexico


SST=1 SD=010203
DNN="internet"
SST=1 SD=112233
DNN="internet"
Note that BOTH DNNs Have DIFFERENT Slice Descriptors.
United States
Seattle
WASHINGTON
OREGON
MONTANA
IDAHO
WYOMING
NORTH DAKOTA
SOUTH DAKOTA
MINNESOTA
NEBRASKA
IOWA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
PENN
NEW YORK
Ottawa
Toronto
Chicago
New York
MAINE
VT
NH
MA
CT
RI
MD
DE
NJ
WEST VIRGINIA
KENTUCKY
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
Miami
NEVADA
UTAH
COLORADO
KANSAS
MISSOURI
OKLAHOMA
TEXAS
LOUISIANA
ARIZONA
NEW MEXICO
CALIFORNIA
Las Vegas
Los Angeles
San Diego
Gulf of California
Gulf of Mexico


Use sst=1, sd=010203, DNN="internet"
Your phone on the FL panhandle connects to the internet via Central PA, causing ALL your traffic to and from the internet flows up and down the eastern coast line before ingress/egress to the internet.
SST=1 SD=010203 DNN="internet"
SST=1 SD=112233 DNN="internet"
Your phone
United States
Ottawa
Toronto
Chicago
New York
Miami
Las Vegas
Los Angeles
San Diego
Gulf of California
Gulf of Mexico
MINNESOTA
WISCONSIN
MICHIGAN
NEW YORK
MAINE
IOWA
NEBRASKA
NEVADA
UTAH
COLORADO
KANSAS
MISSOURI
INDIANA
KENTUCKY
VIRGINIA
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
ARKANSAS
LOUISIANA
TEXAS
OKLAHOMA
NEW MEXICO
ARIZONA
CALIFORNIA
PENN
MD
DE
NJ
CT
RI
MA
NH
VT


Use sst=1, sd=112233, DNN="internet"
Your phone on the FL panhandle connects to the internet via the FL panhandle DNN, causing ALL your traffic to instantly access the internet.
SST=1 SD=010203
DNN="internet"
SST=1 SD=112233
DNN="internet"
Your UE is here
United States
Chicago
Toronto
Ottawa
New York
Las Vegas
Los Angeles
San Diego
Miami
Gulf of California
Gulf of Mexico
NORTH DAKOTA
MINNESOTA
WISCONSIN
MICHIGAN
SOUTH DAKOTA
WYOMING
NEBRASKA
IOWA
NEVADA
UTAH
COLORADO
KANSAS
MISSOURI
INDIANA
PENN
NEW YORK
MAINE
VT
NH
MA
CT
RI
MD
DE
NJ
WEST VIRGINIA
KENTUCKY
VIRGINIA
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
CALIFORNIA
ARIZONA
NEW MEXICO
OKLAHOMA
ARKANSAS
MISSISSIPPI
ALABAMA
GEORGIA
LOUISIANA
TEXAS
FLORIDA


If you are here, then use:
SST=1
SD=778899
DNN=internet
SST=1 SD=010203
DNN="internet"
SST=1 SD=778899
DNN="internet"
SST=1 SD=112223
DNN="internet"
Seattle
WASHINGTON
OREGON
MONTANA
IDAHO
WYOMING
NORTH DAKOTA
SOUTH DAKOTA
MINNESOTA
NEBRASKA
IOWA
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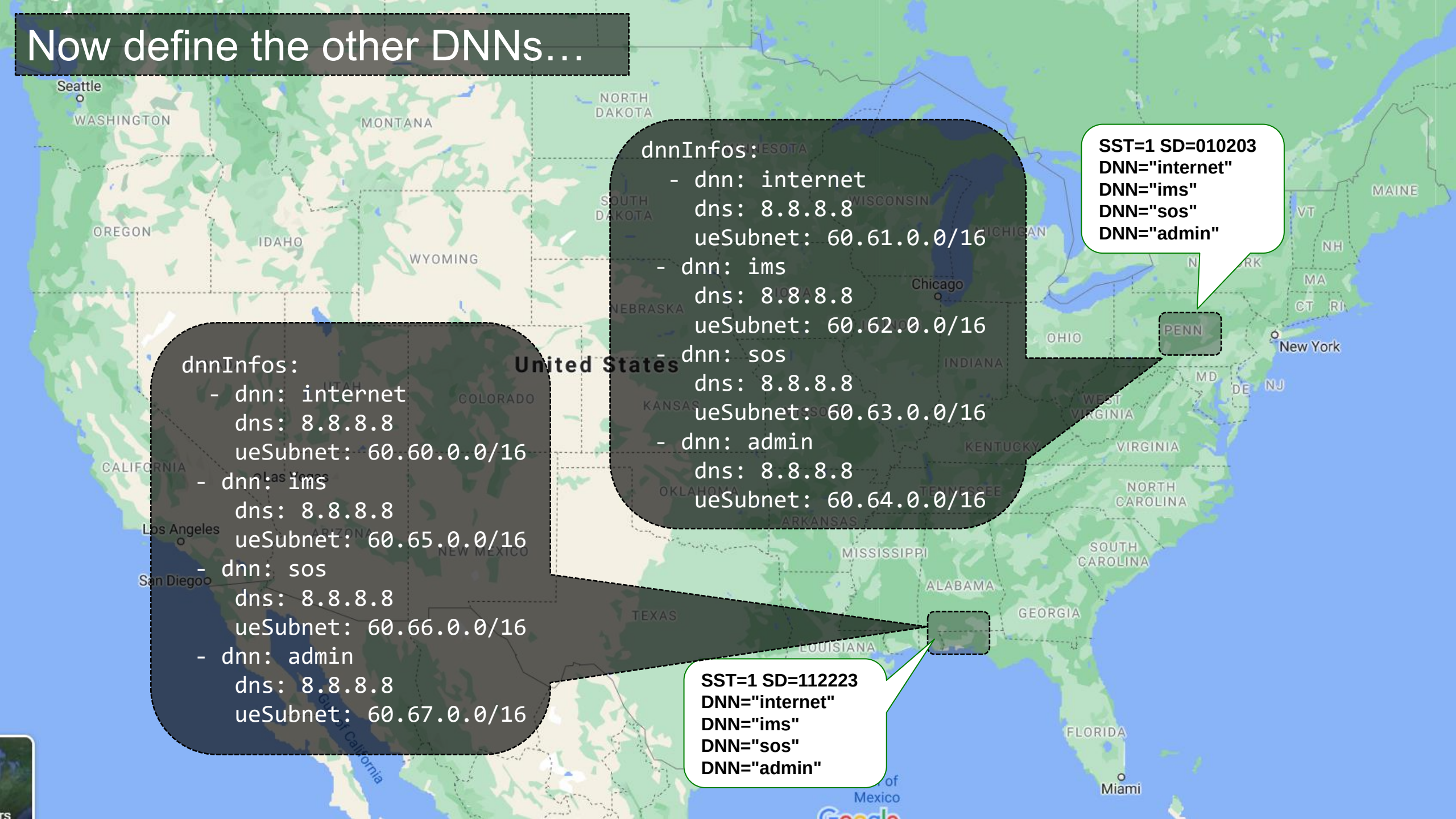
MISSOURI
OKLAHOMA
ARKANSAS
MISSISSIPPI
ALABAMA
LOUISIANA
TEXAS
CALIFORNIA
Las Vegas
Los Angeles
San Diego
ARIZONA
NEW MEXICO
Gulf of California
Gulf of Mexico
FLORIDA
Miami

Demonstration

Now define the other DNNs…



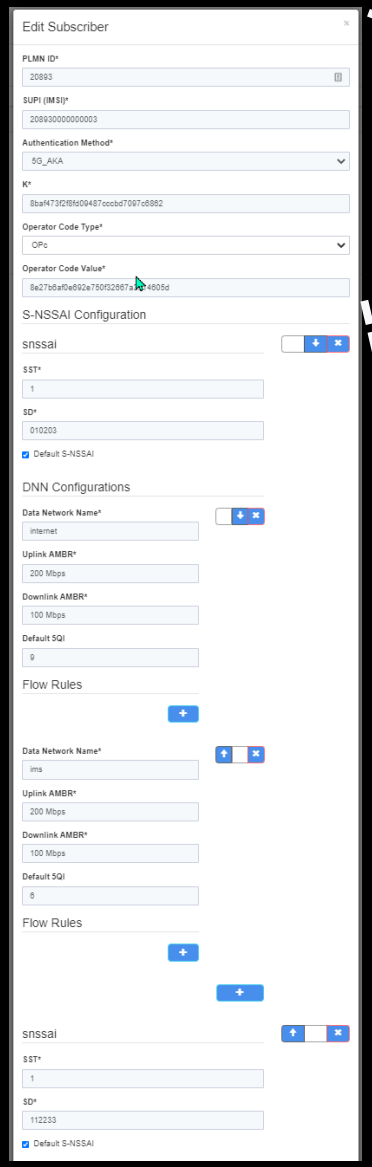

```
dnnInfos:
  - dnn: internet
    dns: 8.8.8.8
    ueSubnet: 60.61.0.0/16
  - dnn: ims
    dns: 8.8.8.8
    ueSubnet: 60.62.0.0/16
  - dnn: sos
    dns: 8.8.8.8
    ueSubnet: 60.63.0.0/16
  - dnn: admin
    dns: 8.8.8.8
    ueSubnet: 60.64.0.0/16
```

SST=1 SD=010203
DNN="internet"
DNN="ims"
DNN="sos"
DNN="admin"

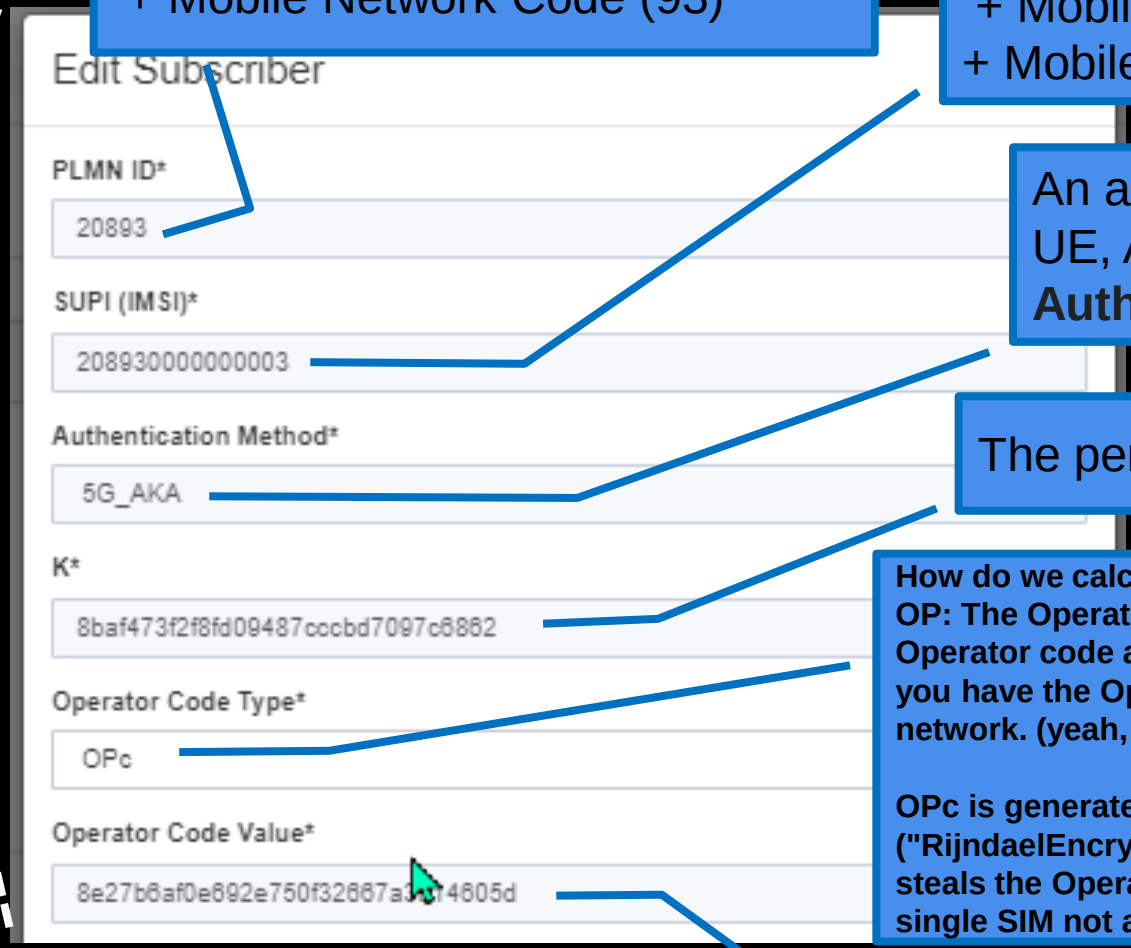
```
dnnInfos:
  - dnn: internet
    dns: 8.8.8.8
    ueSubnet: 60.60.0.0/16
  - dnn: ims
    dns: 8.8.8.8
    ueSubnet: 60.65.0.0/16
  - dnn: sos
    dns: 8.8.8.8
    ueSubnet: 60.66.0.0/16
  - dnn: admin
    dns: 8.8.8.8
    ueSubnet: 60.67.0.0/16
```

SST=1 SD=112223
DNN="internet"
DNN="ims"
DNN="sos"
DNN="admin"

Understanding 5G Subscriber Configuration



MCC Mobile Country Code (208)
+ Mobile Network Code (93)



MCC Mobile Country Code (208)
+ Mobile Network Code (93)
+ Mobile Subscriber ID Number (0000000003)

An authentication protocol used between the UE, AMF, and AUSF, known as **Authentication and Key Agreement** .

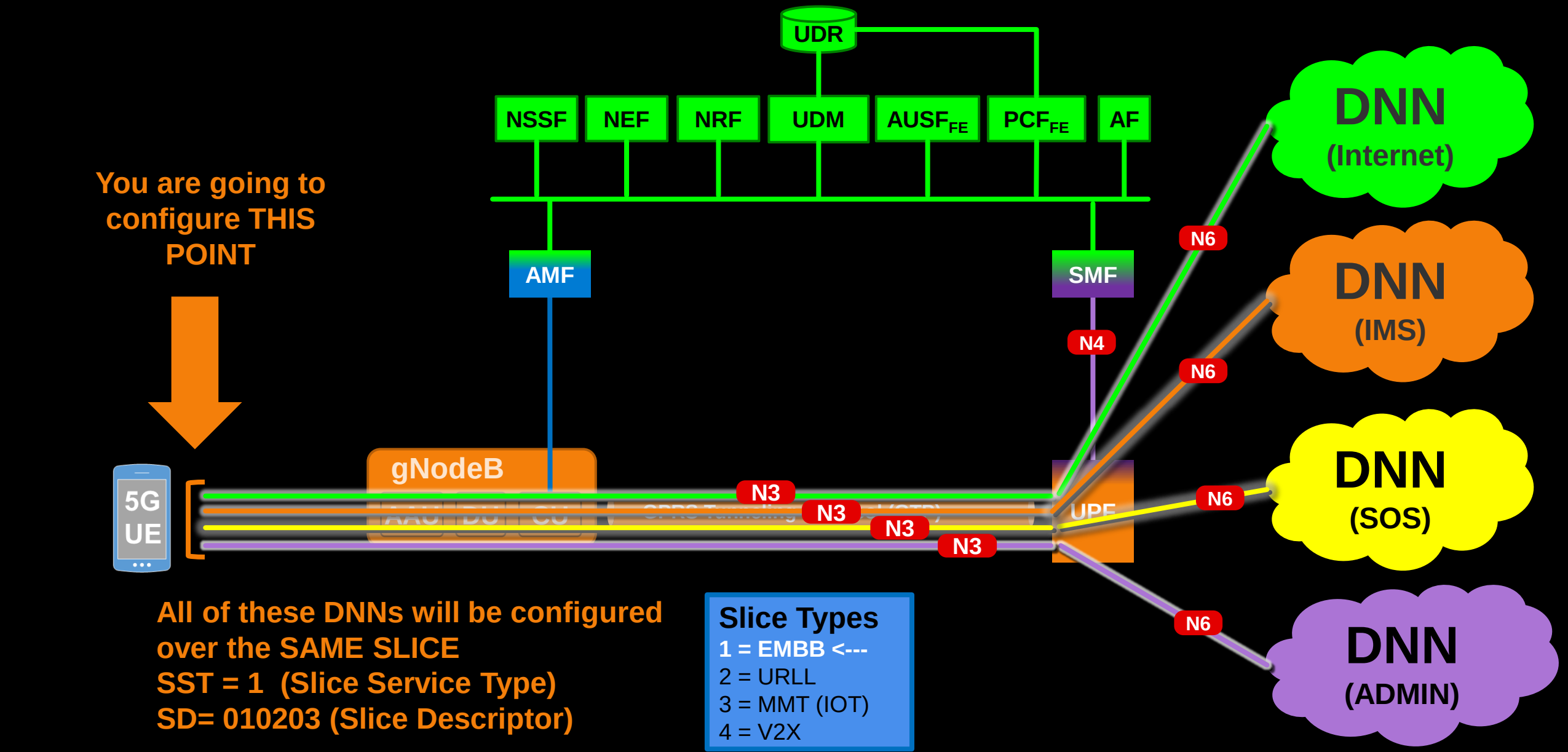
The permanent subscription key

How do we calculate the Operator Code Value? OP or OPc?
OP: The Operator Code Value is the Operator Code! Since the Operator code applies to ALL the phones in the operator's network, if you have the Operator Code you can spoof ALL SIMS in the operators network. (yeah, bad idea to use OP!)

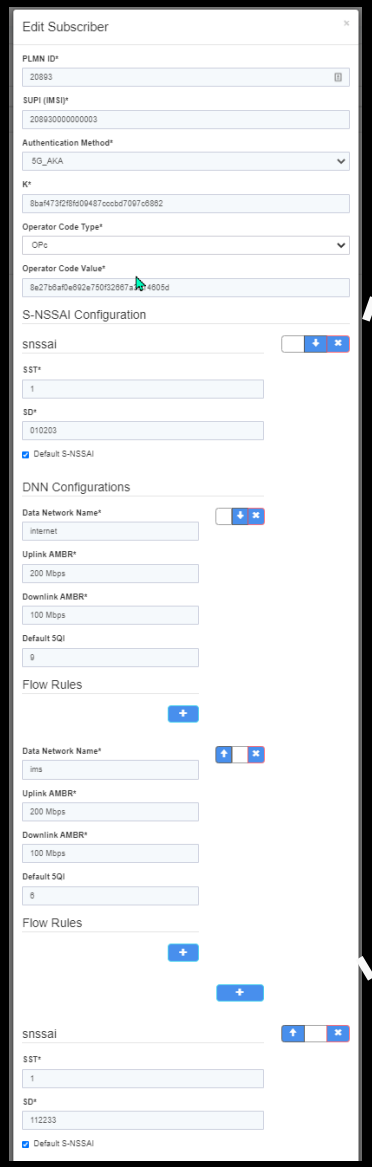
OPc is generated from the OP and K* (secret Key) by using ("RijndaelEncrypt") algorithm which is specific to SIM. If someone steals the Operator Code Value here, then they can only spoof that single SIM not all the SIMs in the network (yeah, use this one!).

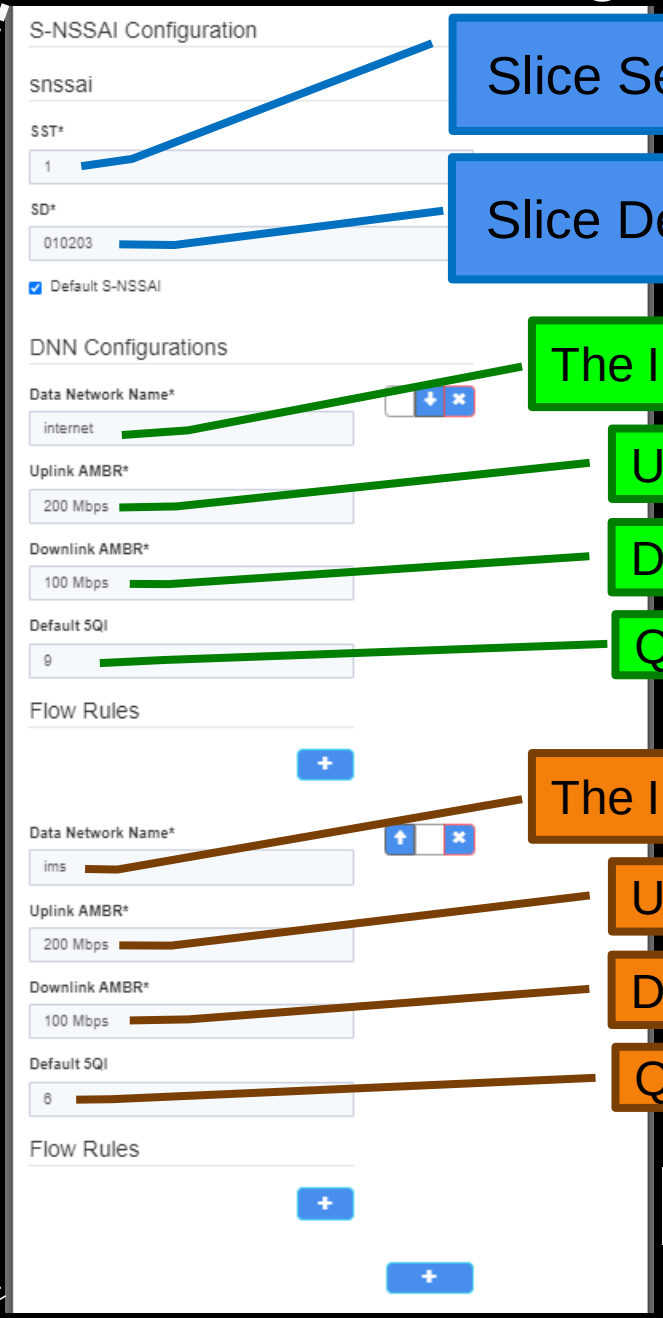
The permanent subscription key

DNN Configuration



Understanding 5G Subscriber Configuration

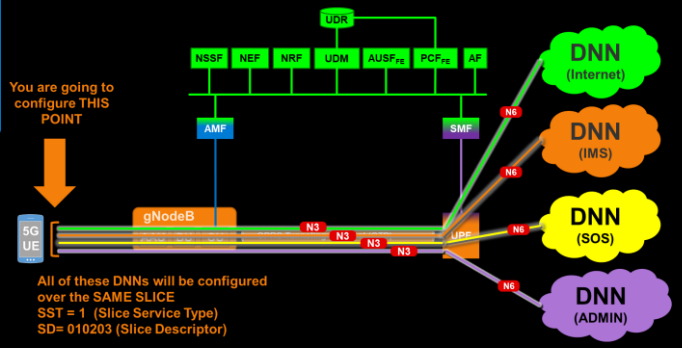




Slice Service Type

Slice Descriptor

Slice Types
1 = EMBB
2 = URLL
3 = MMT (IOT)
4 = V2X



The INTERNET DNN

UPLINK Aggregate Max bandwidth. (Throttles you if you exceed!)

DOWNLINK Aggregate Max bandwidth. (Throttles you if you exceed!)

Quality Control Index

The IMS DNN

UPLINK Aggregate Max bandwidth. (Throttles you if you exceed!)

DOWNLINK Aggregate Max bandwidth. (Throttles you if you exceed!)

Quality Control Index

We still need two more DNN types, the SOS, and admin.

QUESTIONS

COURSES

5G Overview

Non-technical, high-level overview

(coming soon)

5G Essentials

Hands-on practice to empower you to take an active role in working with 5G engineers

Deploying 5G

As a continuation from 5G Essentials, you will receive hands-on practice in deploying a 5G network at scale

(coming soon)

Developing Microservices

Learn essential microservices concepts and practice common tasks taken to develop microservices

Kubernetes Bootcamp

Hands-on practice to deploy your services on Kubernetes.

SDN/NFV/SD-WAN

Hands-on practice to provision network resources with greater flexibility using SDN and NFV

(new update)

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