NPSTC
NATIONAL PUBLIC SAFETY TELECOMMUNICATIONS COUNCIL

# NATIONAL BROADBAND NETWORK CONCEPTUAL DESIGNS

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**Washington DC**
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**By**
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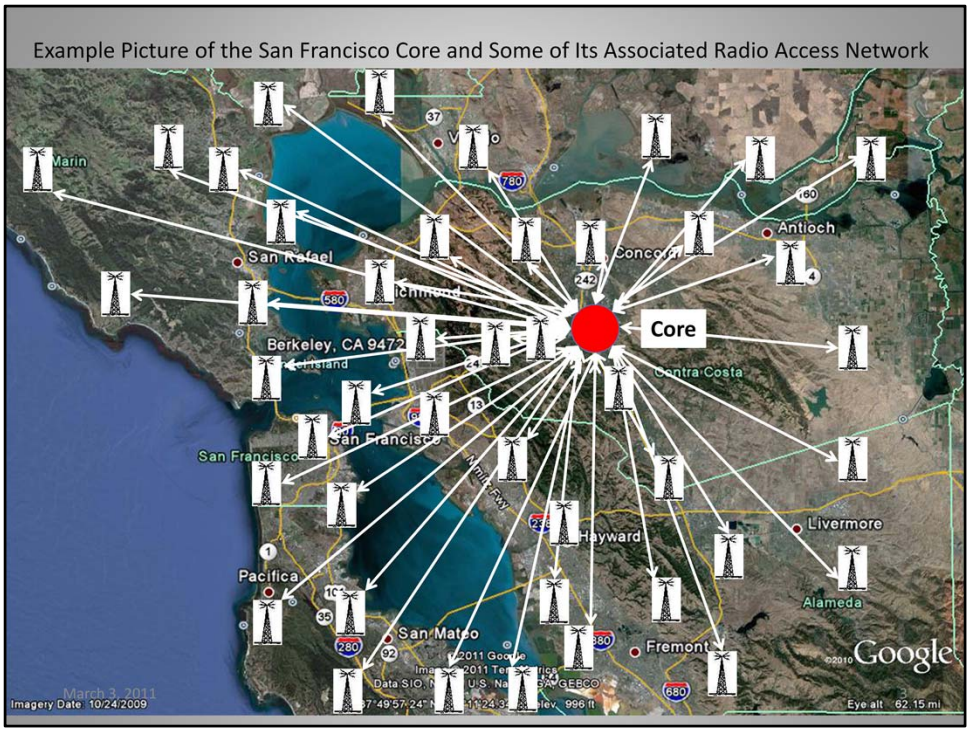
**NPSTC Interoperability Committee**

*NPSTC is a federation of organizations whose mission is to improve public safety communications and interoperability through collaborative leadership.*

# Opening Note

- While the pictorials in this presentation could be misconstrued as an architecture, they are intended to be only high level concept drawings to help illustrate the difference between the network-of-networks approach and a single national network.
- For real-world implementation, a great deal of engineering analysis would go into every component of each drawing, regardless of approach, to determine such things as optimal core location, interconnection of the core network, etc.




This slide shows what could be the initial buildout of only the San Francisco Core and its associated Radio Access Network (RAN).

RANs are assumed to exist in the blue geographic coverage area polygons for the following slides in this presentation, but individual radio sites and their associated connectivity to a core are not shown on any other slide.

Note that the white arrows represent logical connections between a RAN node (broadband cell site) and the core. Actual physical connections for this specific buildout are planned to use the Bay Area's extensive Public Safety microwave backhaul network and other connectivity that exists and/or is planned.

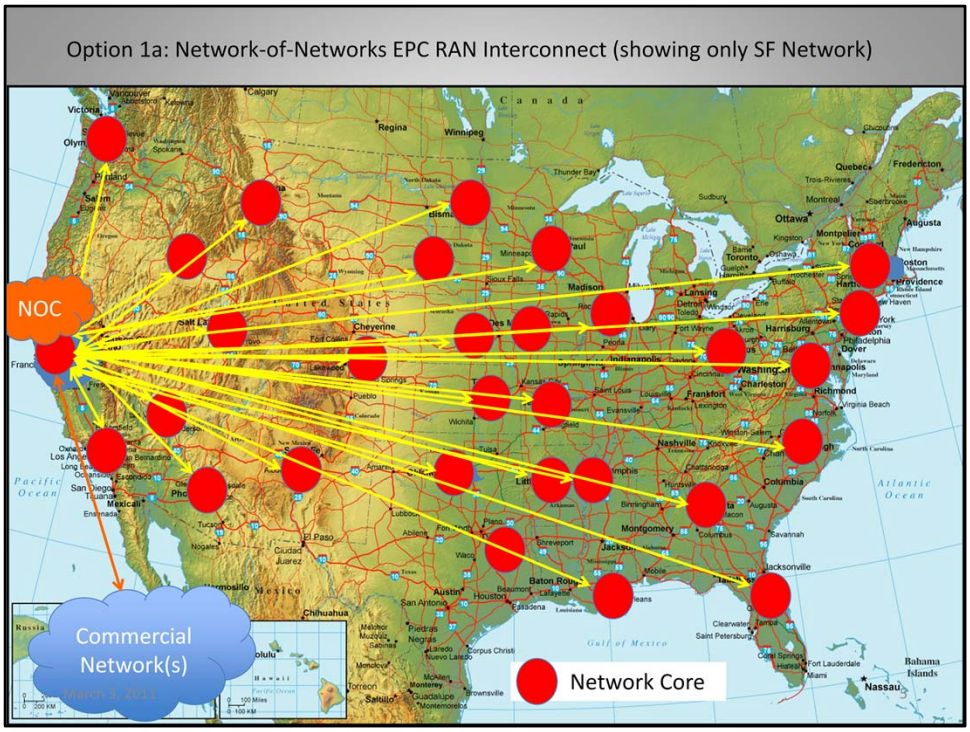
## Network-of-Networks Solution

- Multiple IDs (PLMNs), one for each Public Safety Network
  - Forces roaming between public safety networks, and all associated engineering and business expenses for roaming replicated between each network
  - May not be possible to get many IDs from ATIS IOC
- Inconsistent user subscription fees for each network and roaming fees between PS networks (TBD)
- Duplication & Overbuild = unnecessary expenses
- Upgrades inconsistent across Public Safety networks
- Public safety roaming also required onto commercial networks
  - One agreement between each Public Safety Network, and each supported commercial network, or
  - An agreement between each Public Safety Network and a Clearing House & Roaming Hub.

The Network-of-Network solution can be fielded in at least two ways, shown in following slides as Option 1a and Option 1b.

Option 1 in its various flavors requires an excessive number of extremely expensive cores, Network Operations Centers (NOCs) and network connectivity in order to support nationwide roaming.

Independently managed networks also lead to inconsistent roll-out of network improvements and upgrades nationwide.

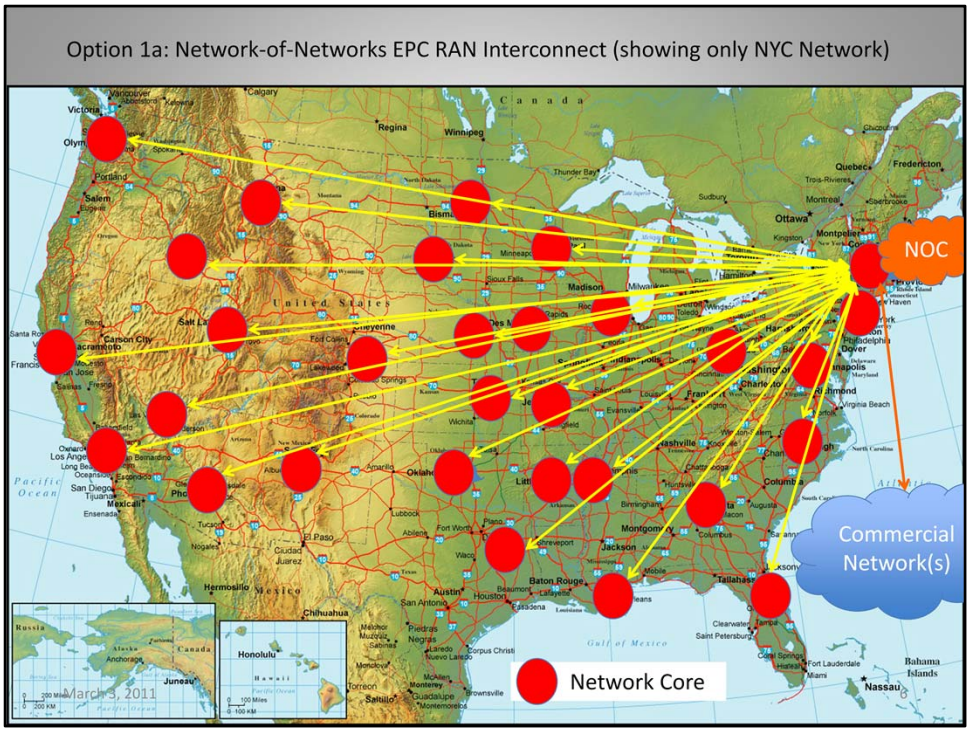



This slide shows only the SF Core and its associated NOC and interconnect to Commercial Network(s), as well as its required connectivity to all other Public Safety networks across the country.

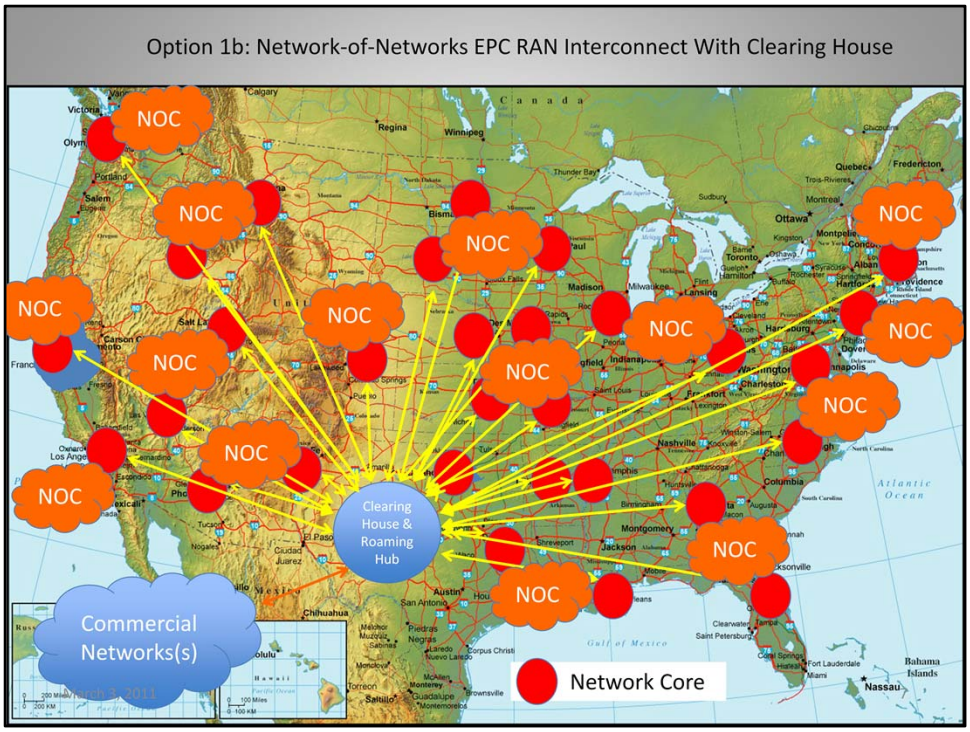
Important to note is that the yellow connectivity lines shown on this and the following two slides represent very high bandwidth pinned connectivity required to be operational at all times 24/7/365, representing significant initial and ongoing operational costs.

Option 1a has a significant hurdle for roaming in that roaming subscribers would have to be provisioned/registered with the network they are entering before they could use that network, a process similar to going into a commercial wireless store and obtaining initial service with a new provider, except that the process will be more complex on the Public Safety network due to security-related issues (authentication, etc). This could add significant delays to roaming should the local databases not be prepopulated. For example, every year local/state/Federal fire fighters routinely move around the Western States during wildfire season; their subscriber handsets would not be able to access any network where they were not registered until the provisioning/registration process could be completed. The LMR equivalent to this restriction would be bringing a trunked radio to an incident where it would have to be reprogrammed to access the local trunking system(s), something that COMLs are instructed to do only as a last resort due to the significant amount of expertise and

time required and a process that is inherently difficult to do in the field at an incident scene.



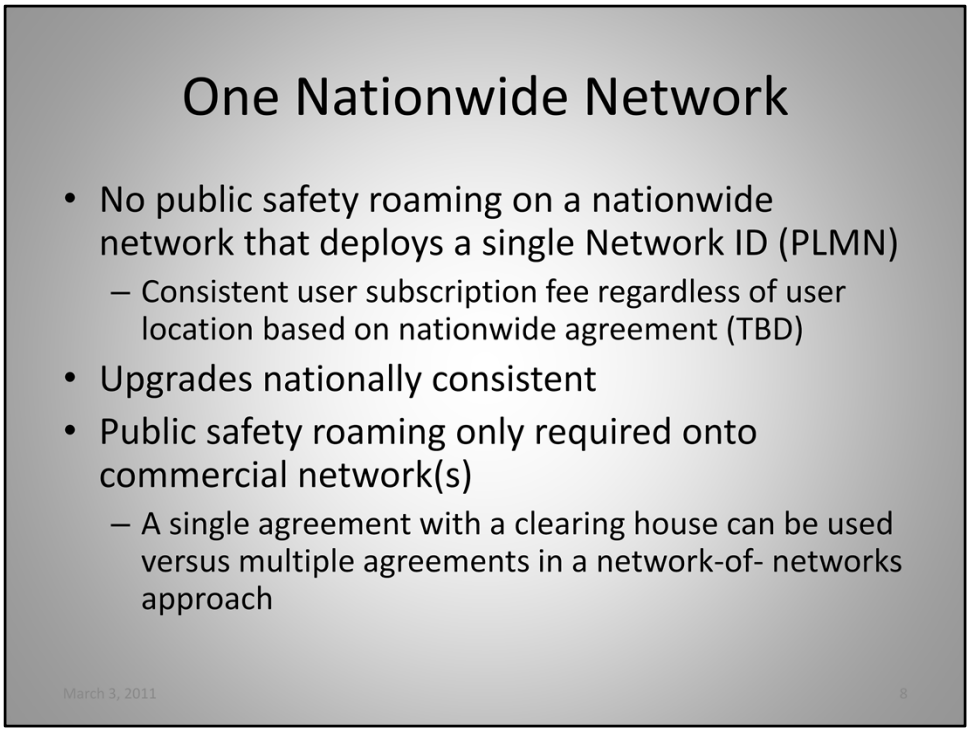

Similar to the previous slide, this slide shows only the New York City Core and its associated NOC and interconnect to Commercial Network(s), as well as its required connectivity to all other Public Safety networks across the country.



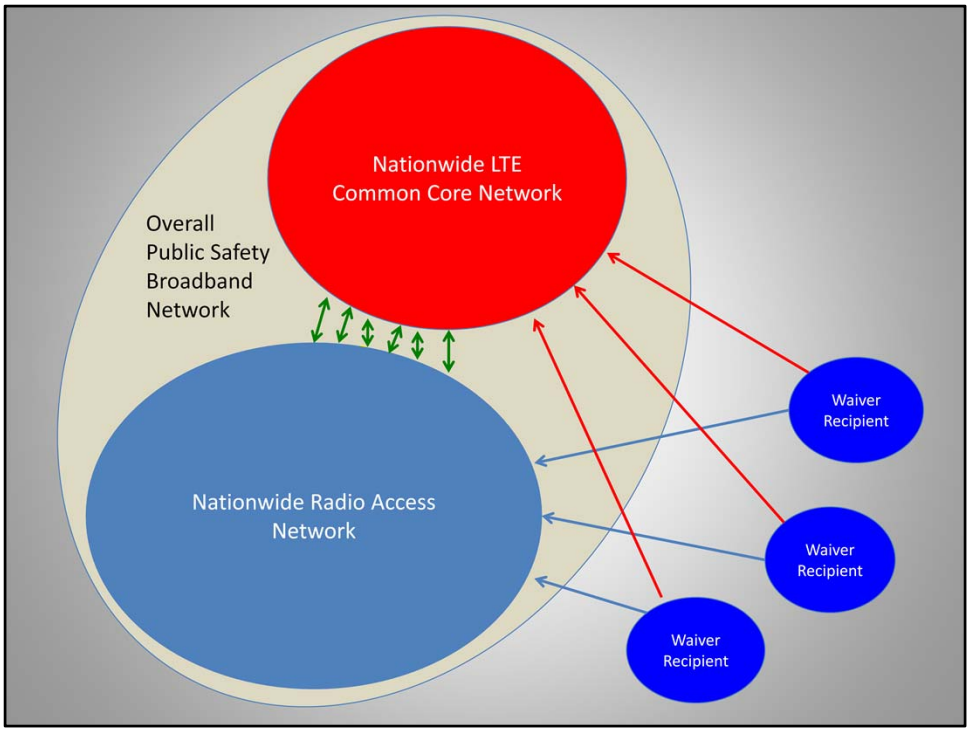

Option 1b employs a Clearing House and Roaming Hub to provide connectivity between Public Safety cores and to Commercial Network(s) to eliminate the myriad of direct connections between each network, but does not address the potentially large number of NOCs required to support the various networks.

In this pictorial, NOCs serve one or more (up to 4, for example) Network Cores based upon the desires of the regional core "owners."

For Option 1b, roaming and security-related issues (authentication, etc) would be handled through the Clearing House and Roaming Hub that would coordinate the movement of subscriber handsets around the various networks, addressing the requirement that subscriber units be registered with each of the independent networks in order to roam into their service areas.

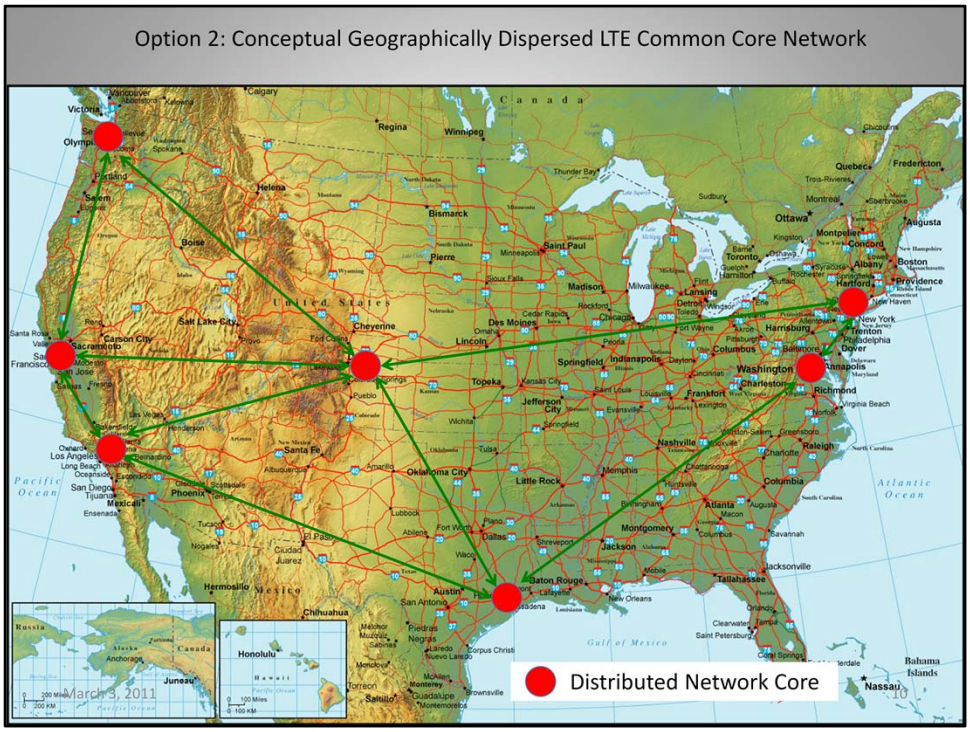



Roaming is only required when operating on a network other than the subscriber's own network. With a single nationwide public land mobile network (PLMN) ID, public safety has no requirement to roam except when they leave the nationwide Public Safety network and need to use a Commercial Network.




This diagram shows that current/planned investments in Cores and RAN can be gracefully migrated forward from individual cores/RANS operated by Waiver Recipients to a single national network, hopefully leaving minimal stranded investment.

Conceptually, in a nationwide LTE network, you have an Evolved Packet Core network (EPC, shown in red) and a Radio Access Network (RAN, shown in blue). This diagram shows both of these major elements, and is intended to demonstrate that it is not to late to achieve a national network. Work will need to be done to pull appropriate components of the waiver recipients infrastructure into the EPC and RAN that comprise the national network. The complexity of this work depends on how far their deployments differ from the national network.



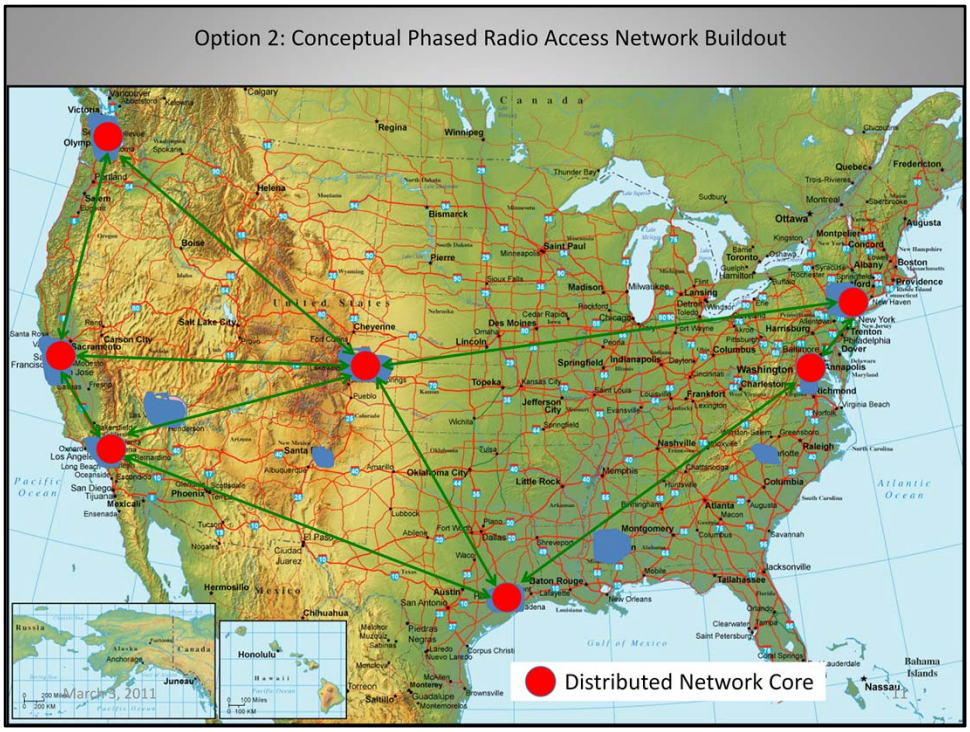

IMPORTANT NOTE: The following slides for Option 2 are conceptual, with distributed core locations based upon geographical separation and population centers. A detailed engineering analysis will be required to determine the proper network topology and appropriate number/placement of primary and hot standby core nodes.

It is our understanding that Verizon, for example, is supporting 88 million subscribers with a total of under 10 active and hot standby cores that are geographically separated and all capable of backing up the other cores in the event of a failure.

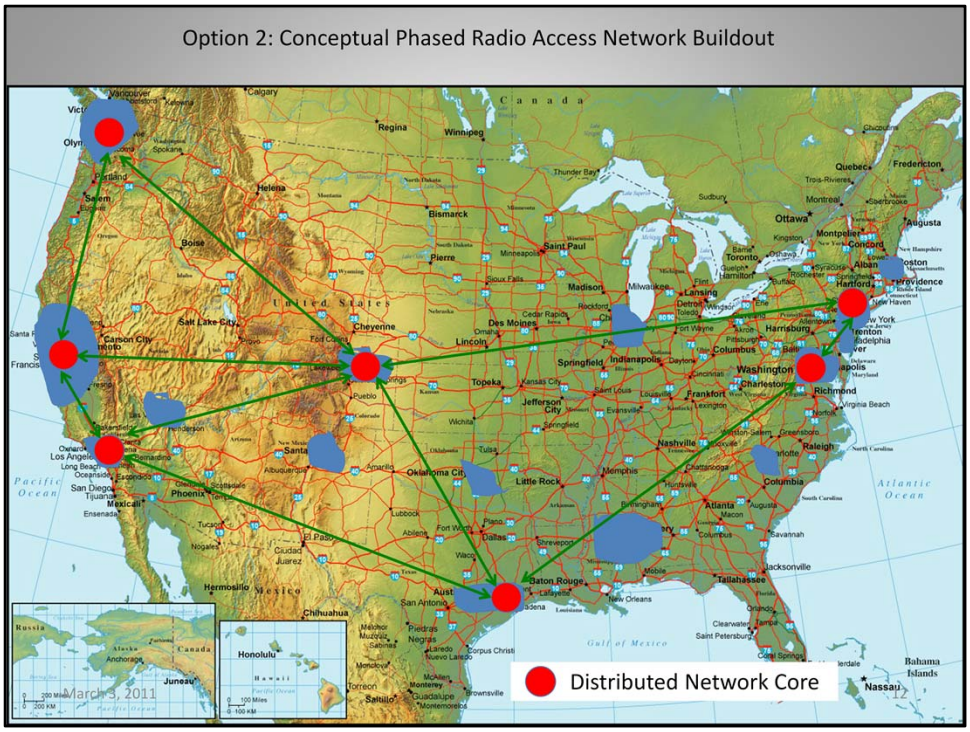
Public safety, with an estimated 4 million subscribers (not including secondary responders), should likewise require some small amount more than a commercial carrier to ensure required redundancy.

Option 2 requires connectivity between the 7 conceptual cores that support the nationwide Public Safety network.

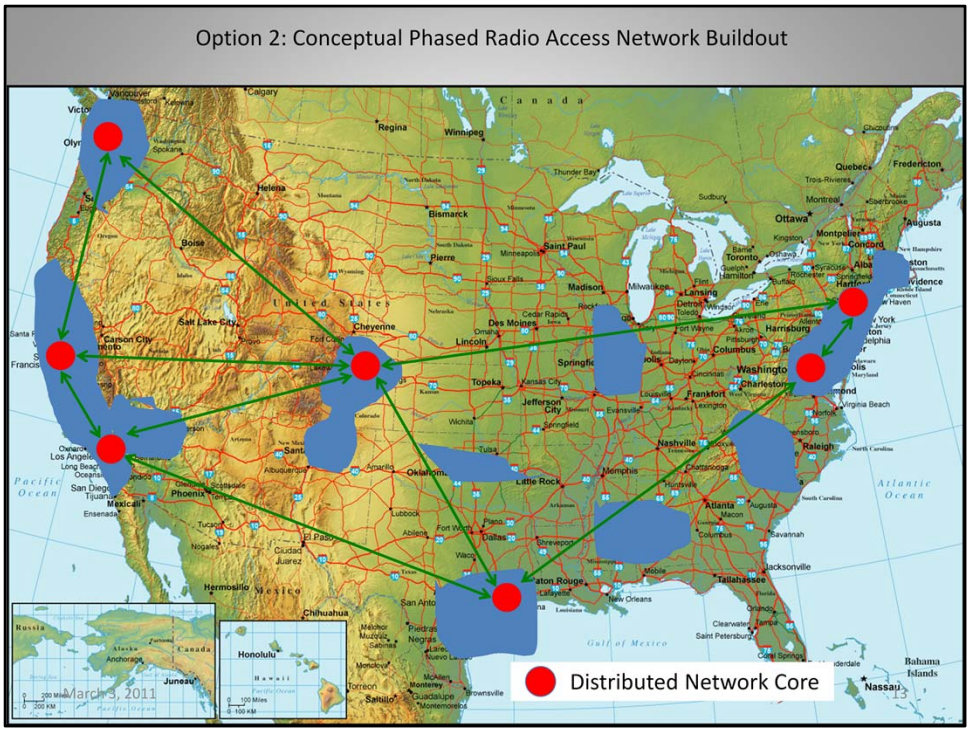
The green lines represent extremely high bandwidth connectivity between nodes of the distributed core. There is likely a need to provide multiple connections for any one node such that no node would be isolated from the network due to loss of a single connection nor subject to any single point of failure.



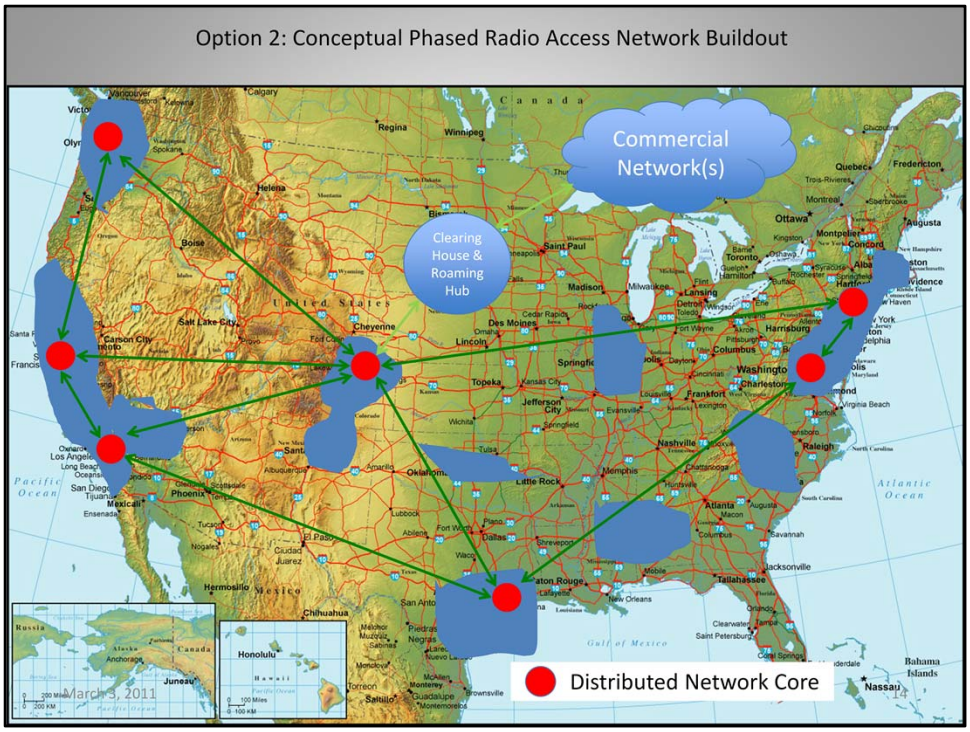

A local core is not required to support diverse geographical areas, as shown by the blue areas that are remote from any of the 7 cores.




This slide shows local areas around the distributed core expanding, as well as new geographic area coverage being added, again supported by the core network.

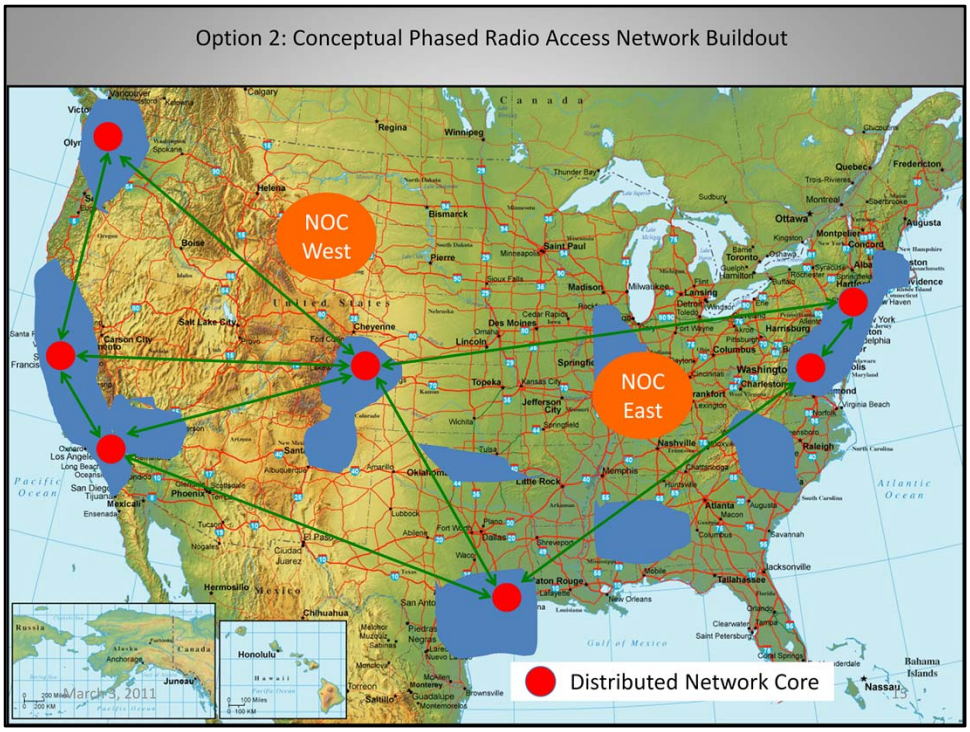



Continued expansion.




This slide shows a connection between a nationwide Public Safety network and a commercial network through a Clearing House & Roaming Hub.

The light green lines represent high bandwidth between the Public Safety network and a single Clearing House & Roaming Hub that provides roaming support onto Commercial Network(s).




This diagram shows how Network Operations Centers could be geographically dispersed for redundancy and to meet operational requirements.

# In Summary

A flexible , reliable and vibrant National Broadband Network will allow responders and support staff to dramatically increase effective and efficient support for daily operations and incident response by enhancing coordination & situational awareness, reducing response time, and promoting effective management through timely delivery of needed information, thus ensuring continuity of government and increasing the safety of life and property.

# Remember Our Mission!

- Bring to a successful conclusion every incident so that all responders and support staff can return safely to their families at the end of every day, and
- To the maximum extent possible, ensure that the public we serve can likewise return safely to their families and homes at the end of their day.