Network Identifiers Management Overview

Background and Overview

Presented to FCC PSHSB

November 2, 2011

V14.4

This materials is presented as a draft based on current understanding to stimulate discussion and provoke meaningful discussion.

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References

[1] 3GPP TS 36.401 v10.3.0 (9/2011)

[2] 3GPP TS 23.003 v10.3.0 (9/2011)

[3] *International IMSI Assignment and Management Guidelines and Procedures*, v12, December 2010.

[4] *National PLMN ID Management Framework*, Gino Scribano, MSI, Oct 2011 , draft, v2, 10/3/2011.

[5] *Network Identifiers & PLMN ID Myths*, APCO 2011, Emil Olbrich, PSCR, August 2011.

[6] 3GPP TS 36.413 v10.3.0 (9/2011)

[7] *LTE Network Identifiers*, Bob Pavlak, Chris San-Gaspar, 6/2011.

[8] *Network ID Study Item Contribution*, Alcatel-Lucent, DC-Office of the Chief Technology Officer, Motorola Solutions, Texas, 9/6/2011.

[9] *Interoperability Order*, FCC PS Docket No. 06-229, DA 10-2342, December 10, 2010.

[10] *Texas Waiver Order*, FCC PS Docket No. 06-229, DA 11-893, May 12, 2011.

[11] *Re: PS Docket 06-229 Request for a PLMN ID*, Letter to Mike Simpson, Adm. James Barnett, 10/12/11.

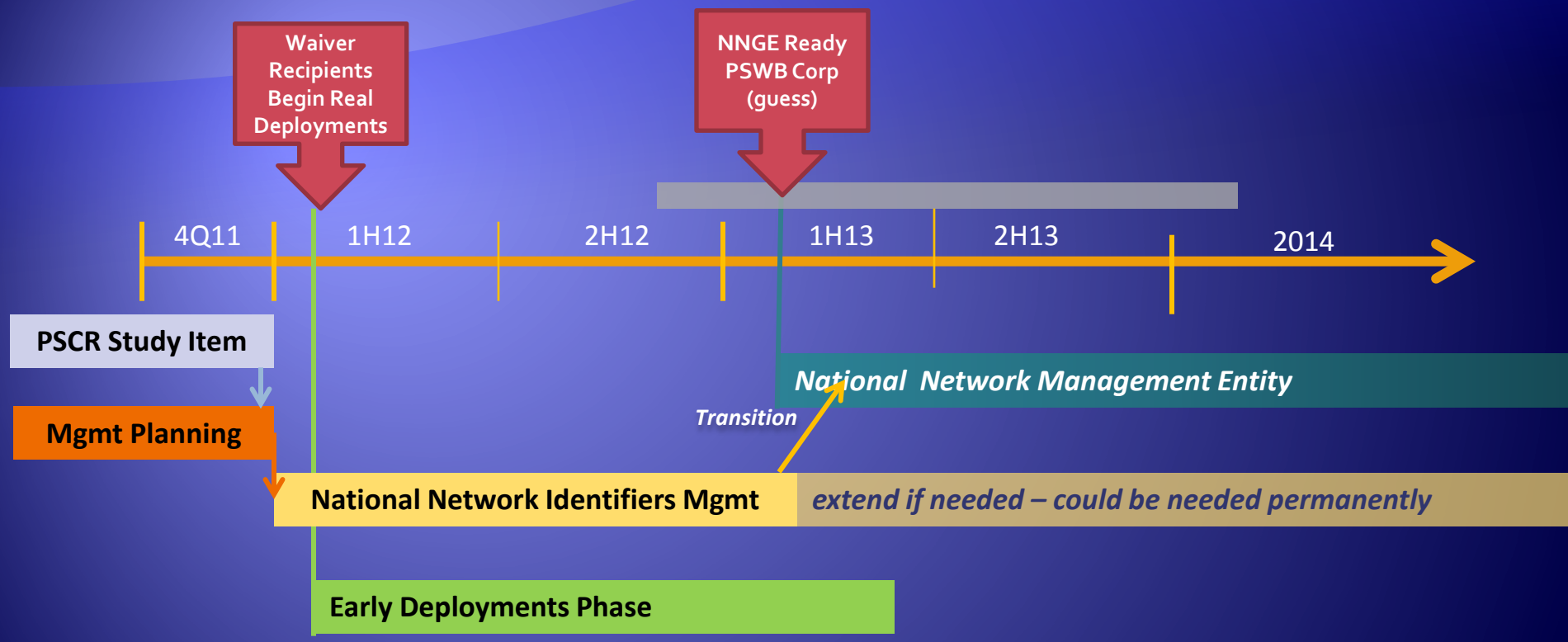
Topics

- Network Identifiers Introduction
- Timeline View
- PLMN ID Overview
- Identifiers One by One
- Dependency on PLMN ID
- Usage Traits Overview
- Management Models
  - Database architecture options
- Allocation Recommendations

Network Identifiers Introduction

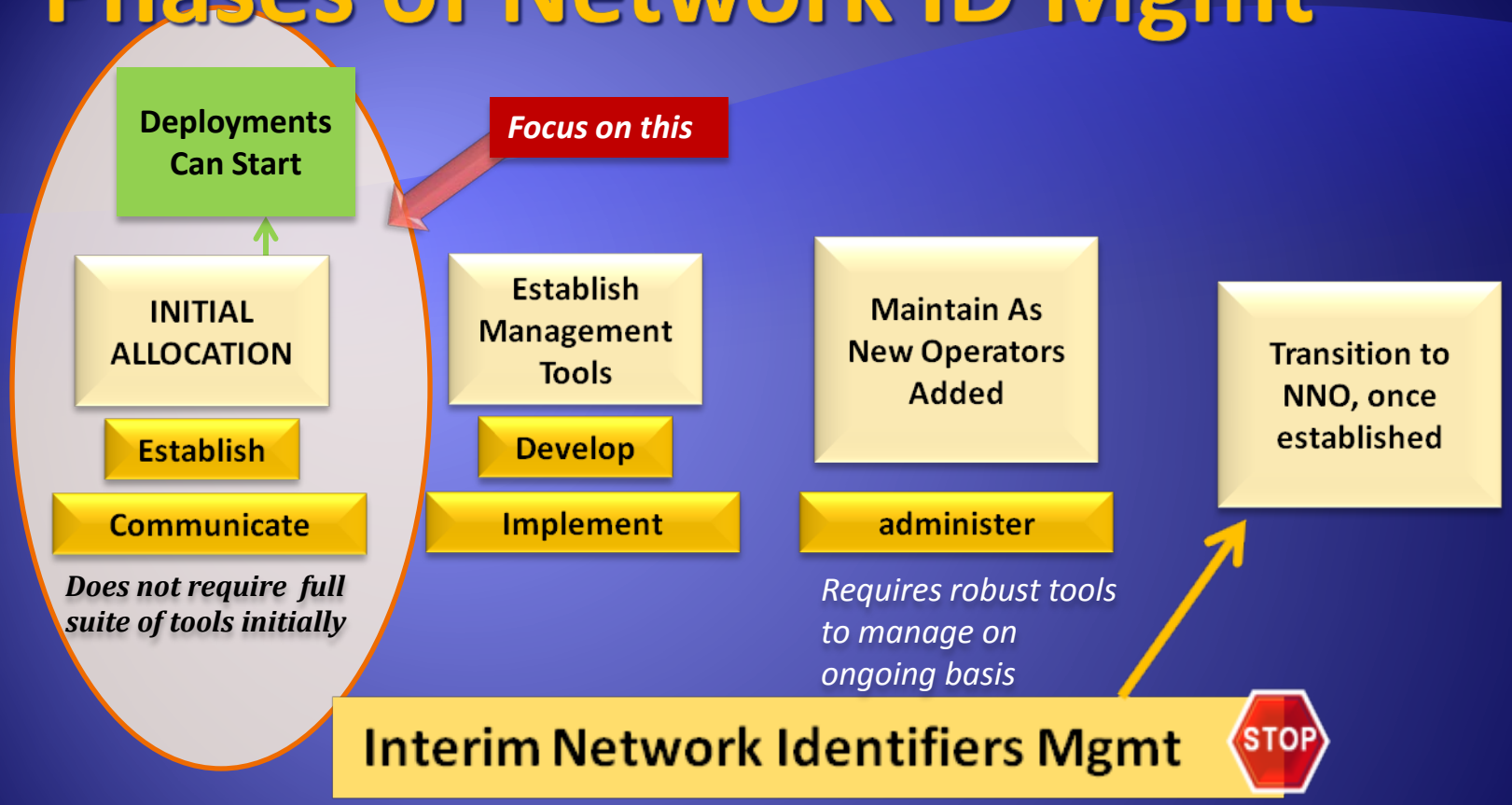
- The primary network identifier is the PLMN ID
  - Similar to WACN-System ID in P25
- LTE has multiple Network Identifiers which have to be coordinated in order for the network to operate.
- This material focuses on four of them which need to be managed for uniqueness by a network operator:
  - MSINs – Mobile Subscriber Identification Numbers
  - MMEGIs – MME Group Identifier
  - TACs– Tracking Area Codes
  - ECIs – E-UTRAN Cell Identifiers
  - APNs – Access Point Names
- *MANY* more identifiers need to be managed, and some details about these primary identifiers need to be resolved

Ntwk ID Mgmt: Timeline View



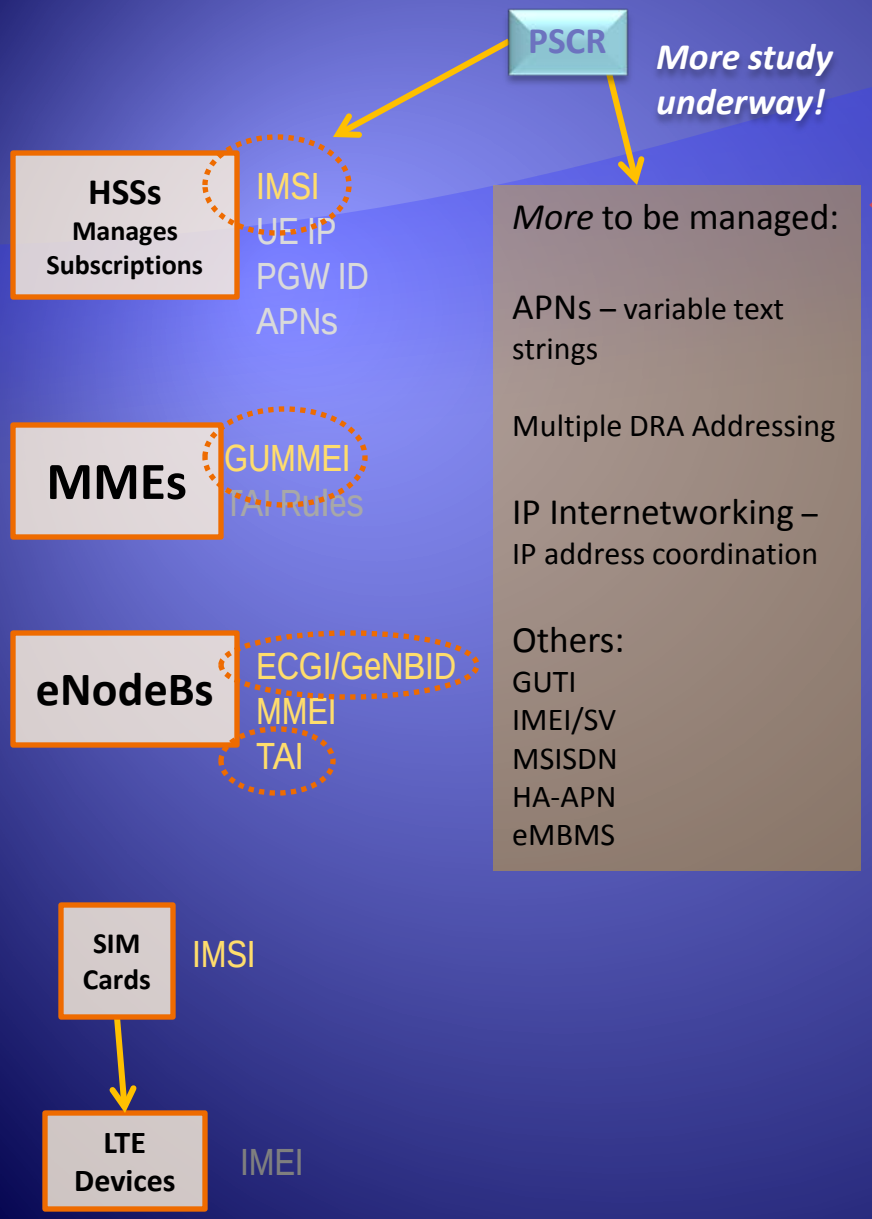
- Mgmt needed from 1st deployment until Corporation established
- If the interim period (in yellow) is relatively long (year or more?), then a fairly sophisticated DB approach will be needed
  - Still uncertainty around nw PSBB Corporation – requires passage of pending legislation and that funding becomes available

Phases of Network ID Mgmt



- Although initial allocation does not require that a DB system be implemented, this will be needed as timeframe goes on and other systems need to be administered and maintained.
  - The longer ad-hoc management is done the more risks and problems will need to be managed later

Scope of This Material



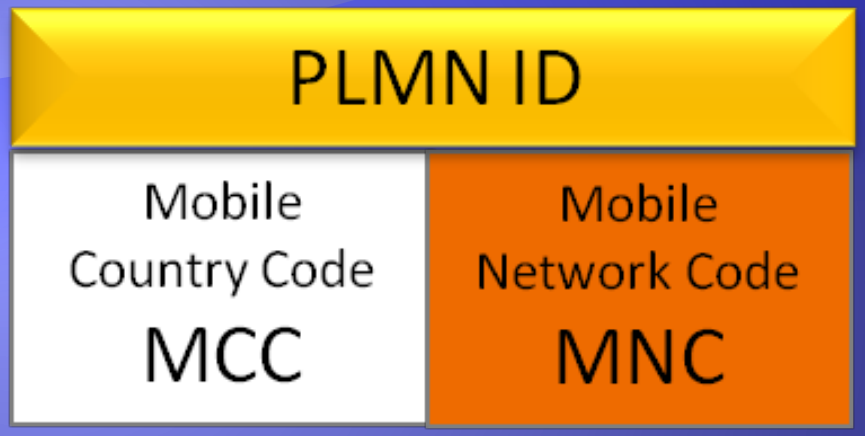
Being Discussed Here

- This analysis addresses just four of the numerical IDs which require national coordination
  - Many more identifiers exist
  - *We look forward to PSCR Network Id Study Group guidance!*

[8]

Public Land Mobile Network ID

The PLMN ID aka Home Network Identifier

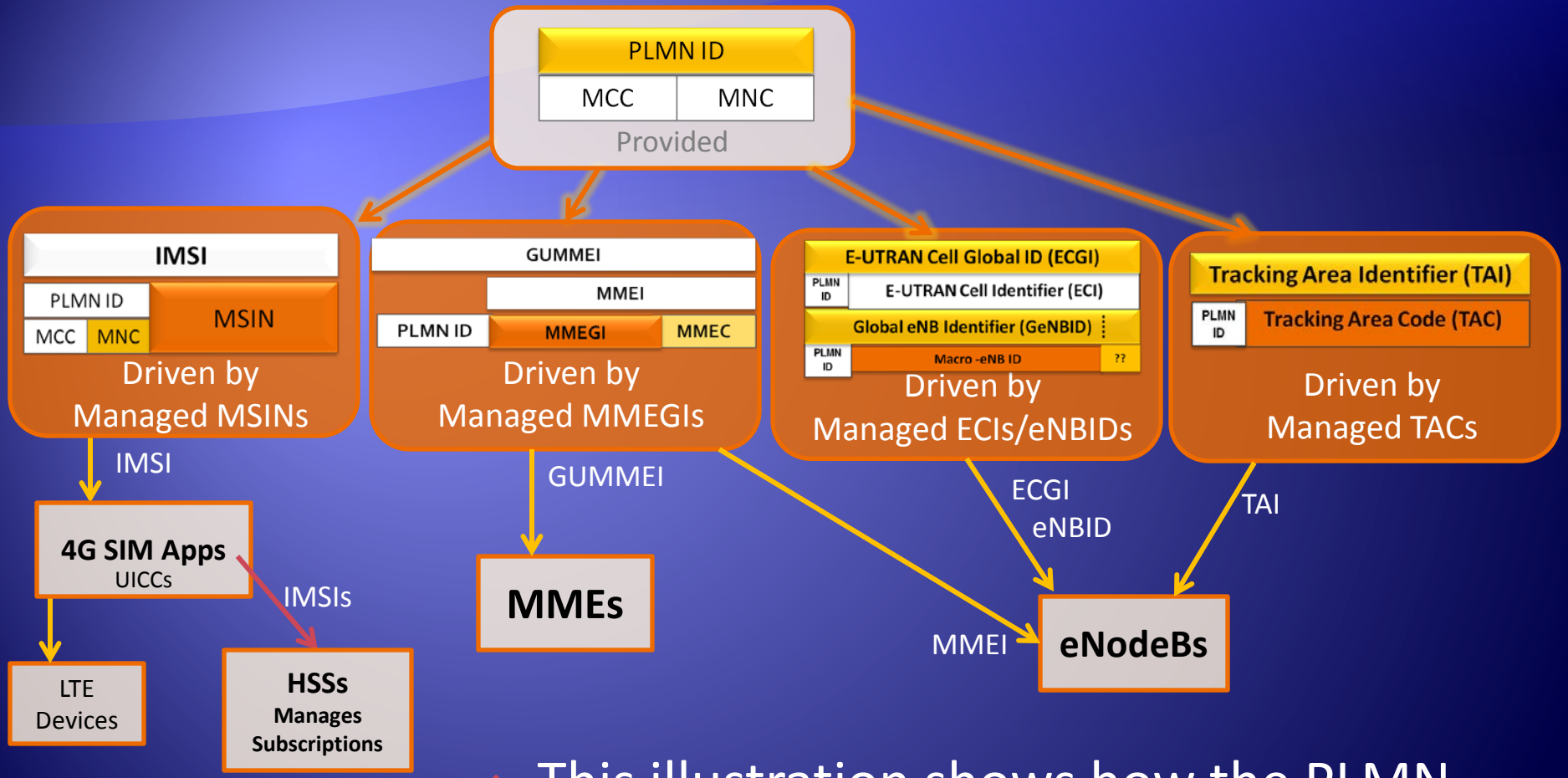


MNCs can be 2 or 3 digits

- 3 digit Mobile Country Code (MCC) – Identifies the home *country* of a mobile terminal.
- 3 digit Mobile Network Code (MNC) – Identifies the home *network* of a mobile terminal

[5] Page 3

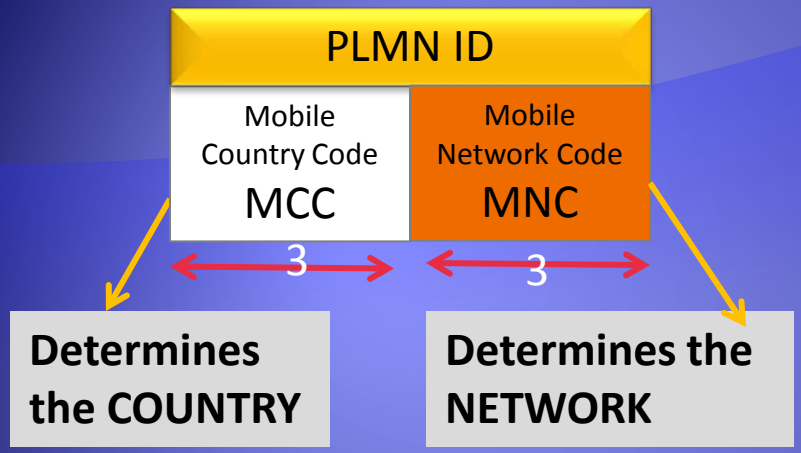
PLMN ID Dependencies



- This illustration shows how the PLMN ID proliferates throughout the network

The PLMN ID

TEST IDS
310-014
311-400



PLMN ID = MCC + MNC

EXAMPLE: 315-911

TERMS:
MCC – Mobile Country Code
MNC – Mobile Network Code
PLMN ID – Private Land Mobile Network Identifier

<u>ATTRIBUTES</u>

Size of US Space: ~7000

Available: ~6700

Number of digits: 3+3 alphanumeric

Allocated by ATIS IMSI Oversight Committee

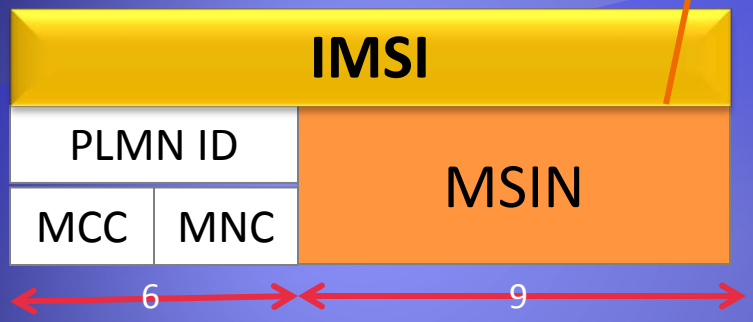
- PLMN IDs are a GLOBAL, FINITE resource
  - They are used in all 3GPP-based systems
- MCC drives global uniqueness
- MNC drives uniqueness within US MCCs
- Many network identifiers within a single PLMN ID must be <u>unique</u>

[all refs]

International Mobile Subscriber Identity

The IMSI (IM-zee)

Goes into the USIMs



PLMN ID = MCC || MNC
IMSI = PLMN ID || MSIN

TERMS:
IMSI - International Mobile Subscriber Identity
MSIN – Mobile Subscriber Identification Number
PLMN ID – Public Land Mobile Network Identifier
USIM – Universal Subscriber Identity Module

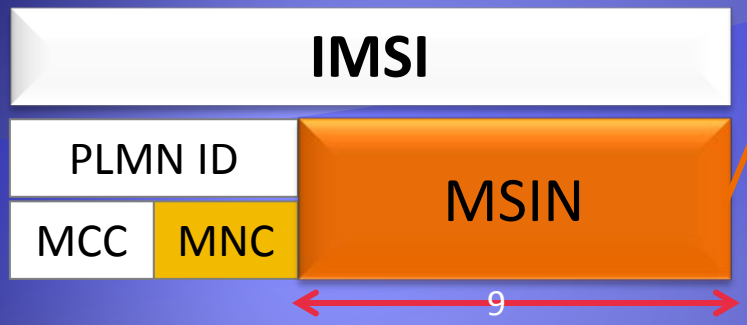
IMSI ATTRIBUTES
Size of Space: 10^{15}
Number of digits: 15 max

- IMSIs must be globally unique
- IMSIs identify the subscription on the network
  - SIMS (USIMs) can be used in multiple terminals
- Networks use IMSIs determine the terminal's home network
- Allow charging and billing
- Entered upon activation into the HSS
- Relies upon unique and coordinated MSINs
- Used to identify all USIM cards used on a network.
- Examples
  - 315-911 123456789
  - 315-911 100750001

[2],[6], [4], [5]

Mobile Subscriber Identification Number

The MSIN (EM sin)



PLMN ID = MCC + MNC
IMSI = PLMN ID + MSIN

EXAMPLE: "100750001"

TERMS:
IMSI - International Mobile Subscriber Identity
MSIN – Mobile Subscriber Identification Number

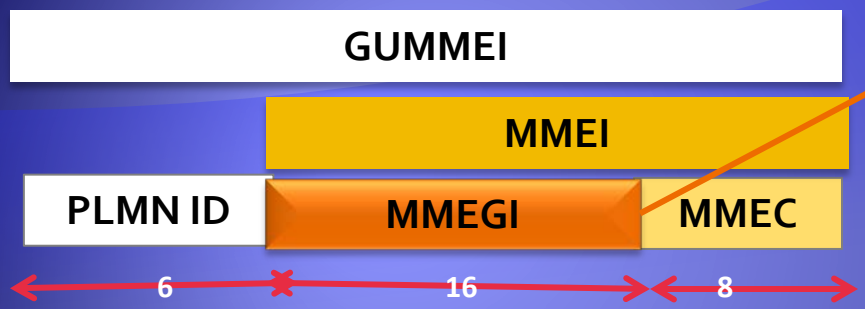
ATTRIBUTES
Size of Space: 1,000,000,000
Number of digits: 9 alphanumeric
Contiguous allocations more efficient for network to handle

NNO managed uniqueness

- MSINs create the uniqueness of the IMSI
- Per ITU the Network Operator is responsible for coordinating MSIN allocations
- Used to identify all SIM cards used on a network.
- Examples:
  - 123456789
  - 100750001

MME Group Id & MMEI

The MMEGI (em em EE jee), MMEI (em em ee EYE)



GUMMEI = MMEI + PLMN ID
MMEI = MMEGI + MMEC

MMEGI Example: "2203"
MMEC Example: "04"

TERMS:
GUMMEI – Globally Unique MME Identifier
MMEI – MME Identifier
MMEGI – MME Group ID
MMEC – MME Code

ATTRIBUTES
Size of Space: 65,533
Number of digits: 16 (2 HEX octets)
No need to be contiguous
Regions typically need 1-10

NNO managed uniqueness

- MMEI identifies an MME and must be unique within PLMN ID
- MMEGI identifies a group of MMEs and must be unique within PLMN ID
- Shared MMEGIs would allow MME pooling

Example MMEGI = 2203, MMEC= 04: FQDN: mmegi2203.mme.epc.mnc001.mcc315.3gppnetwork.org

Tracking Area Code

The TAC (TAK)

NNO managed uniqueness

Tracking Area Identity (TAI)

PLMN ID	Tracking Area Code (TAC)

16

Hex Range: "0001" to "FFFD"

TAI = PLMN ID + TAC

TAC Example: "19CD"

TERMS:
TAI – Tracking Area Identity
TAC – Tracking Area Code
PLMN ID – Public Land Mobile Network Identifier

<u>TAC ATTRIBUTES</u>
Size of Space: 65,533
Managed in Hexadecimal
Number of digits: 16 (2 Octets)
Does not need to be contiguous
Most regions will need 10s to 100s

- Identifies a *<u>group</u>* of eNodeBs
- Must be globally unique
- Uniqueness driven by TAC
  - TAC used for tracking UE location and load distribution
- Example:

	high byte (hb)	low byte (lb)
Example:	19	CD
	NNO	**RNO**
	National	*Reg/SubNatl*

[2] – 23.003 19.4.2.3

eNodeB & Cell Identifiers

The ENBID (EN bid) & ECI

NNO managed uniqueness

E-UTRAN Cell Global ID (ECGI)

PLMN ID	E-UTRAN Cell Identifier (ECI)

28

Hex Range: 00001 to FFFFFF

Global eNB Identifier (GeNBID)

PLMN ID	eNBID

20

TERMS:
GENBID – Global eNodeB Identifier
eNBID – eNodeB Identifier
ECGI – E-UTRAN Cell Global Identifier
ECI – E-UTRAN Cell Identifier

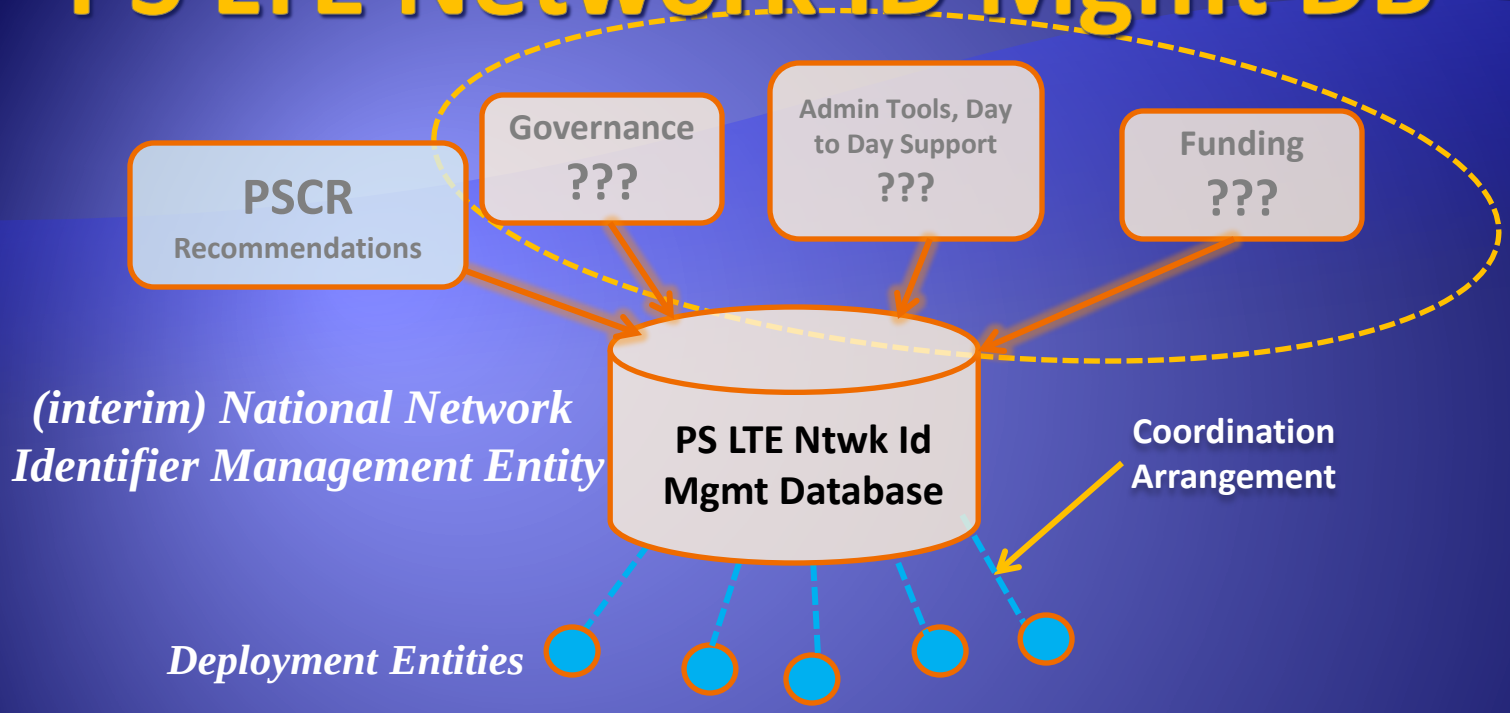
ATTRIBUTES

Size of ECI Space: 16.7M
Number of digits: 28
Size of eNBID Space: 1,048,575
Do not need to be contiguous
Most regions will need 100s-1000s

- Drives global uniqueness of eNodeB and Cells within eNodeBs
- 20 Leftmost bits of ECI correspond to eNodeB ID
- Last octet identifies cell or sector
- Examples:
  - "00600 0C" = eNB: 1536, cell 12
  - "FE100 03" = eNB: 1040640, cell 3

Example eNodeB ID = 00600, FE100 FQDN:
enb600.enb.epc.mnc001.mcc315.3gppnetwork.org
enbFE100.enb.epc.mnc001.mcc315.3ppnetwork.org

PS LTE Network ID Mgmt DB



- The "Public Safety LTE Network Identifier Management Database" is the set of tools that will be needed to manage and track Network Identifier Allocations
- Managed through agreements with deployment entities
- This database is used as the basis for initially configuring the PS LTE Network and subscribers but is NOT CONNECTED TO OPERATIONAL SYSTEMS

PLEASE NOTE: The following content is for discussion, NOT FINAL, preliminary and subject to change.

Allocation Examples

DRAFT FOR DISCUSSION

v4

Prepared by:
Cynthia Wenzel Cole

November 2, 2011

V14.4

This materials is presented as a draft based on current understanding to stimulate discussion and provoke meaningful discussion.

Note to Reviewers

- This document discusses the methodologies the State of Texas is suggesting be considered for managing Nationwide PS LTE Network Identifiers in response to the 10/12/11 FCC letter.
  - If this information or assertions are deemed prematurely specific for the FCC submission, then we will simply withhold those proposals or specifics.
- This is a great opportunity to make some progress on addressing this show stopper issue
- As emphasized throughout the material, the numerical values and specifics provided in the following allocation illustrations are for discussion and EXAMPLE only.
- Any material which is deemed to be of any operational value and therefore sensitive, will be maintained as confidential and not released publicly.

THIS IS A DRAFT DOCUMENT. WHAT WE SUBMIT WILL BE VERY DIFFERENT. OUR SUBMISSION AND WILL DEPEND UPON YOUR RESPONSE TO THIS MATERIAL.

We greatly appreciate your feedback!

v2

Next Steps

done
Next Step

- Review and comment on answers to PLMN ID questions
  - Review next week in similar webinar
- Need to synch up allocation ideas with PSCR

- KEY DATES for managing the response:
  - Review Thursday, October 20
  - Draft out Friday, October 21
  - Comments due COB Tuesday, October 25
  - Discuss, provide update Thursday October 27
    - Send final for desktop review week of Oct 31
  - Complete, edit, review, file with FCC by November 7

UPDATED

Allocation Objectives

- It should be based upon a numerical methodology which is neutral, logical and fair
- Keep large reserves and “buffer zones” available to allow for growth and change
- Lay out state by state allocations in a manner which is logical and advantageous managing network identifiers
- Need for contiguous allocations calls for a lay out by geography
- This proposal uses Federal regions 1-10
- The plan should create a framework which is stable and effective 10-20 years

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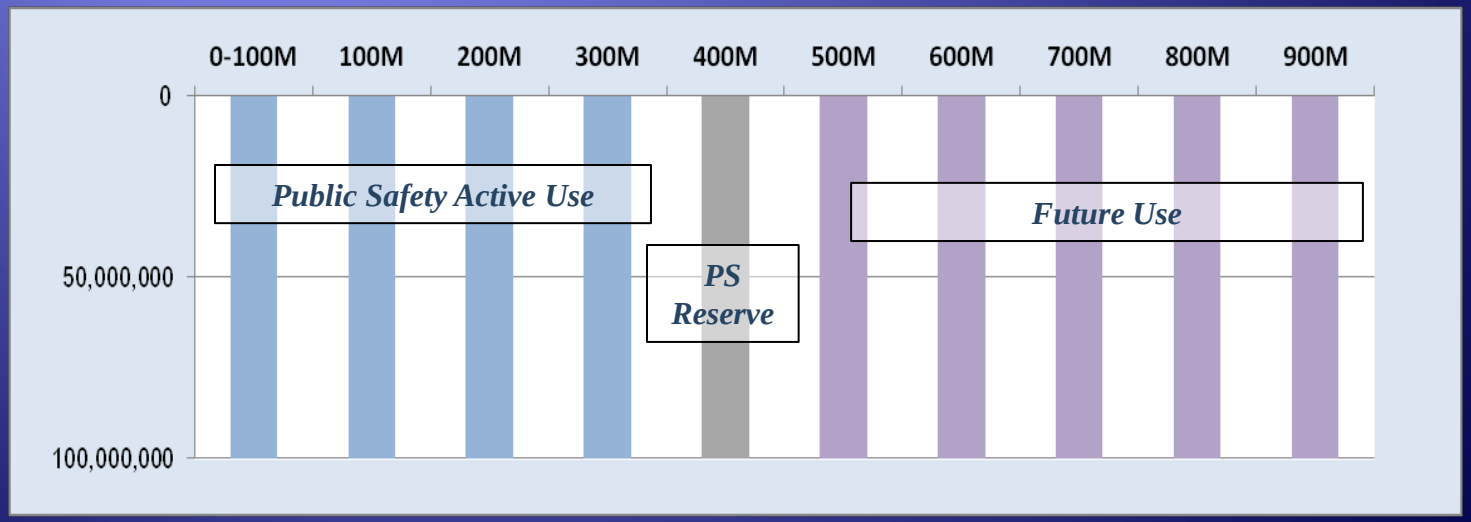
Techniques for Flexibility

- Create Buffer Zones
- Establish "Other" category for each
  - Per DHS-OEC
- Establish "Public Safety Reserve"
- Reuse allocation techniques where possible
- Simplify where possible

1B Allocation EXAMPLE, v1

- MSIN Allocations shown derived from numerical analysis
- Use only lower half of MSIN space
  - Leaving upper half for future use



v2

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Tweak Weightings (v2.1 output)

- Simplified
  - Kill "Disasters/Yr"
- Increase Pop
- Increase UASIs

Weighting	55%	25%	10%	10%	X FACTOR	
STATE	Pop	Geography	Crime Rate	UASIs		REGIO
Connecticut	1.145997699	0.155423761	1.500517126	2.8	**1.096984165**	1
Maine	0.429404845	1.028541422	1.431737046	0.0	**0.636481725**	1
Maryland	1.856467883	0.324601563	2.148115891	1.4	**1.455908204**	1
Massachusetts	2.147702386	0.256514406	1.584720275	4.2	**1.820503608**	1
New Hampshire	0.43144845	0.288213898	1.390854574	0.0	**0.448435579**	1
Rhode Island	0.343057502	0.037660612	1.627870845	0.0	**0.360883863**	1
Vermont	0.202523366	0.298521667	1.461335728	1.4	**0.47104073**	1
New Jersey	2.836336554	0.241859988	1.353204142	4.2	**2.172437182**	2
New York	6.365158333	1.524804586	1.311527836	4.2	**4.42985768**	2
Delaware	0.288307204	0.062902225	2.266283812	0.0	**0.4009229**	3
District of Colum	0.195323846	0.00211123	3.459303512	4.2	**0.87055294**	3
North Carolina	3.055597348	1.635333669	2.349579721	1.4	**2.46325882**	3
Pennsylvania	4.105699699	1.406762009	1.478856788	0.0	**2.757711016**	3
Virginia	2.567564112	1.260466212	1.523084704	2.8	**2.157363063**	3
West Virginia	0.592748591	0.752311857	1.722280437	0.0	**0.686317733**	3
Alabama	1.533748384	1.605714359	2.459469084	0.0	**1.490937109**	4
Florida	6.038297554	1.821898068	2.525357339	5.6	**4.584629461**	4
Georgia	3.201629086	1.812863247	2.370502928	1.4	**2.590050991**	4
Kentucky	1.405218553	1.25466033	1.601277393	1.4	**1.385551915**	4
Mississippi	0.9615417	1.480810285	2.065443708	0.0	**1.105594877**	4
South Carolina	1.485714881	0.966104909	2.586879505	0.0	**1.317357363**	4
Tennessee	2.050853312	1.308527734	2.51339312	2.8	**1.984218345**	4

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UPDATED

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Regional Block Size Calculation

v2.1

No States PerRegion	FEMA	LIVE LINKS	2,000,000	1000000	MSINS Per Region (M)	MSINS Per Region (M)
7	**1**	6.290237875	7	7	21,000,000	**22**
2	**2**	6.602294862	8	2	18,000,000	**20**
6	**3**	9.336126471	10	6	26,000,000	**28**
7	**4**	14.45834006	15	7	37,000,000	**38**
6	**5**	14.58788795	15	6	36,000,000	**38**
5	**6**	13.62347632	14	5	33,000,000	**35**
4	**7**	5.837457049	7	4	18,000,000	**20**
6	**8**	7.937066865	8	6	22,000,000	**24**
4	**9**	14.58551574	15	4	34,000,000	**35**
4	**10**	6.741596813	7	4	18,000,000	**20**
		100	**106**	**51**	**263,000,000**	**280**

v2

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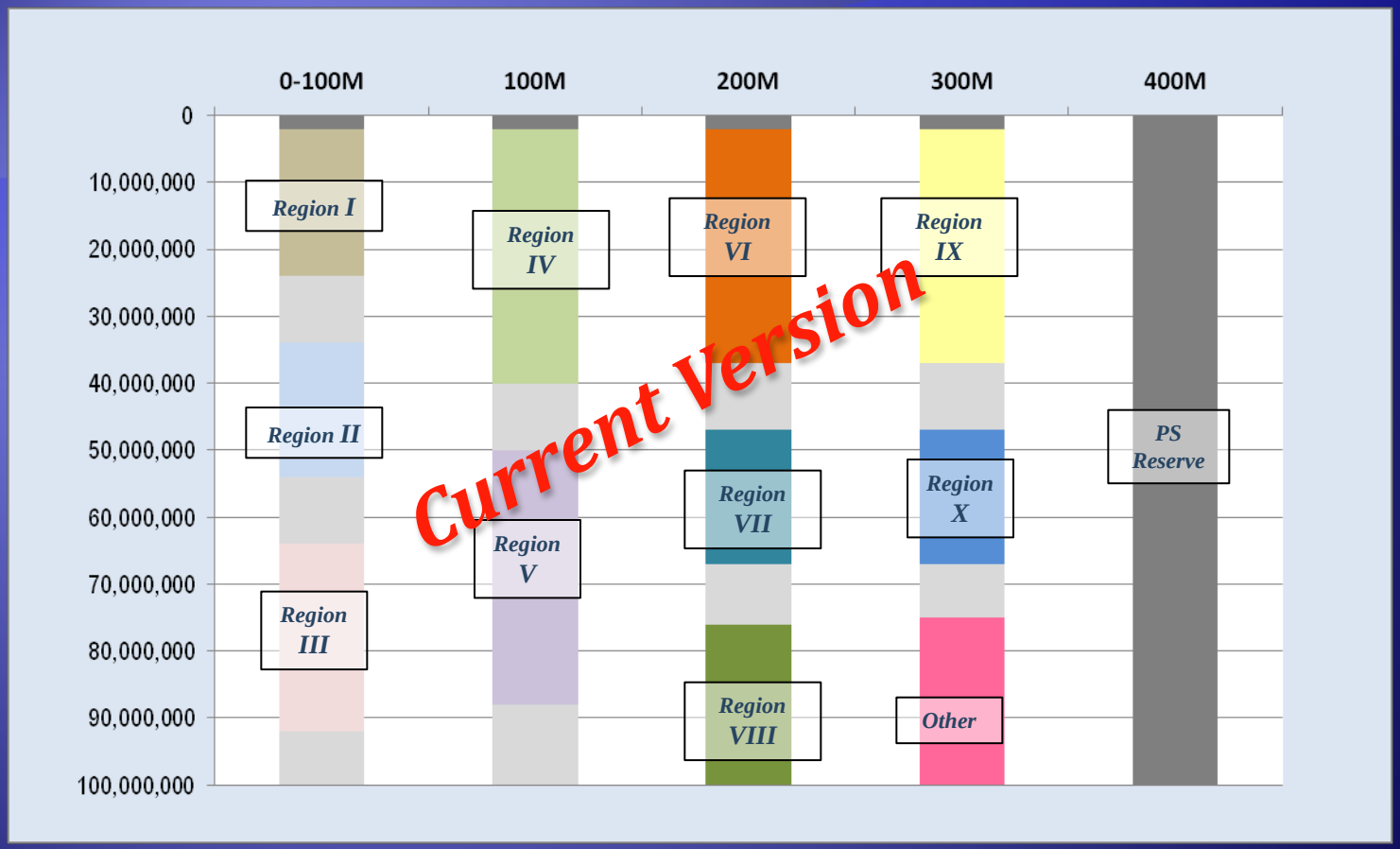
EXAMPLE MSIN Allocation, v2.1



- This picture is example of what national allocation body will need to produce and maintain.
- Initial modeling done at Federal Region Level (I – X)
  - We'll recommend reservations be managed between national entity and States

v3

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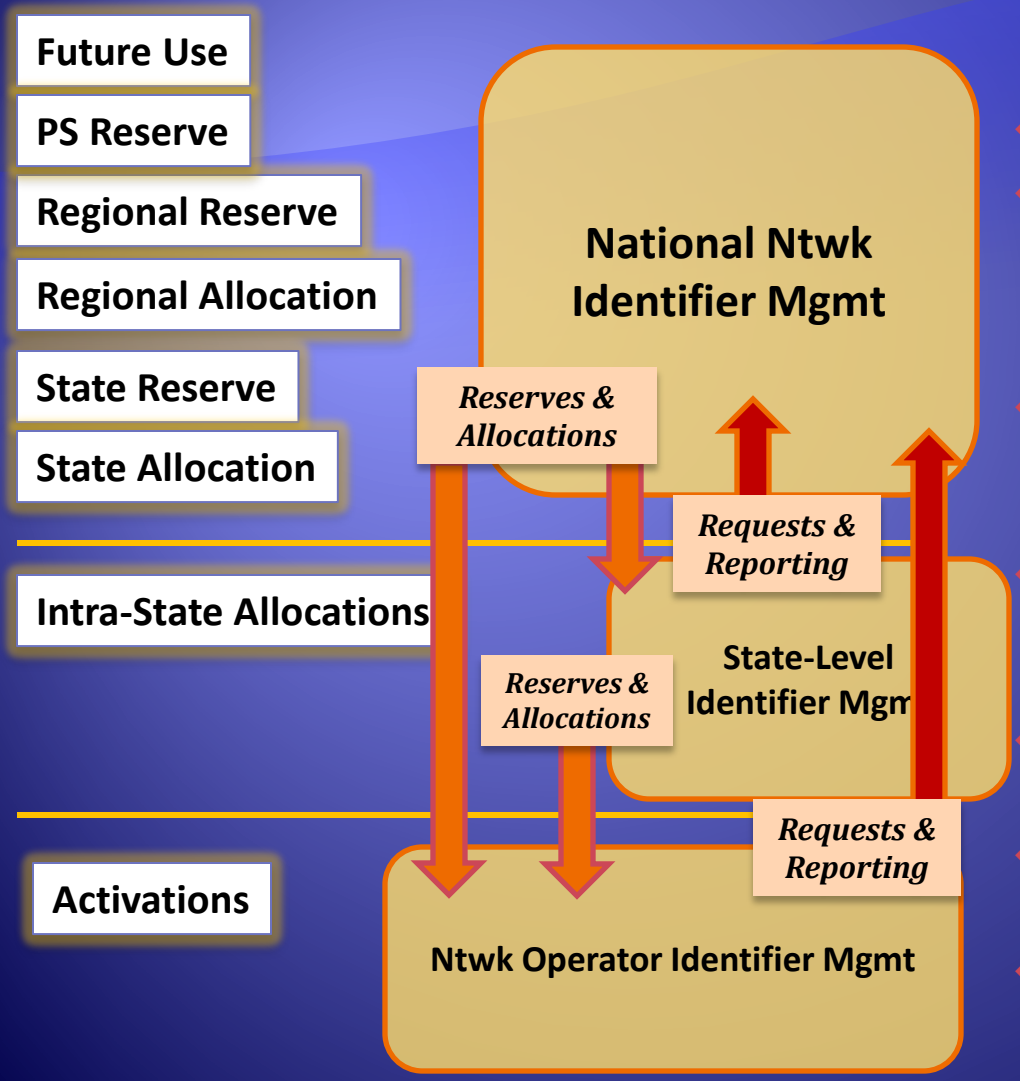
Responsibilities by Layer



- Focus on state level planning
- National entity has majority of responsibility for national identifiers
  - By definition
- Plan must demonstrate coordination with State entity per May 2010 R&O
- Identifier reserves & allocations flow down from national, to state to operator
- Requests for identifiers flow up from operators
- This raises many important questions
- *JUST IDEAS FOR NOW!*

v4

NOT UPDATED

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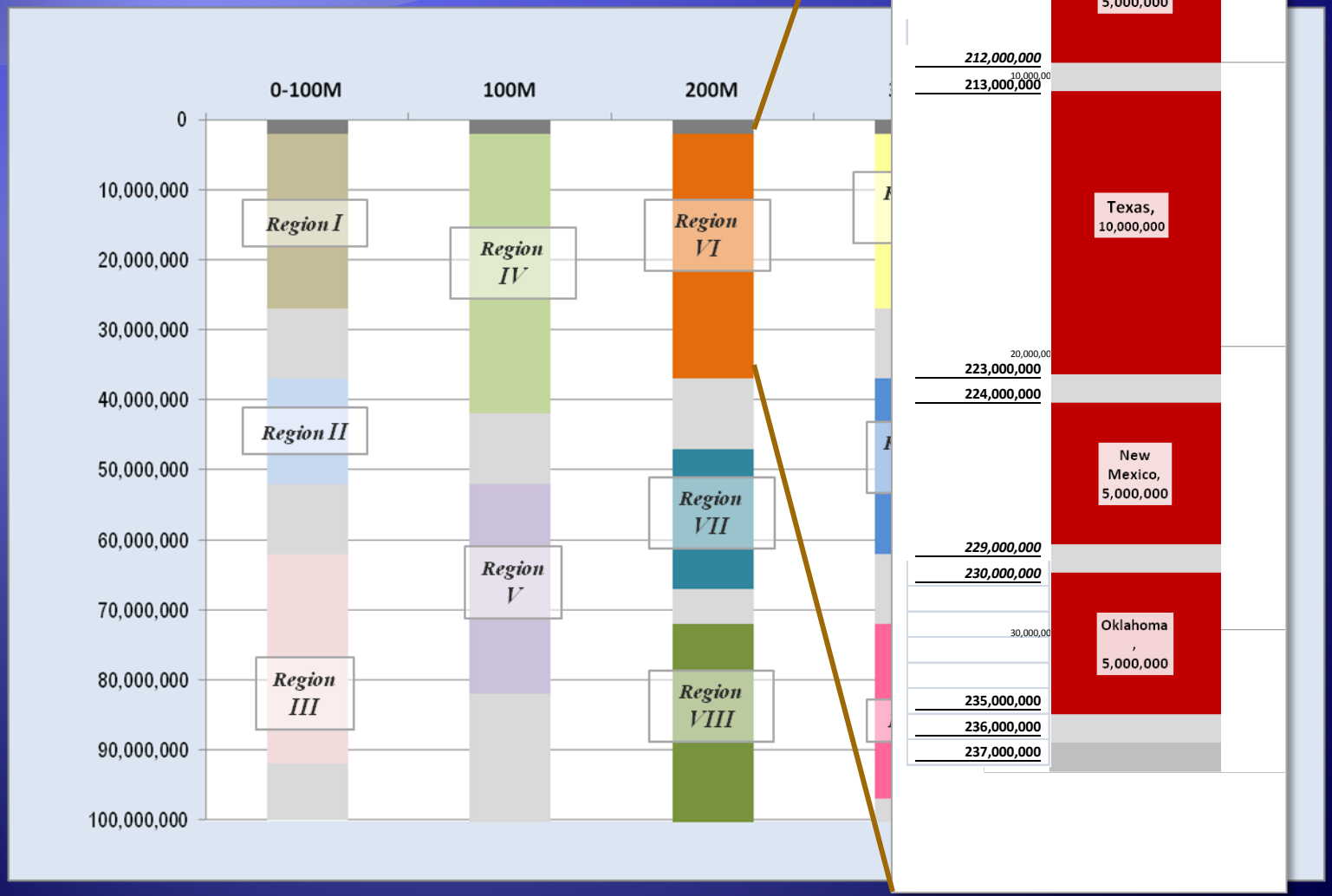
Region VI Example



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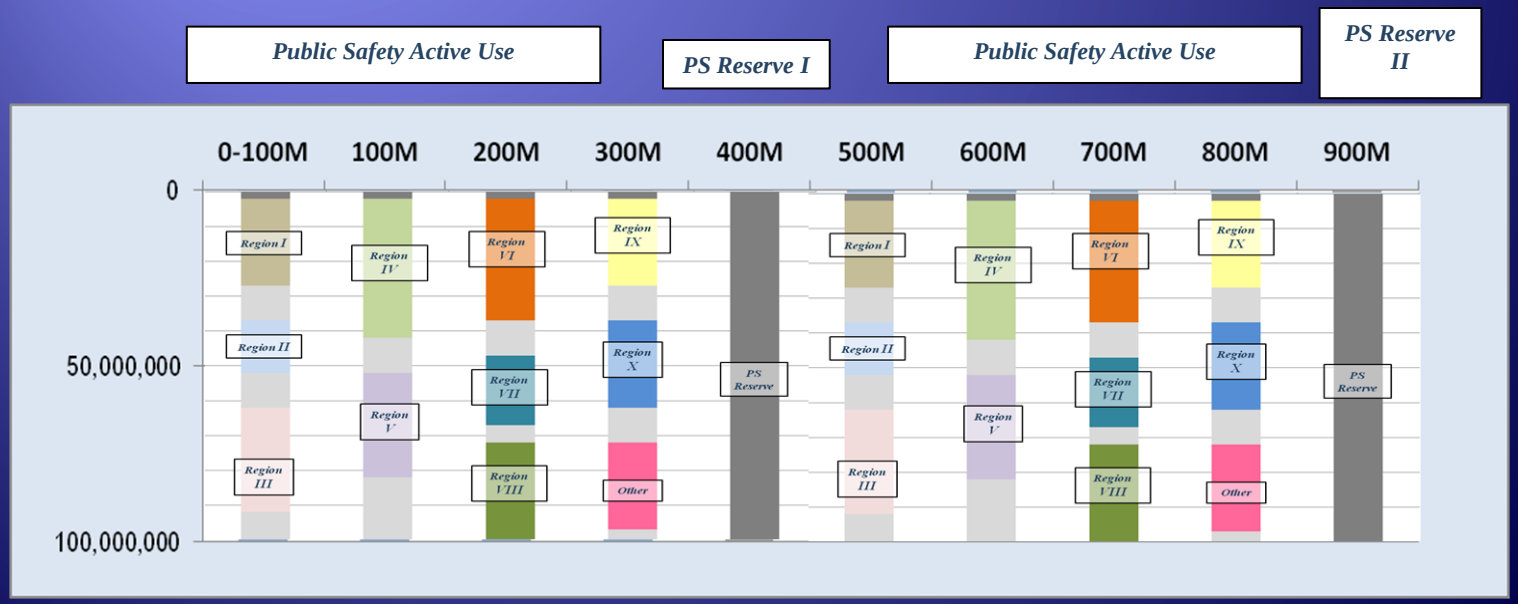
Expansion View

- Once lower range began getting occupied, OR
- If large numbers of non-PS users are added
- Simply replicate allocation in upper range



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Access Point Names (APNs)

APN

63 Octets

37 Octets

APN NI

APN OI

Driven by PLMN ID

55 CHAR

8 CHAR

<label1> . <label 2> . <label 3> … <labelN> .apn.epc.mnc911.mcc315.3gppnetwork.org

Regional Entities | **NATL** | **Driven by PLMN ID**

- APNs identify packed data networks to UEs
- Use 8 char to left of apn for national uniqueness
- BBNO would manage remaining labels to left.
- Leftmost label reserved for use by interoperable services shared nationwide
- A consistent naming convention will be needed

EXAMPLES

ims.national.apn.epc.mnc911.mcc315
Securityalerts.dhs.apn.epc.mnc911.mcc315
Internet.BIGNET.apn.epc.mnc911.mcc315
Police.dfw.CONNCT.apn.epc.mnc911.mcc315
Homepage.bignet.apn.epc.mnc911.mcc315

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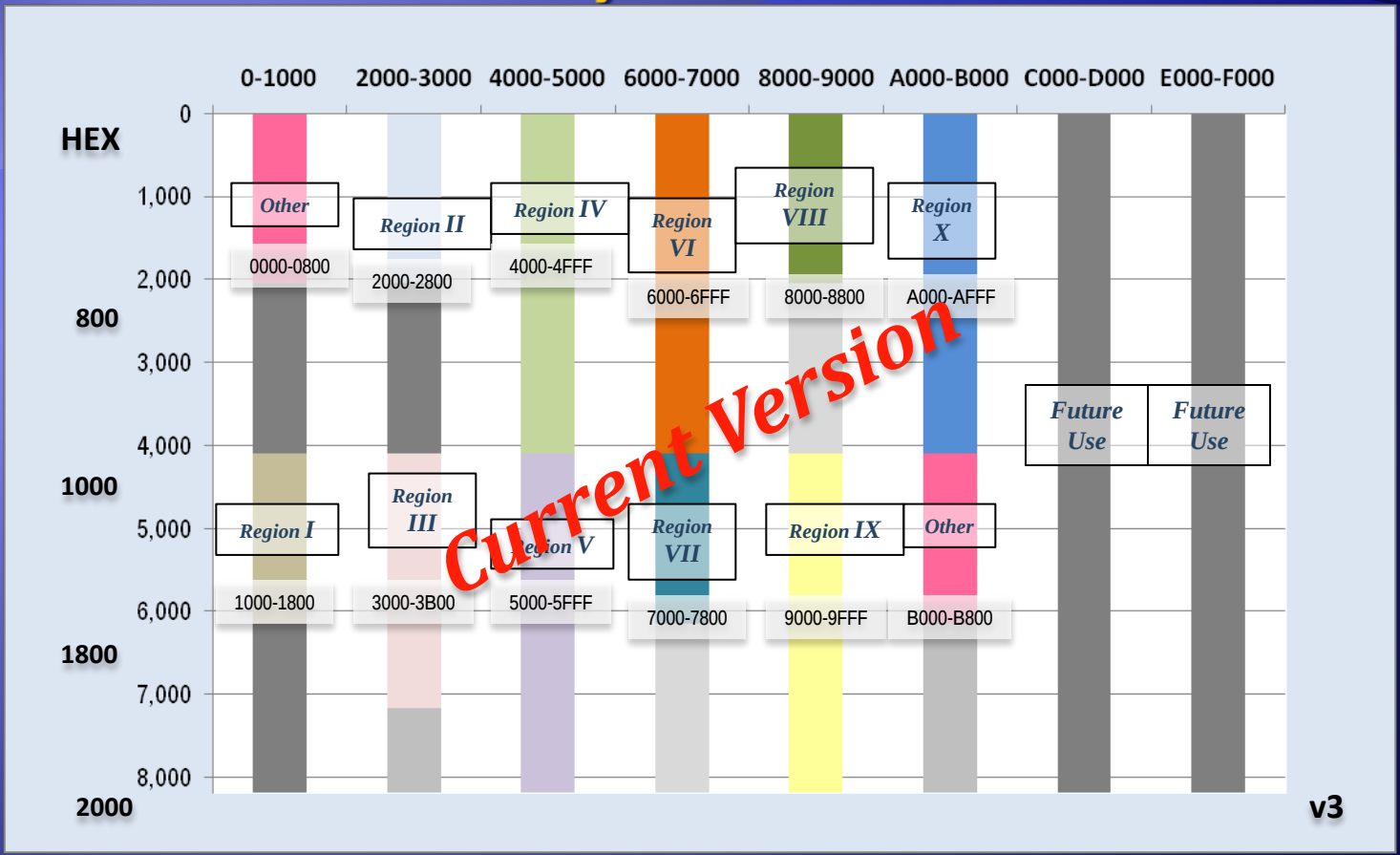
Harmonized TACs, v1



- Align Fed Region number with 4th HEX digit
- Reserve in small (2048), med (3082) & large (4096) "buckets"
- Generate reserves by state
- Operators would need to make a request for activation

v2

MMEGIs, v3 (Harmonized)

STATE	index	Low HEX	Low Dec	HIGH HEX	HIGH Dec	CNT
Connecticut	1.1	110	272	11F	287	16
Maine	1.2	120	288	12F	303	16
Maryland	1.3	130	304	13F	319	16
Massachusetts	1.4	140	320	14F	335	16
New Hampshire	1.5	150	336	15F	351	16
Rhode Island	1.6	160	352	16F	367	16
Vermont	1.7	170	368	17F	383	16
New Jersey	2.1	210	528	21F	543	16
New York	2.2	220	544	23F	575	32
Delaware	3.1	310	784	31F	799	16
District of Columbia	3.2	320	800	32F	815	16
North Carolina	3.3	330	816	33F	831	16
Pennsylvania	3.4	340	832	34F	847	16
Virginia	3.5	350	848	35F	863	16
West Virginia	3.6	360	864	36F	879	16
Alabama	4.1	410	1040	41F	1055	16
Florida	4.2	420	1056	43F	1087	32
Georgia	4.3	440	1088	44F	1103	16
Kentucky	4.4	450	1104	45F	1119	16
Mississippi	4.5	460	1120	46F	1135	16
South Carolina	4.6	470	1136	47F	1151	16
Tennessee	4.7	480	1152	48F	1167	16

Current Version

- Excerpt from example of state by state allocation
- Operate in small allocation in 0000 – 0FFF range

v4

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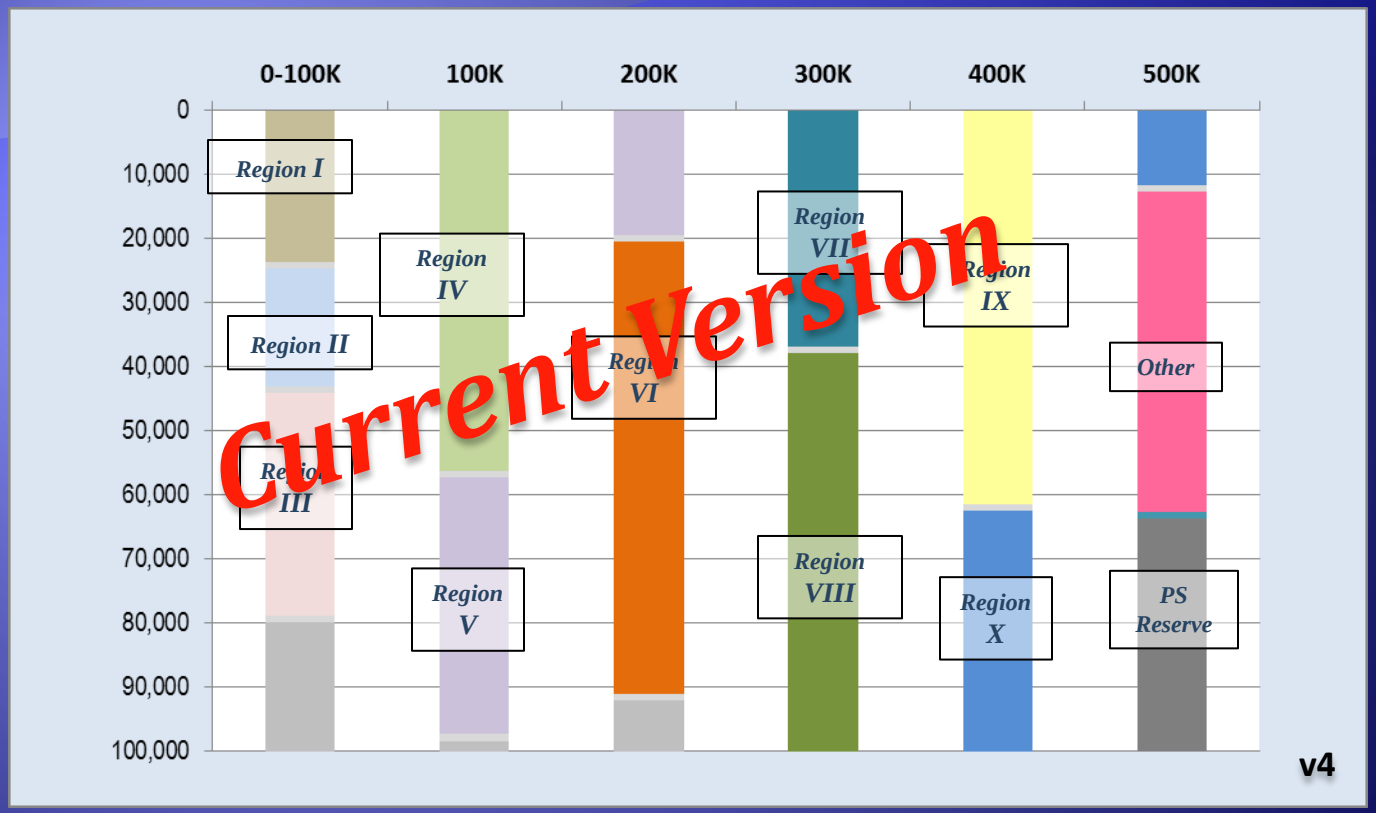
eNBIDs, v4 (NEW)



- After feedback: 70% geo, 20% Pop, 10% UASI
  - Technologist feedback has been this identifier needs to be driven more from geography, some contributions from population and UASIs

Thank You!