R3-082216

Stage 2 Principles for HNB Bootstrapping, Provisioning, and Operation

RAN3#61

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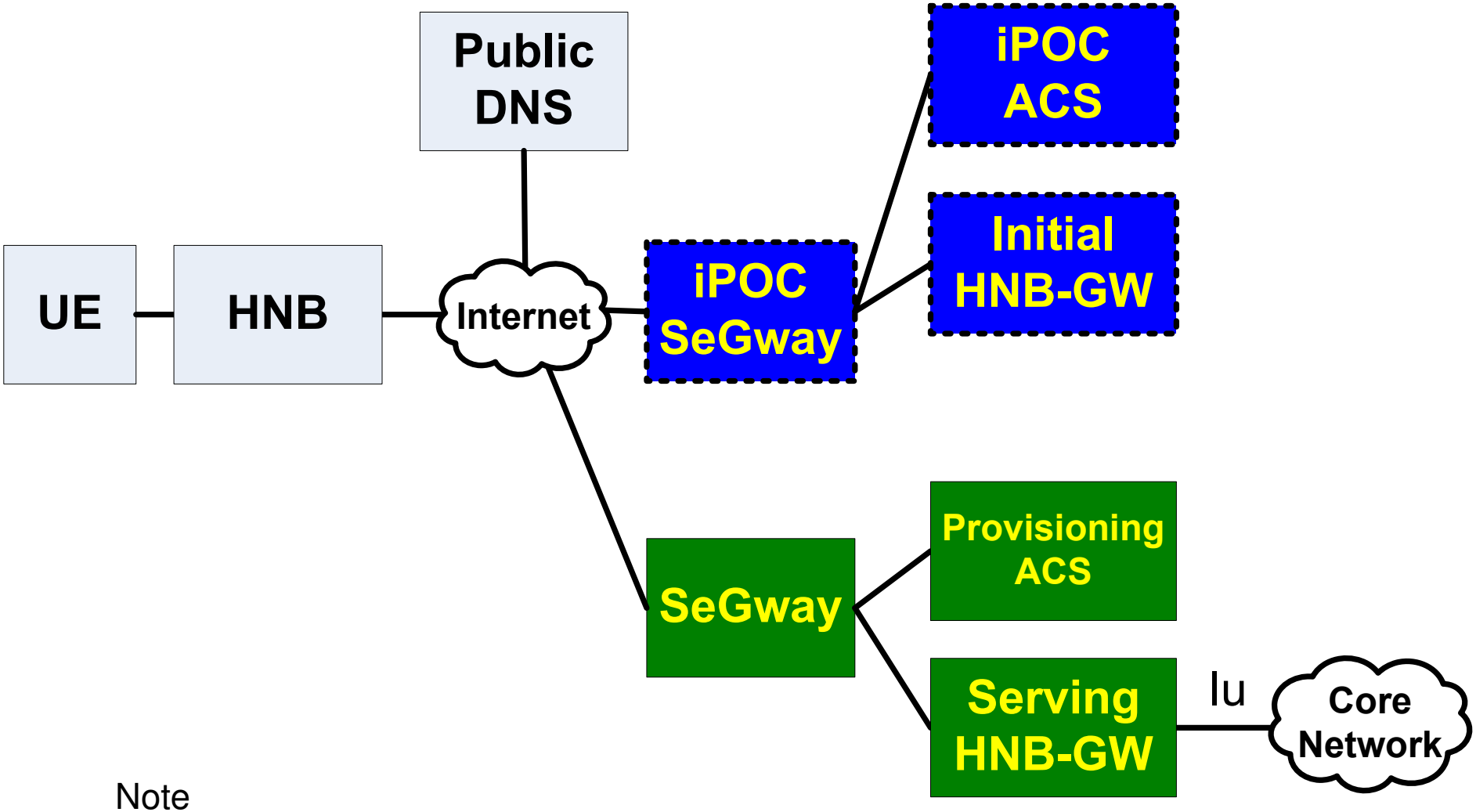
Overview

- Basic concepts
- Architecture reference model and entities
- Key functional requirements
- HNB-GW flexible architecture features
- Stage 2 call flows
- Radio Environment Measurements
- Data elements provisioned by the ACS

Basic Concepts

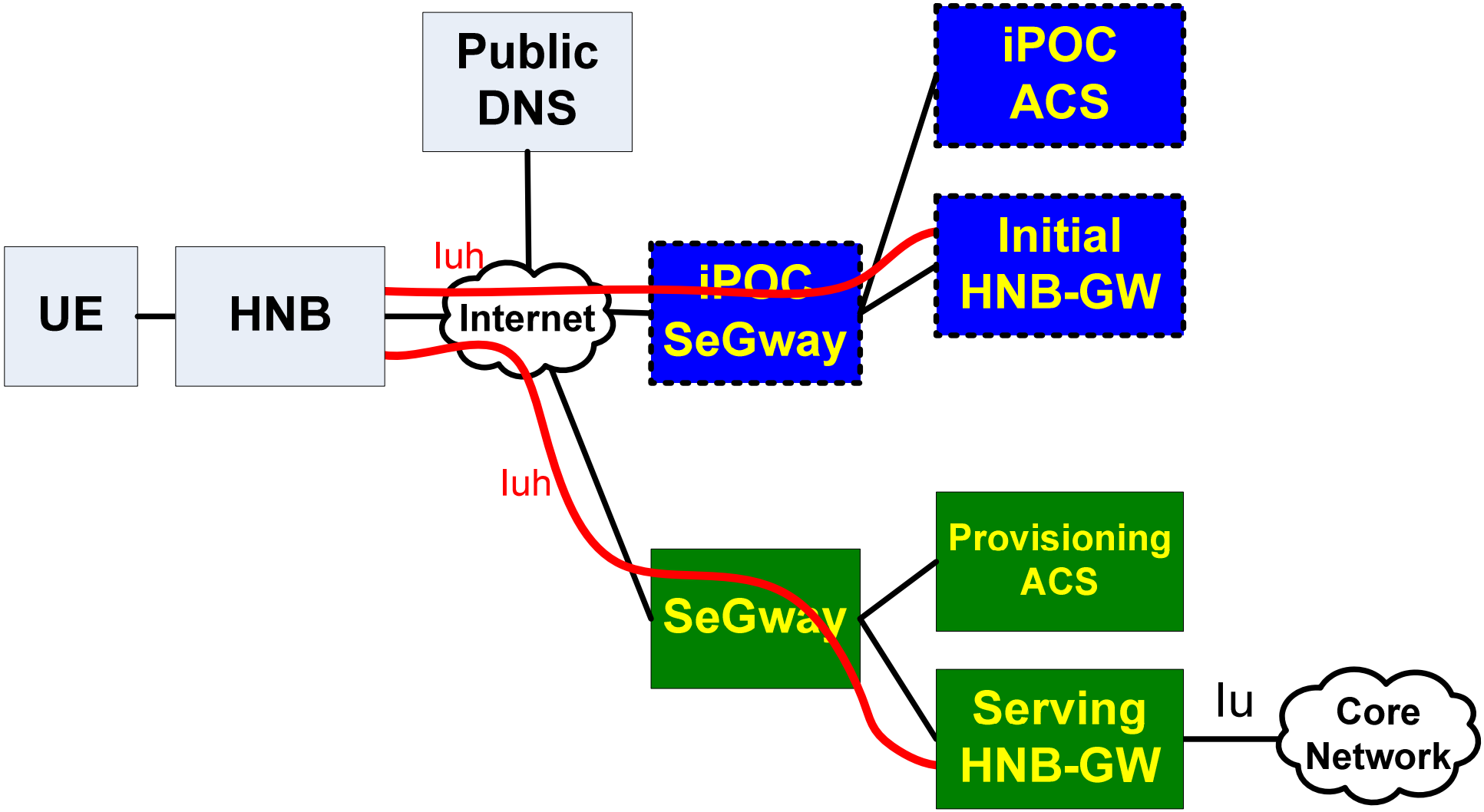
- Distinguish role of the provisioning/management system from the HNB-GW
  - Overall architecture specified by 3GPP
  - Provisioning/management is provided by TR-069 family of standards (Broadband Forum)
  - Iuh and interface to core network specified by 3GPP RAN3
- Support for HNB integral with RGW (e.g., incorporated into DSL Modem), as well as standalone (e.g., separate “box” connected to user’s home network router)
- Support a highly flexible and scalable architecture for both the provisioning/management system and the HNB-GW(s)
- Simplify HNBAP and RUA
  - Reduce number of messages where possible
  - Consideration of SAP requirements to RANAP on top and SCTP on bottom
  - No change to RANAP
  - Treat RANAP as transparent communication between HNB and CN as much as possible
- Optimize Iuh to reduce complexity of HNB and HNB-GW
  - TLV representation for easier parsing and extensibility
  - Single protocol

Architecture Reference Model

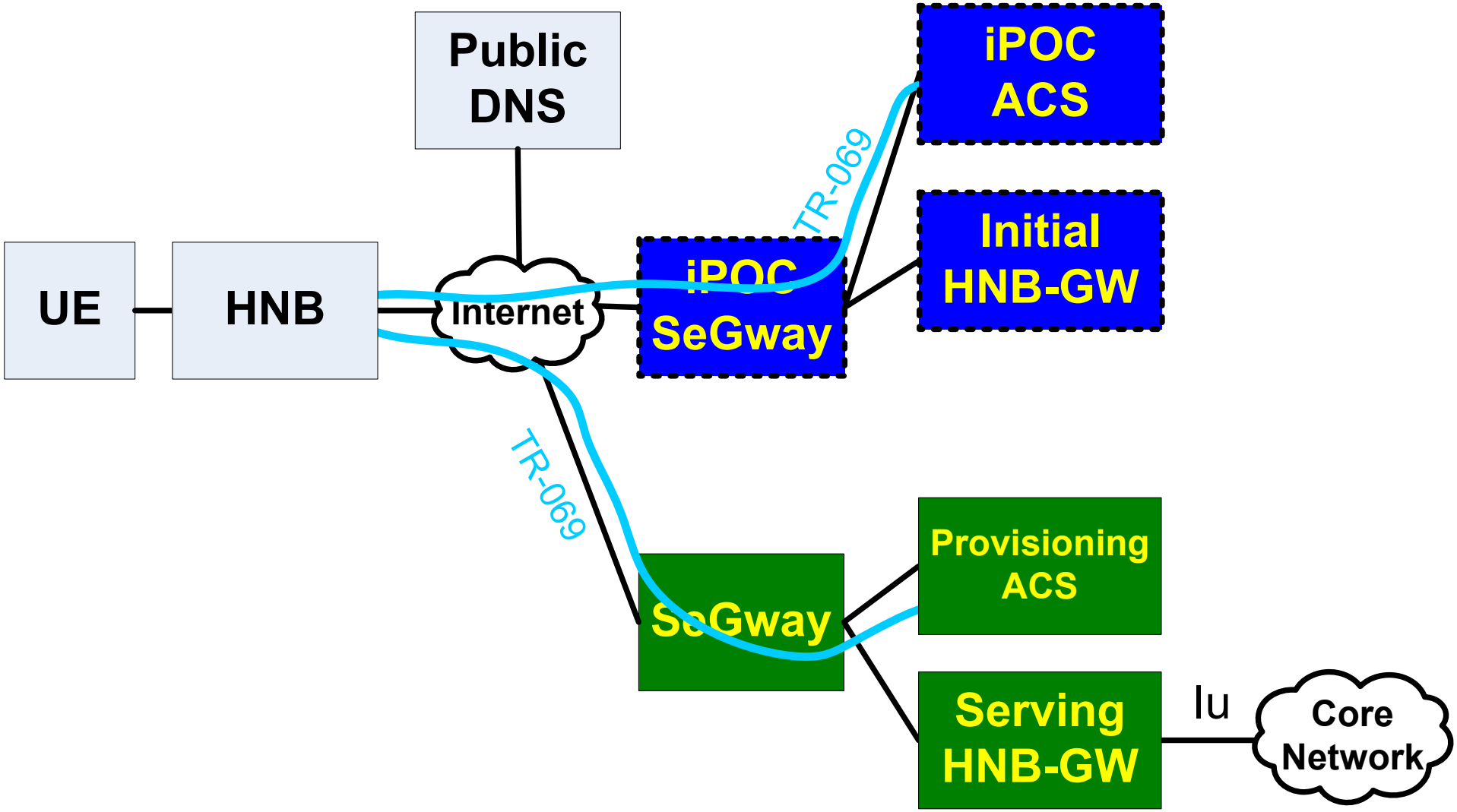


Note
- iPOC ACS, Initial HNB-GW, and iPOC SeGway are optional and may be the same as the Provisioning ACS, Serving HNB-GW, and SeGway

Iuh


Public DNS
iPOC ACS
Initial HNB-GW
UE
HNB
Iuh
Internet
iPOC SeGway
Iuh
Provisioning ACS
SeGway
Serving HNB-GW
Iu
Core Network

Provisioning and Management Interfaces



Beyond the Scope of RAN3

Entities (1)

- iPOC Auto Configuration Server (ACS)
  - Based on TR-069
  - Initial provisioning of HNB
  - Determines “Tentative Location” (potentially unverified), which can be used to find the serving ACS, SeGway, and HNB-GW
  - May be integral to RGW ACS or separate

- iPOC Security Gateway (SeGway)
  - IPsec security gateway
  - IKEv2 authentication of HNB device and HNB user subscription (SA3)
  - Provides access to iPOC ACS (optionally) and initial HNB-GW

- Initial HNB Gateway (HNB-GW)
  - Terminates Iuh from HNB
  - Determines whether there is a need to redirect the Iuh interface to another HNB-GW

Entities (2)

- Provisioning Auto Configuration Server (ACS)
  - Based on TR-069
  - Determines the Certified Location of the HNB (potentially based on Radio Environment Measurements (REMs)
  - Provides final provisioning of HNB and ongoing management functions (e.g., measurement and event reporting)
  - Directs HNB to Serving HNB-GW
  - *May be the same as the iPOC ACS*
- Security Gateway (SeGway)
  - IPsec security gateway
  - IKEv2 authentication of HNB device and HNB user subscription (SA3)
  - Provides access to iPOC ACS (optionally) and initial HNB-GW
  - *May be the same as the iPOC SeGway*
- Serving HNB Gateway (HNB-GW)
  - Terminates Iuh from HNB
  - Provides service to the HNB
  - Redirects the Iuh interface to better serving HNB-GW
  - *May be the same as the Initial HNB-GW*

Key Functional Requirements

- Implementation architecture flexibility
- Minimize options
- Simplify HNB and HNB-GW
- Clean, simple bootstrapping with minimum amount of information required to be pre-provisioned in the HNB
- Deployment flexibility
  - Various broadband internet types
  - Common ACS with RGW/Modem vs. separate ACS for HNB RAN domain
- Support various options for location determination as required by carriers
  - E.g., HNBs with/without GPS
- Optimize overall call flows for “blue sky” scenarios, while preserving scalability and flexibility
  - E.g., iPOC (ACS, SeGway, HNB-GW) may be the ultimate serving (ACS, SeGway, HNB-GW), therefore requiring no redirection, tunnel re-establishment, etc.

Flexible HNB-GW Architecture Support Features

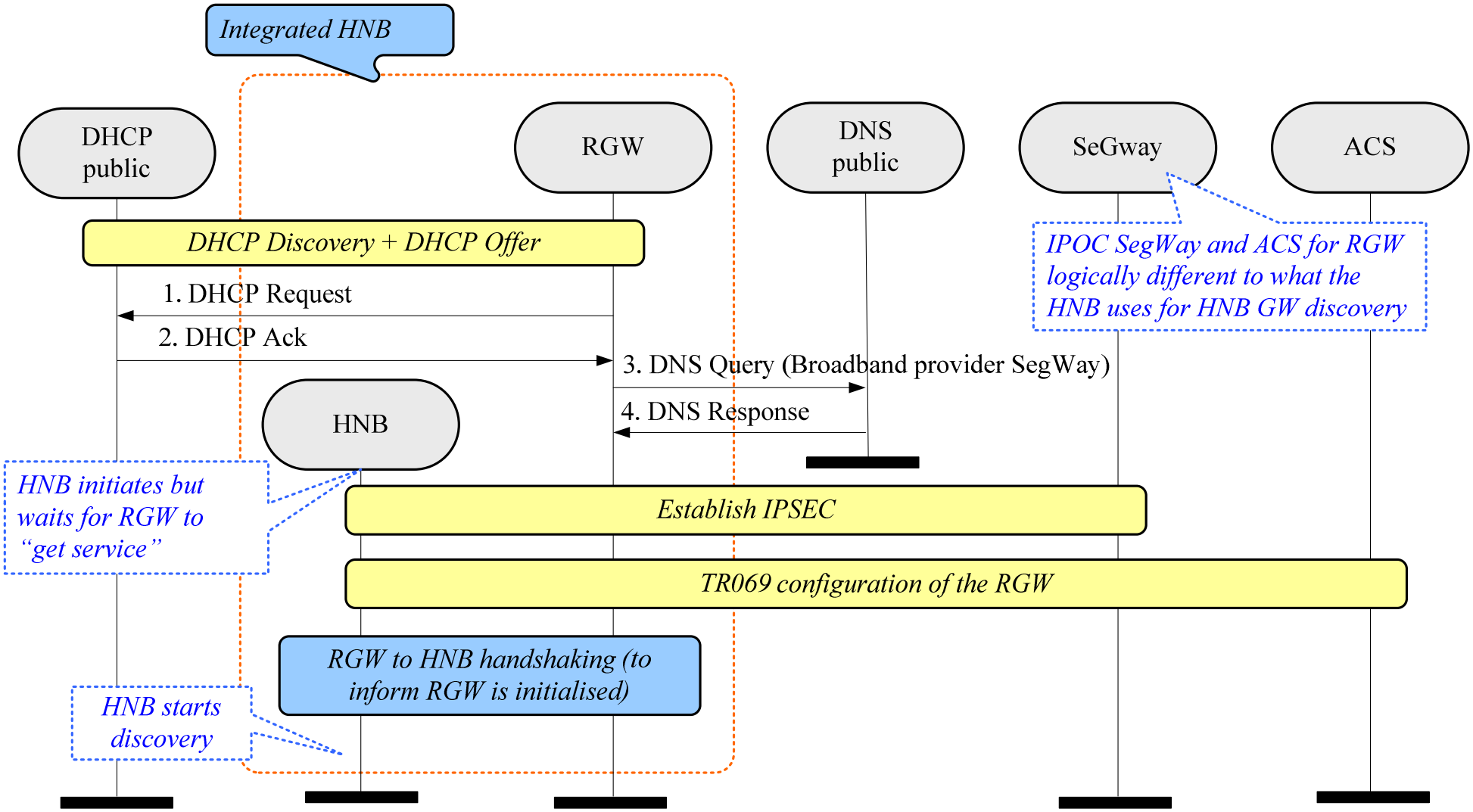
- Provisioning options:
  - Provisioned by ACS using TR-069
  - Ordered list of potential SeGways, Provisioning ACSs, Serving HNB-GWs
  - HNB steps through list sequentially (under control of HNB-GWs) until it finds an HNB-GW that accepts its registration)

- HNB-GW redirection methods (at discretion of HNB-GW):
  - Accept (i.e., no redirection required)
  - Reject
    - HNB may try next entry in list if provisioned by the ACS
    - Cause codes can be used to handle specific scenarios, e.g., to reject back to ACS for re-provisioning
  - Reject and redirect to a *specific* HNB-GW

Stage 2 Call Flows

- HNB and RGW Bootstrapping and Initial Provisioning
- HNB Successful Registration with iPOC ACS and Initial HNB-GW
  - iPOC ACS == Provisioning ACS
  - Initial HNB-GW == Serving HNB-GW
- HNB Successful Registration with First Provisioning ACS and Initial HNB-GW
- HNB Successful Registration after HNB-GW Redirect to Next on List
- HNB Successful Registration after HNB-GW Redirect to Another HNB-GW
- HNB Successful Registration after HNB-GW Redirect Back to ACS for Reprovisioning
- UE Registration Following Successful HNB Registration

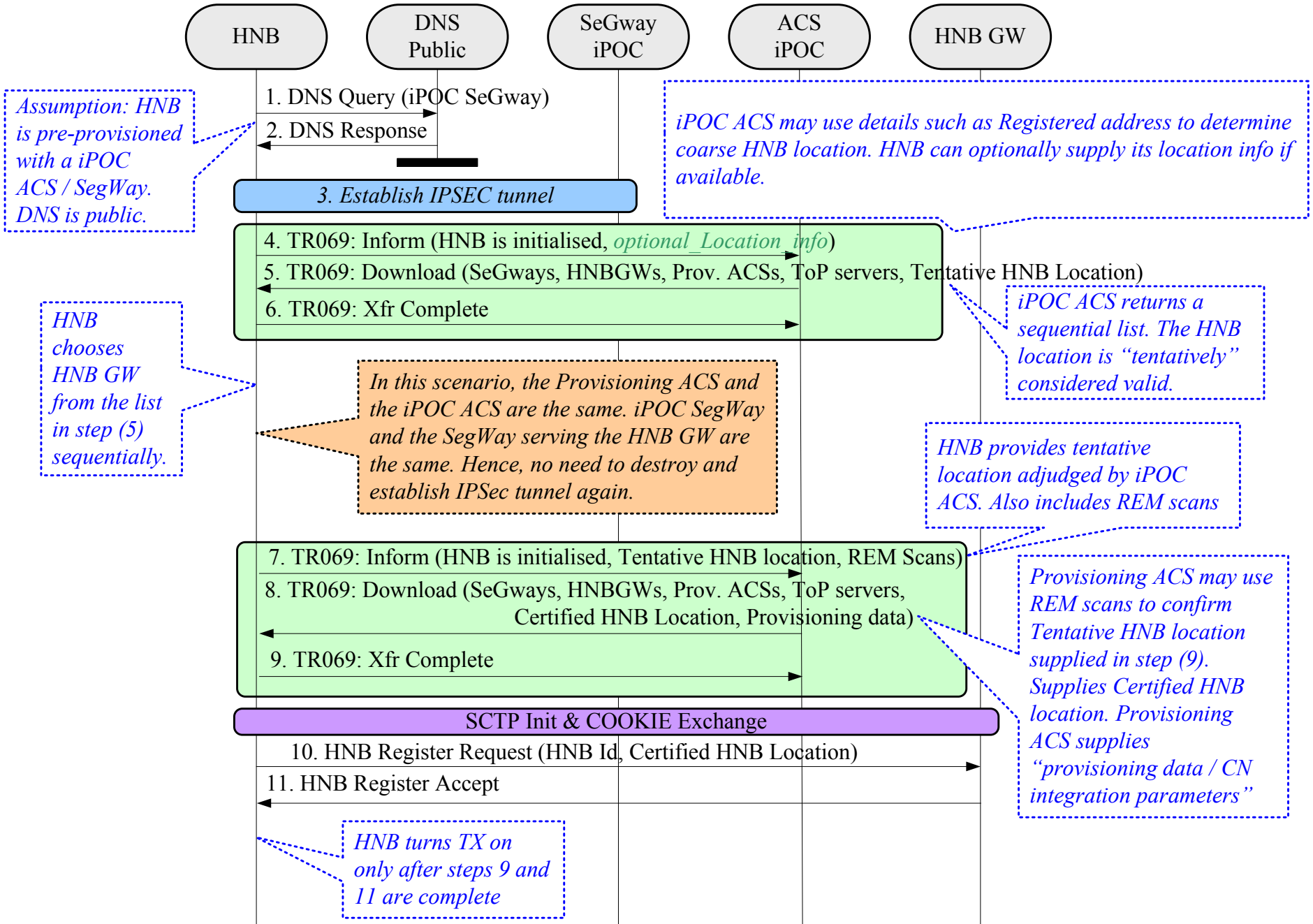
HNB and RGW Bootstrapping and Initial Provisioning (1)



HNB and RGW Bootstrapping and Initial Provisioning (2)

- HNB & RGW can be a, single, integrated device or could be stand alone devices.
- The Residential Gateway (RGW) performs the DHCP discovery and receives corresponding DHCP offers.
- RGW chooses a DHCP, sends a DHCP Request and receives the corresponding DHCP ACK
- TR069 configuration of the HNB happens via an Initial Point of Contact (iPOC) SegWay and ACS.
  - For some integrated HNB/RGW cases, the TR069 configuration for both the HNB and RGW may occur over a security association with a common ACS.
  - Note: These iPOC SegWay and ACS are logically different to what is shown in subsequent slides.
- Via some handshaking mechanism, the integrated HNB identifies the RGW having gone through the initialisation successfully. Note: In the case of a differentiated HNB and RGW, it is assumed the RGW would already be in service. The HNB owner, then, connects the HNB to the “in service” RGW and powers on.
- HNB Gateway (HNB GW) discovery happens next.

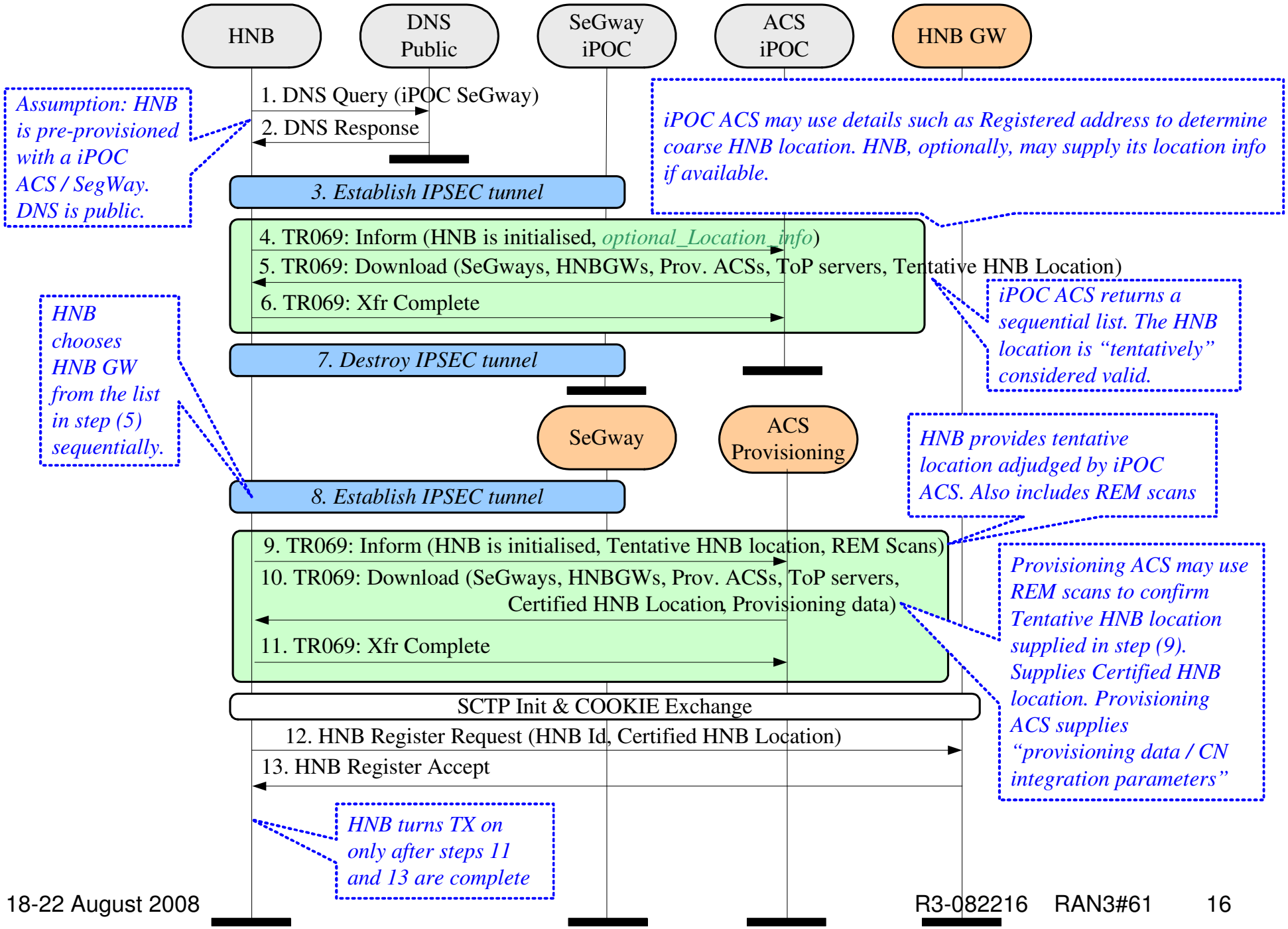
HNB Successful Registration with iPOC ACS and Initial HNB-GW (1)



HNB Successful Registration with iPOC ACS and Initial HNB-GW (2)

- In step (4), optionally, the HNB can send location information. If the HNB has a GPS receiver installed, it could possibly supply its GPS co-ordinates in the TR069 Inform.
- In step (5), the “tentative HNB location” is what the iPOC ACS perceives the HNB location to be. This is not a definitive location.
- HNB will select HNB GW sequentially. More precisely, HNB will attempt 1st HNB GW in the ordered list always. If that attempt fails, it moves onto the 2nd and so on until it succeeds or the list gets exhausted.
- Steps (9) and (11) will have to succeed before the HNB can turn its transmitter on.

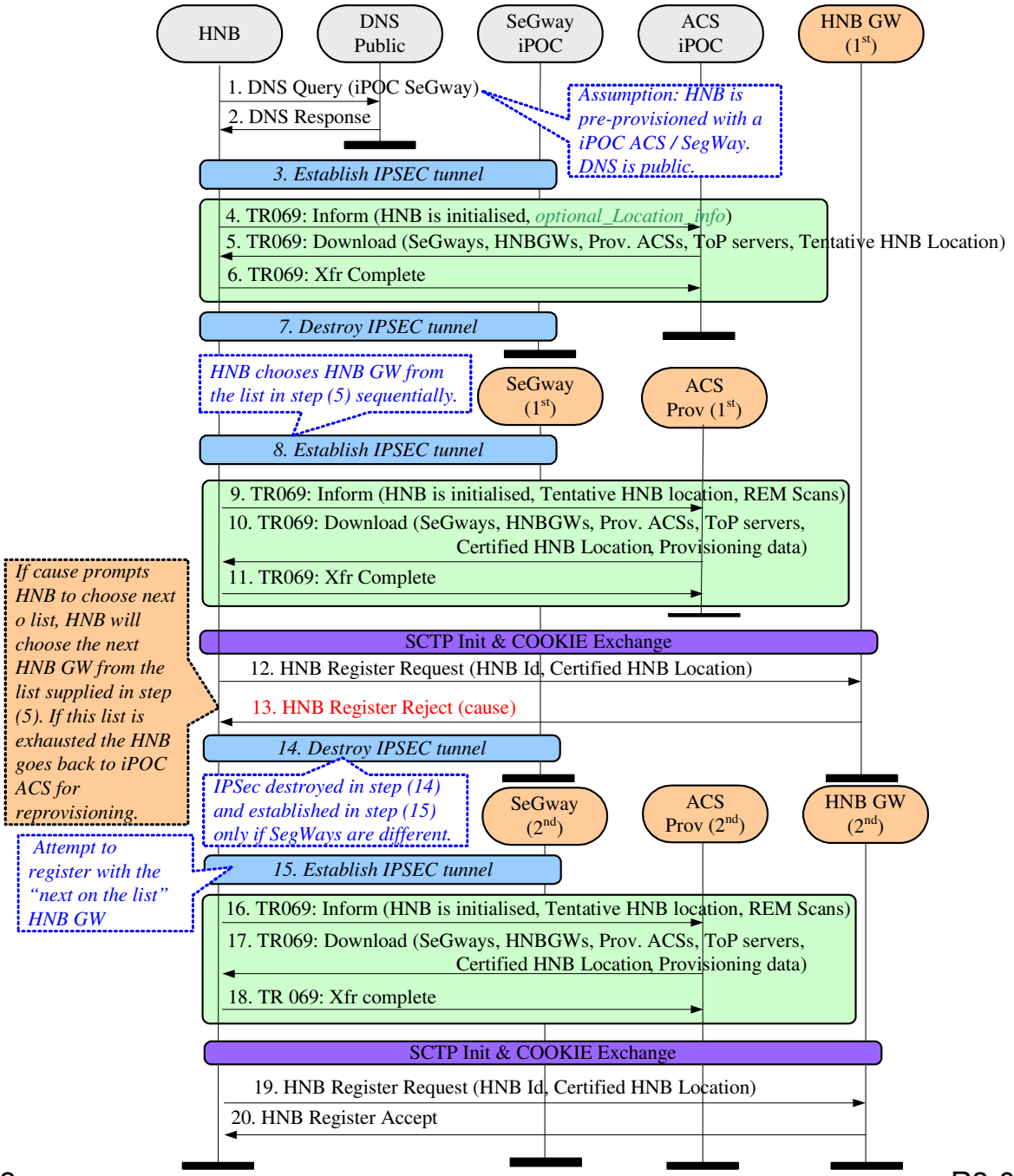
HNB Successful Registration with First Provisioning ACS and Initial HNB-GW (1)



HNB Successful Registration with First Provisioning ACS and Initial HNB-GW (2)

- In step (4), optionally, the HNB can send location information. If the HNB has a GPS receiver installed, it could possibly supply its GPS co-ordinates in the TR069 Inform.
- The “tentative HNB location” is what the iPOC ACS perceives the HNB location to be. This may not be the definitive location.
- HNB will select HNB GW sequentially. More precisely, HNB will attempt 1st HNB GW in the ordered list always. If that attempt fails, it moves onto the 2nd and so on until it succeeds or the list gets exhausted.
- Steps (11) and (13) will have to succeed before the HNB can turn its transmitter on.
- The HNB SHALL NOT offer its services until it has registered and been accepted. That is, the HNB SHALL NOT turn its services on until HNB GW accepts the HNB Register request and until the HNB has downloaded the provisioning data from the Provisioning ACS.

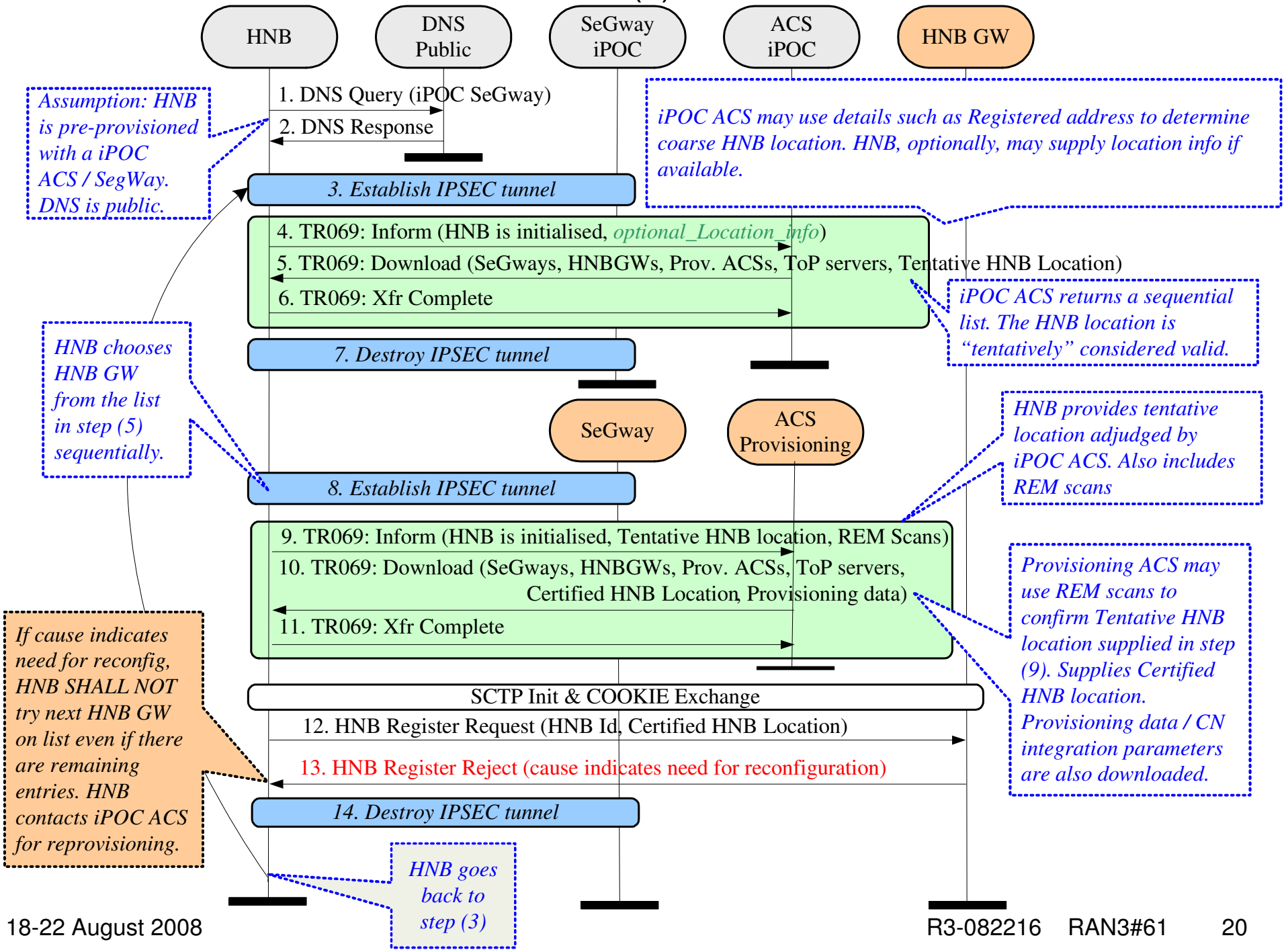
HNB Successful Registration HNB-GW Redirect to Next on List (1)



HNB Successful Registration after HNB-GW Redirect to Next on List (2)

- Until step (12), the same as previous slide
- In step (13), HNB GW may reject and require the HNB to try the next HNB GW on its list.
- If the SegWays happen to be the same, steps (14, 15) are not necessary. That is, IPSec tunnels are destroyed and established only if necessary
- The HNB SHALL NOT offer its services until it has registered and been accepted. That is, the HNB SHALL NOT turn its services on until HNB GW accepts the HNB Register request and until the HNB has downloaded the provisioning data from the Provisioning ACS.

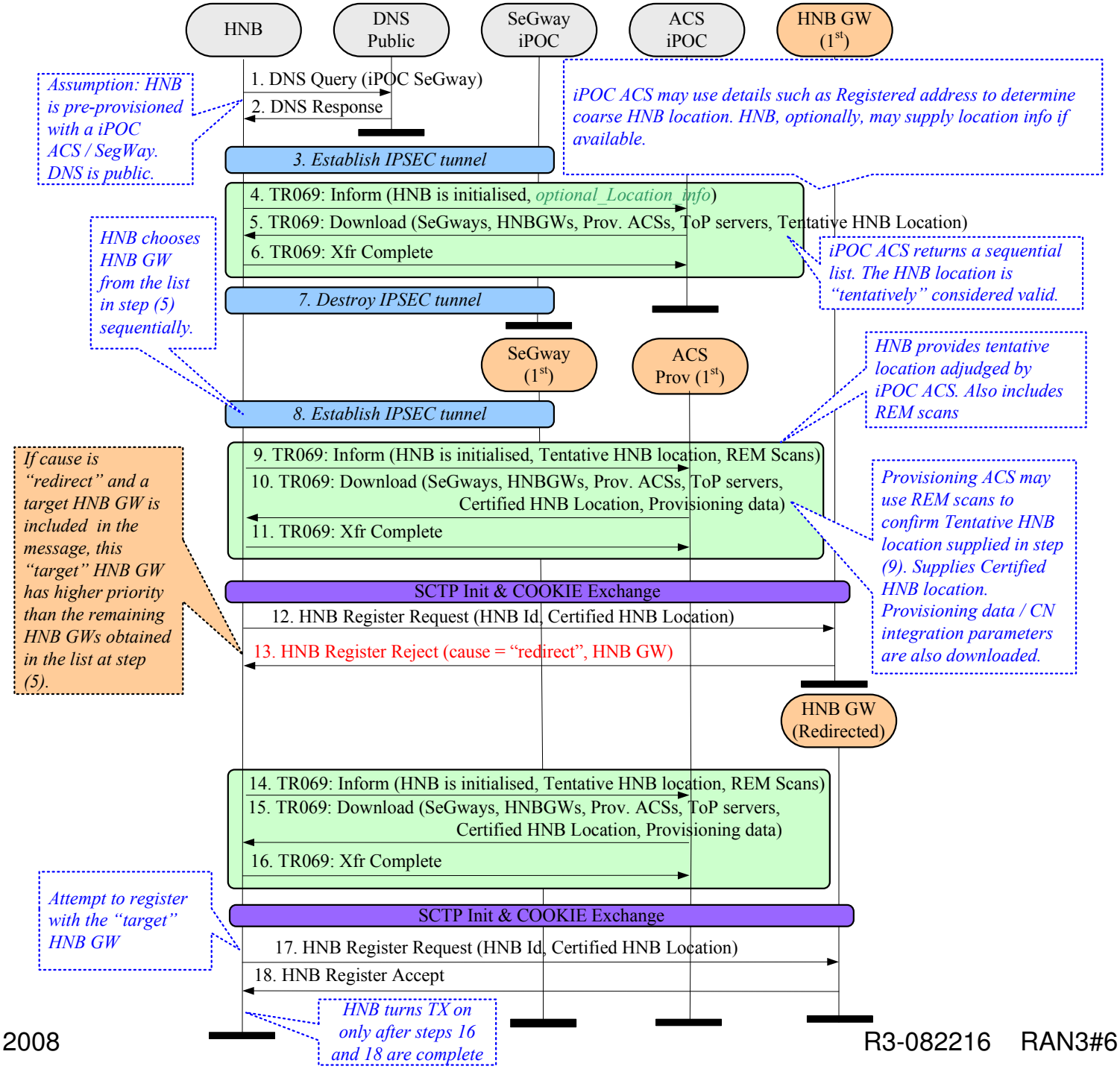
HNB Successful Registration after HNB-GW Redirect Back to ACS for Reprovisioning (1)



HNB Successful Registration after HNB-GW Redirect Back to ACS for Reprovisioning (2)

- Until step (12), the sequence is same as in previous slide.
- In step (13), HNB GW may command the HNB to be reprovisioned. In this event, the ordered list obtained in step (5) is purged. HNB contacts iPOC ACS to be reprovisioned.
- The HNB SHALL NOT offer its services until it has registered and been accepted. That is, the HNB SHALL NOT turn its services on until HNB GW accepts the HNB Register request and until the HNB has downloaded the provisioning data from the Provisioning ACS.

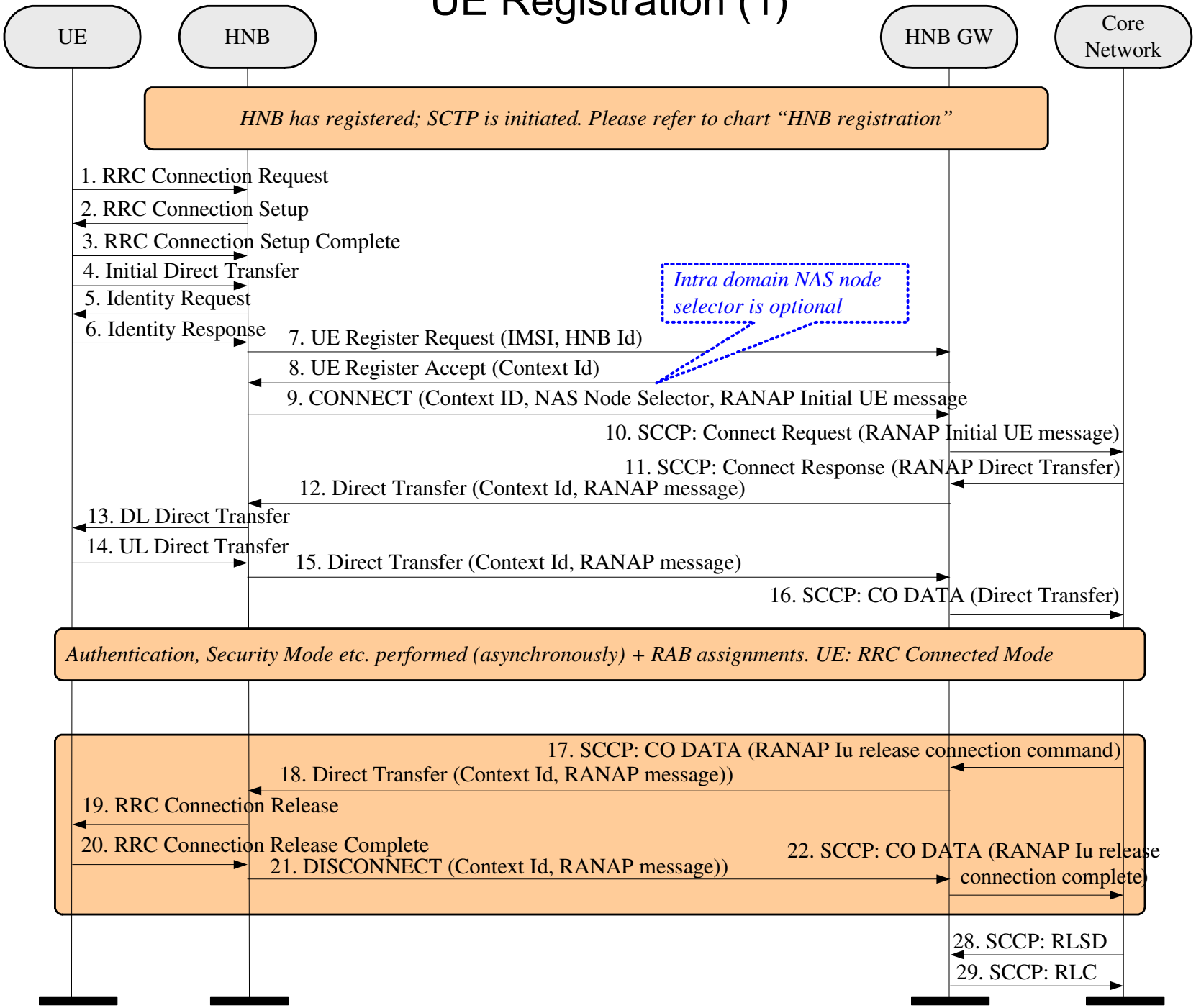
HNB Successful Registration after HNB-GW Redirect to Another HNB-GW (1)



HNB Successful Registration after HNB-GW Redirect to Another HNB-GW (2)

- Until step (12), the sequence is same as in previous slide.
- In step (13), HNB GW may redirect the HNB to register with a different HNB GW (target)
- The HNB SHALL NOT offer its services until it has registered and been accepted. That is, the HNB SHALL NOT turn its services on until HNB GW accepts the HNB Register request and until the HNB has downloaded the provisioning data from the Provisioning ACS.

UE Registration (1)



UE Registration (2)

- The HNB SHALL NOT offer its services until it has registered and been accepted. That is, the HNB SHALL NOT turn its services on until HNB GW accepts the HNB Register request and until the HNB has downloaded the provisioning data from the Provisioning ACS.
- The RANAP messages are either sent via Direct Transfer (Connection oriented) or via Connectionless Transfer
- The RANAP messages are transferred transparently for the most part. Some RANAP messages have to be handled in HNB-GW (e.g. RAB Assignment and RAB Assignment Response.

Radio Environment Measurements

Information provided by the HNB to the Provisioning ACS on the Radio environment monitored scans

- Carrier RSSI
- DL UARFCN
- Cell CPICH RSCP
- Primary SCR
- PLMN type, PLMN ID.
- LAC, RAC
- Cell Id
- Cell Reselection parameters
- HCS info
- Cell barring info
- Neighbour cells

Not in scope of RAN3.

HNB Parameters Managed by the ACS

Not in scope of RAN3.

Category	Parameter name	Description (please refer to 25.331 for further details)
RF	*DL UARFCN*	DL UARFCN to be used by the HNB (UL UARFCN is worked out automatically)
	Max TX power	Maximum transmit power allowed to the HNB
	Primary SCR, SF	List of Primary scrambling codes, Spreading factors
	Relative power levels	Relative power levels / offsets of CPICH, AICH, SCH, HS DSCH, HS SCCH, PICH, SCCPCH etc.
Select & Reselect	*Cell Id, Cell Barring, Cell reselection parameters, HCS*	Hysteresis levels, Reselection quality measures, Evaluation times, RAT specific measurement rules, Thresholds for measurements, Barring of access class.
DRX Length	*For CS, PS etc.*	
Timers & constants		Timers and constants for NAS & AS procedures Examples are T3212, N300, T300, N312 etc.
UL Control params	*RACH control*	Preamble cycles, Ramping procedure, PRACH partioning, Access class to ACS mapping, Persistence factor, Random backoff bounds, max UL power on RACH
LAC, RAC, SAC, RNC ID	*Location area ID, Routing area ID etc.*	Details for how these parameters are determined are FFS.
ToP Servers		Timing servers for synchronisation
Access Control list		
Neighbor list	*Intra, Inter FDD and Inter RAT*	Cell Ids, Primary SCR, Measurement quantity, Measurement Quality, Triggers, Periodicity, BSIC, Band Indication, Filter co-efficients, Thresholds and Hysterisis parameters for Event reporting

Preliminary List; Other Parameters May be Required!