

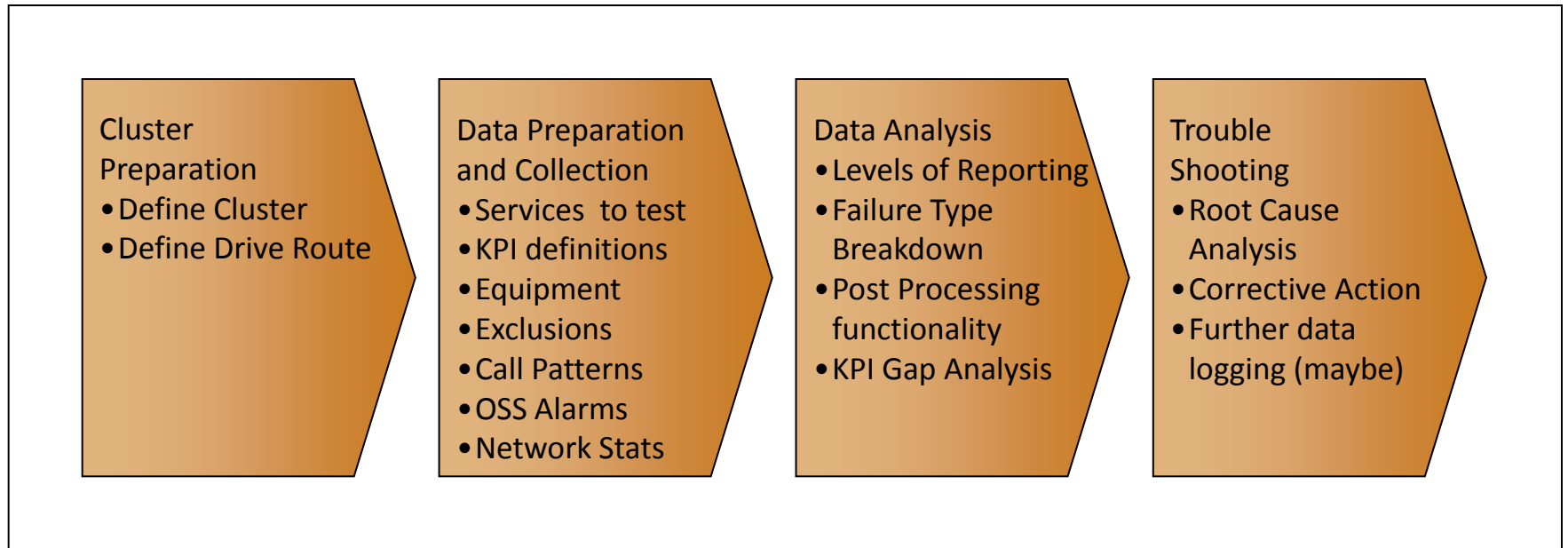
Drive Test Analysis

Objectives

After this module the delegate shall be able to:-

- Understand the different elements required for an effective drive test program
- Understand how all aspects of drive data can be used to obtain a view of network performance
- Differentiate between genuine (RF) and non-genuine (system) failures
- Understand the KPIs that can be obtained

Drive Test Process

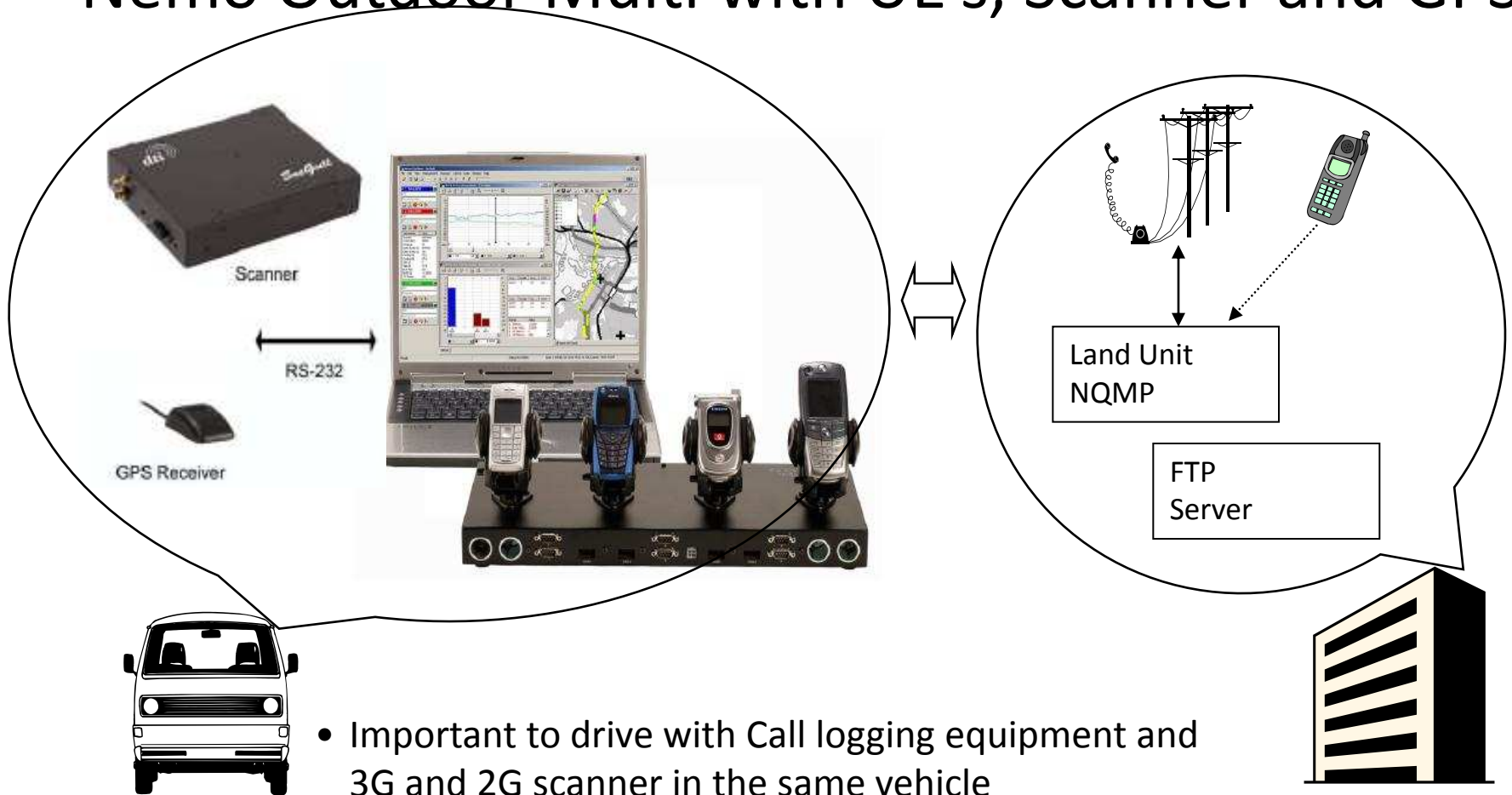


Why Drive the network?

- New Site Integration
- RF Tuning
- Network Optimisation
- Network Benchmarking (Golden Routes)

Drive Test Analysis – Test Equipment

- Nemo Outdoor Multi with UE's, Scanner and GPS



- Important to drive with Call logging equipment and 3G and 2G scanner in the same vehicle

Drive Test Analysis – Test Equipment, Scanner

- The purpose of using the RF scanner is to be able to scan and measure all used carriers/cells and their corresponding DL scrambling codes.
 - For low coverage areas
 - For antenna installation problems
 - For missing neighbours
 - For coverage optimisation
 - With the scanner you can get the following info from the surrounding cells:
 - Different Scrambling codes
 - CPICH RSCP value (dBm)
 - CPICH EcNo value (dB)

Drive Test Analysis – Test Equipment, UE

- The Scanner measures all SCs, whereas the UE only measures SC signals from the cells that the system has informed/ordered the UE through the BCH (neighbour list) or via the “measurement control” message.
 - RSCP Active/Monitored Set
 - Carrier RSSI
 - Ec/No Active/Monitored Set
 - UL/DL Data Throughput
 - The BLER downlink
 - Pilot BER
 - Random Access Initial Tx Power
 - Random Access Preamble Count
 - Random Access Preamble Step
 - Random Access Tx Power
 - SIR target (UE dependent)
 - UE Tx Power
 - Call Statistic: AMR, CS and PS data calls

Drive Test Analysis – Call Patterns

- Enough call samples have to be made to make the measurement statistically valid.
 - In a 50 call sample one dropped call will cause a change in performance of -2%
 - In a 500 call sample one dropped call will cause a change in performance of -0.2%
- Call length should be defined at the beginning
- We can use different call testing patterns for different optimisation techniques
 - Short Calls (for Calls setup performance and delay)
 - Long calls (for Drop call performance and SHO performance)

AMR Call

Mobile Originated Calls (MOC)

- 2 min calls
- 30 sec idle
- UE in Dual mode (2G/3G)

Mobile Terminated Calls (MTC)

- 2 min calls
- 30 sec idle
- UE in dual mode (2G/3G)

PS Call

- GPRS Attach,
- PDP Context Activation
- FTP Download (1MB file)/FTP Upload (500 KB file)
- PDP Context Deactivation
- GPRS Detach
- Alternate download and upload with 30 sec idle time
- Session is upload or download
- UE in Dual mode (2G/3G)

Drive Test Analysis – Det

AMR Statistics

Threshold KPIs		
MOC Setup time	5	sec
MOC CCR	99	%

Event	RAW		END USER	
	Count	Ratio	Count	Ratio
Call Attempts	132		122	
Call Setup Success Rate	108	81.8%	108	88.5%
Call Setup Failure Rate	24	18.2%	14	11.5%
Failures due to Tool (TSF)	10	41.7%		
Failures due to Core Problem	10	41.7%	10	71.4%
Failure ASU (Sync) Problem	2	8.3%	2	14.3%
Failure due to Low Coverage Levels	2	8.3%	2	14.3%
Call Setup Success and Setup Time > 5s	7	6.5%	7	6.5%
Long Setup due to slow cell reselection		0.0%	0	0.0%
Long Setup due to clash with InterRAT reselection		0.0%	0	0.0%
Long Setup due to Unknown (suspect UE)		0.0%	0	0.0%
Long Setup due to Unknown		0.0%	0	0.0%
Average Call Setup Time		3.66		3.66
Call Completion Rate	105	97.2%	105	97.2%
Call Drop Rate	3	2.8%	3	2.8%
Call Drop Poor 3G Coverage	1	33.3%	1	33.3%
Call Drop on GSM due to Interference	2	66.7%	2	66.7%
Overall Call Completion Rate	105	79.5%	105	86.1%
ISHO Attempt	14		14	
ISHO Success	14	100.0%	14	100.0%
ISHO Failed	0	0.0%	0	0.0%
ISHO Failed cause physical channel failure	0	N/A	0	N/A

- Need to agree
 - What 'raw' figures will contain
 - What 'End User' will contain
 - Other cuts of Data

PS Data KPI Report

KPI Thresholds	Value	Unit
Attach Time	4	sec
PDP Activation Time	2	sec
FTP Download Throughput	110	kbit/s
FTP Upload Throughput	55	kbits

Signalling Statistics	Count	Success rate
Attach Attempt	155	
Attach Success	140	90.32%
Attach Time more than threshold	5	3.57%
Attach Time less than threshold	135	96.43%
Attach Failed	15	9.68%
Average Attach Setup Time		1.36
Activate PDP Context Attempt	124	
Activate PDP Context Success	124	100.00%
Activation Time more than threshold	2	1.60%
Activation Time less than threshold	123	98.40%
Activate PDP Context Failed	0	0.00%
Average PDP Context Activation Time		0.96
FTP Download Attempts	51	
FTP Download Success	48	94.12%
FTP Download throughput more than threshold	25	52.08%
FTP Download throughput less than threshold	23	47.92%
Average FTP Download Throughput		107.02
FTP Upload Attempts	32	
FTP Upload Success	30	93.75%
FTP Upload throughput more than threshold	20	66.67%
FTP Upload throughput less than threshold	10	33.33%
Average FTP Upload Throughput		55.53
Data Transfer Cut-off Ratio		6.02%
PDP Context Dropped	4	3.23%
Deactivate PDP Context Request	121	
Deactivate PDP Context Accept	121	100.00%
Deactivate PDP Context Failure	0	0.00%
Detach Request	281	
Detach Accept	129	45.91%
Overall Data Session Completion Rate	78	62.90%

RAU Statistics	Count	Success rate
RAU Attempt	22	
RAU Success	13	59.09%
RAU Failed	9	40.91%

Cell Reselection Statistics	Count	Success rate
Cell Reselection from UMTS to GSM Attempts	2	
Cell Reselection from UMTS to GSM Success	1	50.00%
Cell Reselection from UMTS to GSM Delay E2E		15.27
Cell Reselection from UMTS to GSM Delay Signalling		N/A
Cell Reselection from GSM to UMTS Attempts	1	
Cell Reselection from GSM to UMTS Success	0	0.00%
Cell Reselection from GSM to UMTS Delay E2E		N/A

Time in System	Seconds	Ratio
GSM	171	1.02%
UMTS	16559	98.98%

Drive Test Analysis – Test Case definition Examples

Short calls to test
Call Setup Success

KPI ID	Criteria	Test Description	Trigger	Statistics	Success Rate
KPI-01	Voice 12.2 kbps AMR CCSR	<ul style="list-style-type: none"> •1 MOC+ 1 MTC in the same van, 2 Ues •1 call (party A to party B, party A terminates the call): 15 seconds call + 15 seconds idle. Party A to be logged •350 calls 	<ul style="list-style-type: none"> •Call set-up trigger point: •Party A's UE sends 1st 'RRC Connection Request' •Call completion trigger point: •Party A's UE receives 'RRC Connection Release (cause normal)' •Successful completion if: •15 sec call duration (from RRC Conn. Request to RRC Conn. Release) 	•Cluster_AMR_Overall_CCSR_% = Call Completion / Call Attempts *100	98%
KPI-02	Voice DCR	<ul style="list-style-type: none"> •1 MOC to PSTN, 1 Ue •1 call: 90 seconds call + 15 seconds idle •350 calls 	<ul style="list-style-type: none"> •Party A's UE receives 'RRC Connection Release (cause normal)' •Call Set-up trigger point: •3G UE receives 'RRC: Downlink Direct Transfer (Alerting for NZ, Connect Acknowledge for AU)' •Call completion trigger point: •3G UE receives 'RRC Connection Release (cause normal)' •Successful completion if: •90 sec call duration (from RRC Conn. Request to RRC Conn. Release) •3G UE receives 'RRC Connection Release (cause normal)' 	•Cluster_AMR_Overall_DCR_% = 1 - Call Completion / Set up Calls *100	< 2%
KPI-03	Voice 3G-2G Handover (inter- & intra-MSC)	<ul style="list-style-type: none"> •1 MOC to PSTN, 1 Ue in <u>dual mode</u> •1 call: continuous call until 3G2G coverage border is passed •50 occurrences as a minimum 	<ul style="list-style-type: none"> •3G to 2G HO start point: •UE receives 'RRC: Handover From UTRAN Command' •3G to 2G HO completion trigger point: •UE sends 'Handover Complete' to 2G BSS •Successful completion if: •UE sends 'Handover Complete' to 2G BSS 	•Cluster_Voice_3Gto2G_HO_Overall_SR_% = HO Completion / HO Attempts *100	98%

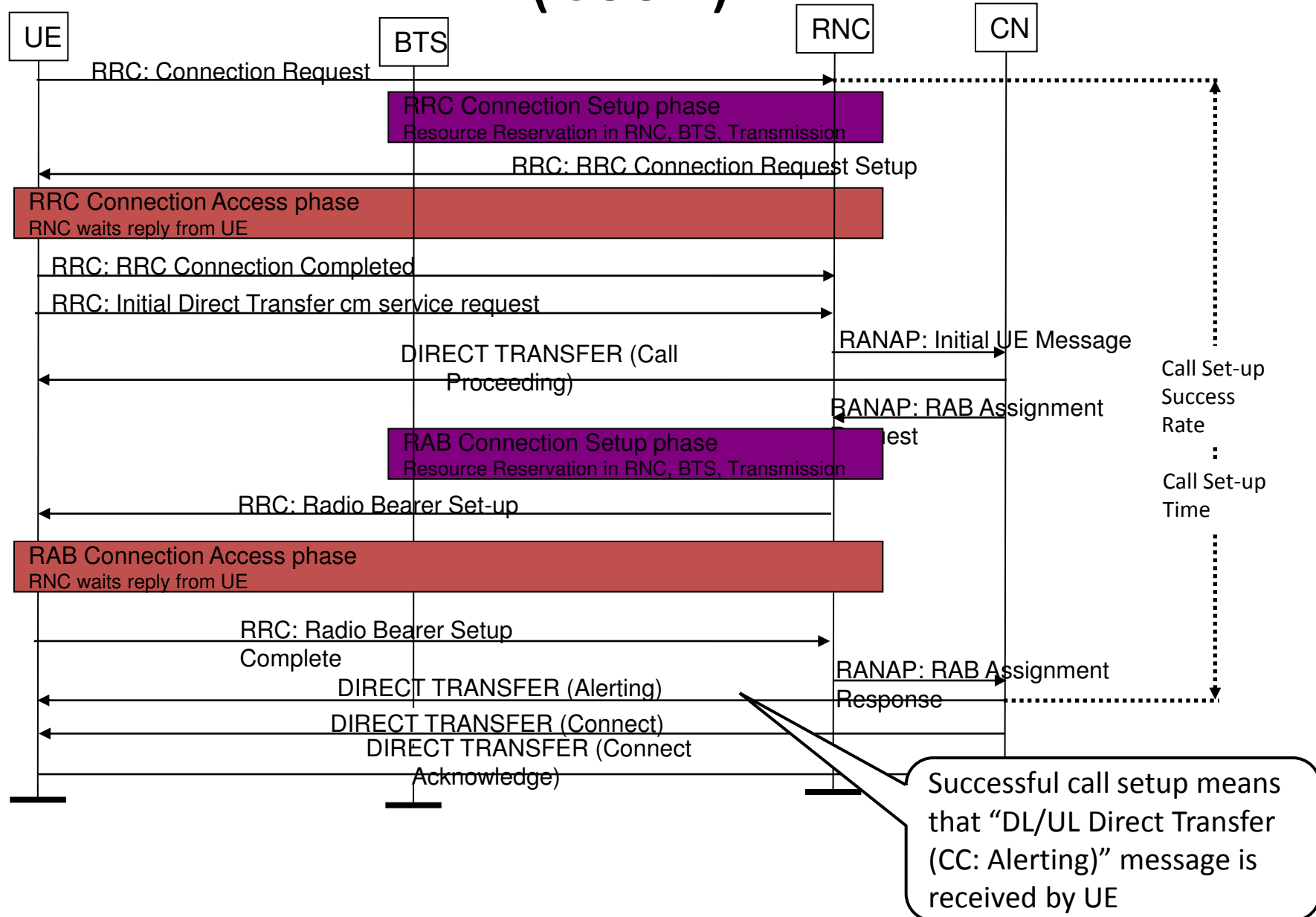
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KPI-08	PS PDP context activation	<ul style="list-style-type: none"> •Same as 10 •350 occurrences 	<ul style="list-style-type: none"> •PS PDP activation trigger point: •UE not PS attached •UE sends 1st 'RRC Connection Request' •PS PDP activation completion trigger point: •UE receives 'RRC: Downlink Direct Transfer (SM: Activate PDP Context Accept)' •Successful completion if: •UE receives 'RRC: Downlink Direct Transfer (SM: Activate PDP Context Accept)' 	•Cluster_PDP_Context_Activation_SR_% = PDP Context Activation Completion / PDP Context Activation Attempts *100	98%
KPI-09	PS throughput downlink	<ul style="list-style-type: none"> •Repeated FTP calls, 1 Mbyte file download, 1 Ue •384 kbps •Average throughput •350 calls 	<ul style="list-style-type: none"> •Data Session Set-up trigger point: •UE receives 1st DL packet •Data Session Completion trigger point: •UE receives last packet •Session output: •Average downlink throughput 	•Cluster_PS_DL_Throughput = Average Throughput Over Data Sessions	200 Kbps

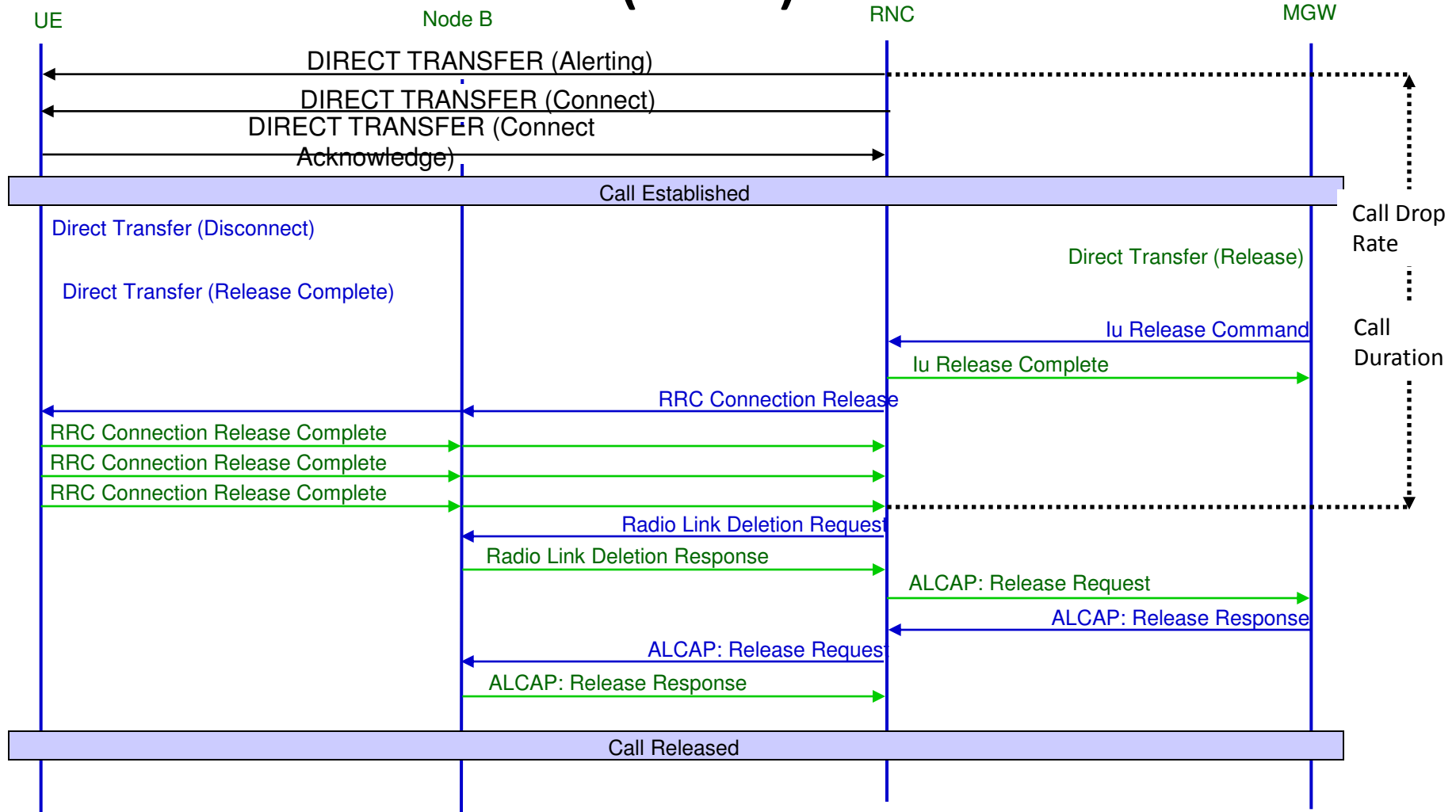
Need to Define the KPI measurement (from Drive test)

- **Call Setup Success - CSSR (voice, circuit switched data)**
 - Successful call setup means that “DL/UL Direct Transfer (CC: Alerting)” message is received by UE.
- **Call Setup Time (voice, circuit switched)**
 - Call setup delay is measured from L3 messages, starting from “RRC Connection Setup” message to “DL Direct Transfer (CC: Alerting)” message.
- **Call Drop (voice, circuit switched)**
 - A dropped call occurs. The call will be dropped in case RRC connection release (not normal release) message has been send from RNC to UE.
- **Session Setup Success (packet switched)**
 - This is related to PDP context activation. Successfully activated PDP context means that activate PDP context accept message has been sent from RNC to UE (RRC: downlink direct transfer (SM:activate PDP context Accept)).
- **Session Setup Time (packet switched)**
 - The “session setup time” is the delay between the time the UE sends the data session activation request until GPRS attach and PDP context activation has been successfully completed.
- **Session Drop (packet switched)**
 - Session drop rate can be defined as the number of successful PDP deactivations against number of successful PDP activations.

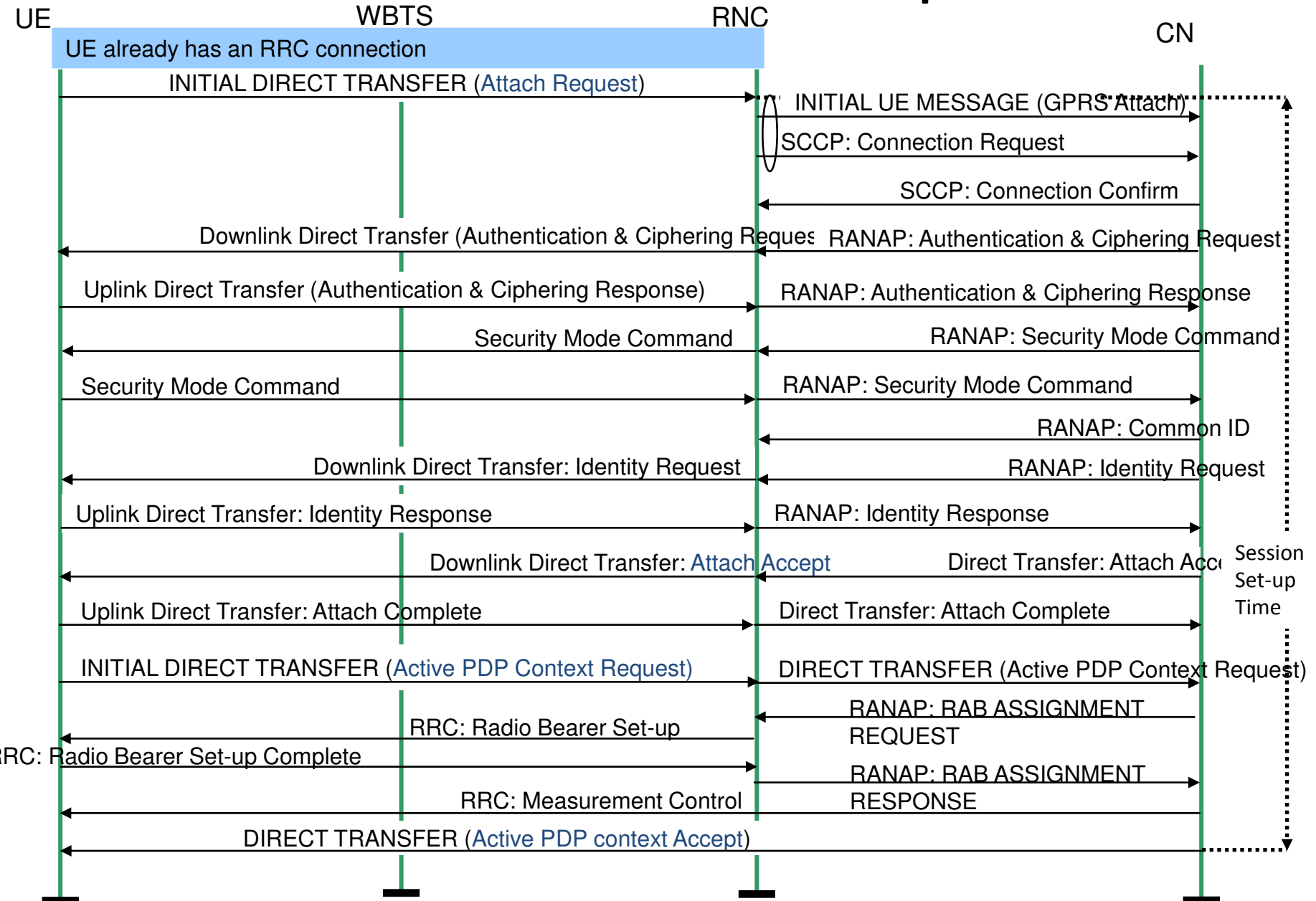
Definition of Call Set-Up Success Rate (CSSR)



Definition of the Call Completion Rate (CCR)



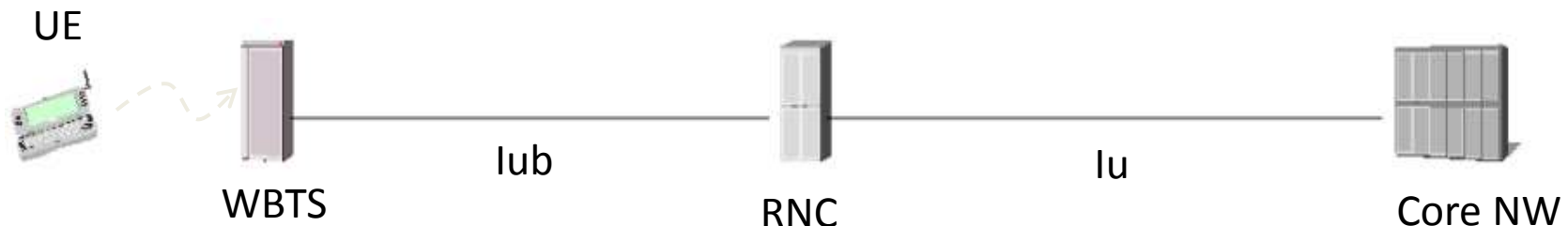
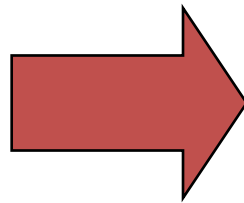
Definition of Session Setup Time - PS



Failure Breakdown

- Non-genuine failures
 - Measurement system fault (Collection Tool or Analysis)
- Genuine failures
 - RF issue (Coverage / Interference / Poor dominance)
 - Missing neighbour
 - System issue WBTS
 - System issue RNC
 - Core network issue
 - System
 - (Unknown)

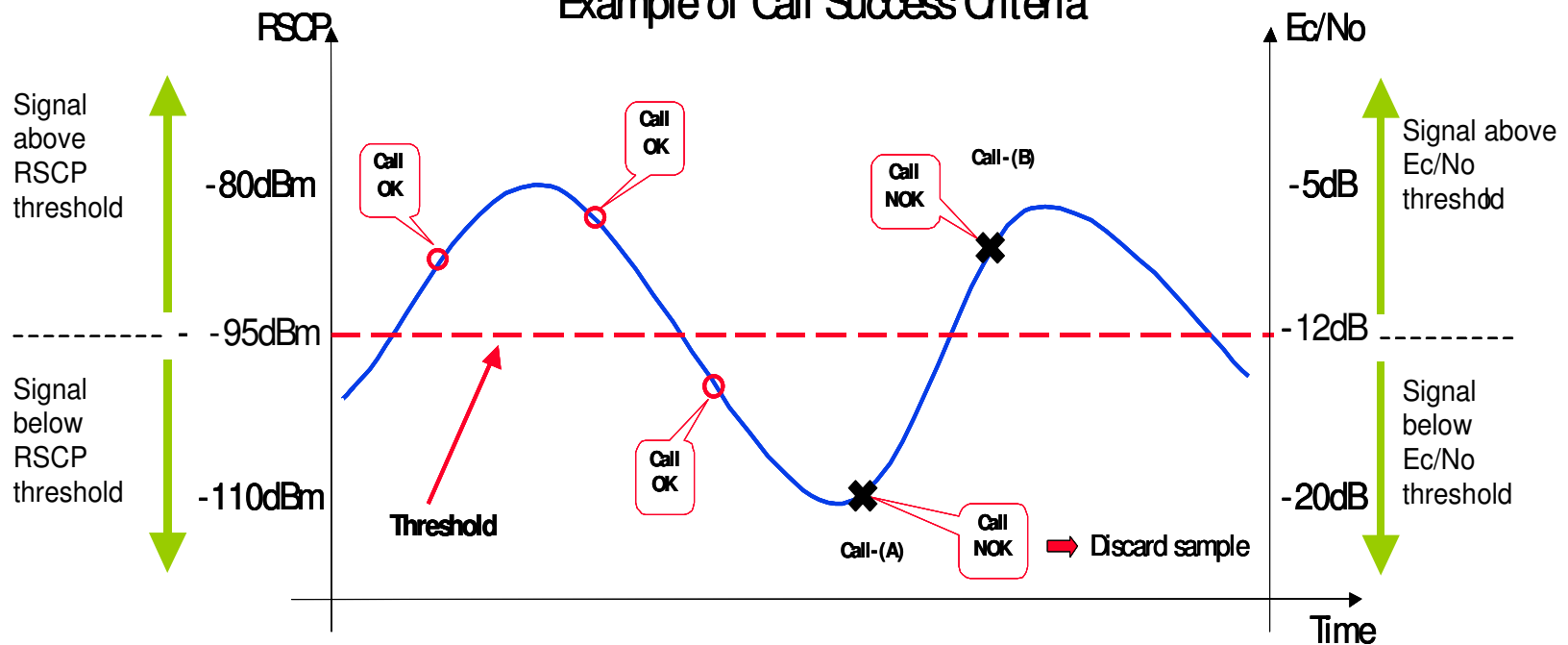
It is beneficial to categorise call failures during the analysis and reporting



Failure Breakdown

- The KPI measurement conditions should be used to define exclusion areas during drive test for acceptance of a cluster.
- All failures happening in those area, that do not respect the coverage requirements should be discarded.

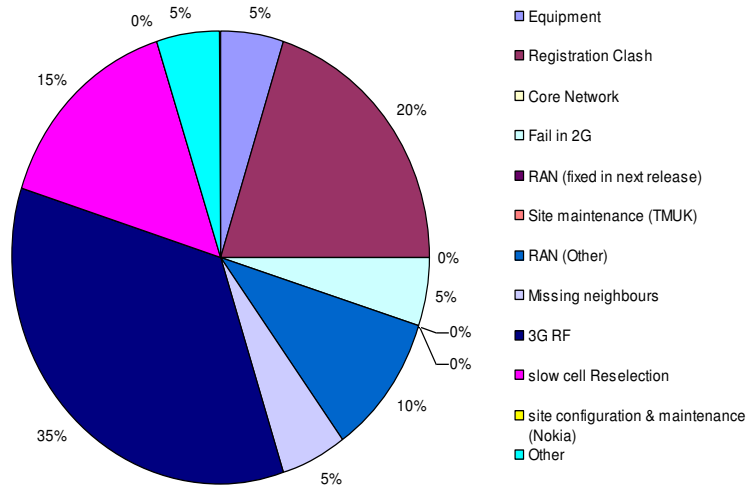
Example of Call Success Criteria



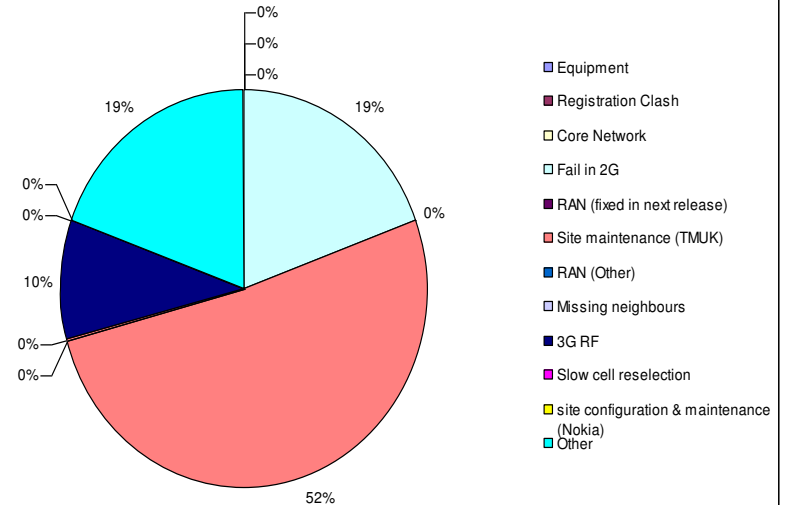
Failure Breakdown

AMR Call Setup Failures

Call Set-up Failures Breakdown - Benchmark Drive



Call Setup Failure Breakdown - Final Drive



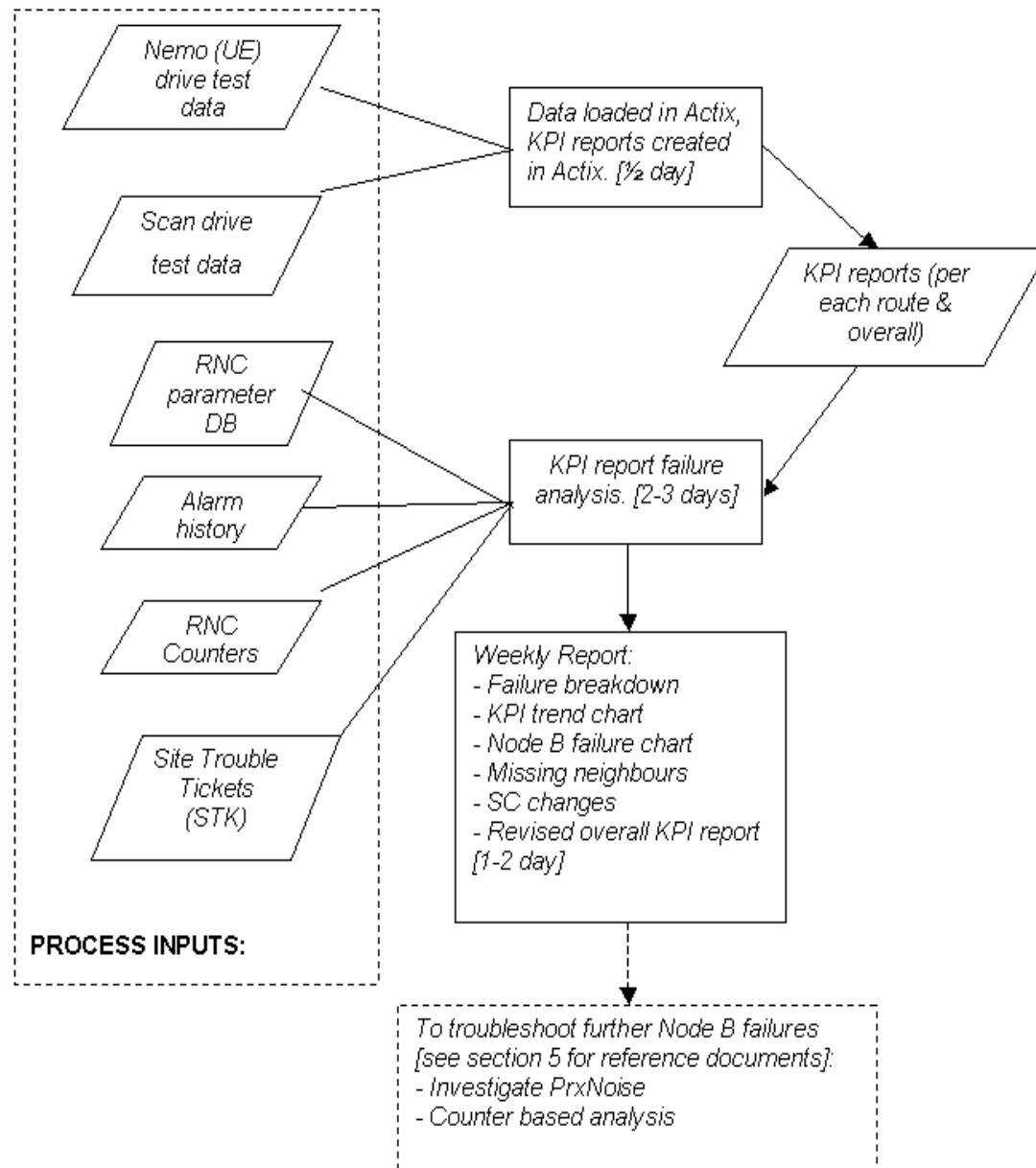
Call Set-up Failures

Failure Type	total	%
Equipment	1	5.0
Registration Clash	4	20.0
Core Network	0	0.0
Fail in 2G	1	5.0
RAN (fixed in next release)	0	0.0
Site maintenance (TMUK)	0	0.0
RAN (Other)	2	10.0
Missing neighbours	1	5.0
3G RF	7	35.0
slow cell Reselection	3	15.0
site configuration & maintenance (Nokia)	0	0.0
Other	1	5.0

Call Set-up Failures

Failure Type	total	%
Equipment	0	0.0
Registration Clash	0	0.0
Core Network	0	0.0
Fail in 2G	6	19.4
RAN (fixed in next release)	0	0.0
Site maintenance (TMUK)	16	51.6
RAN (Other)	0	0.0
Missing neighbours	0	0.0
3G RF	3	9.7
Slow cell reselection	0	0.0
site configuration & maintenance (Nokia)	0	0.0
Other	6	19.4

Drive Survey Analysis Process

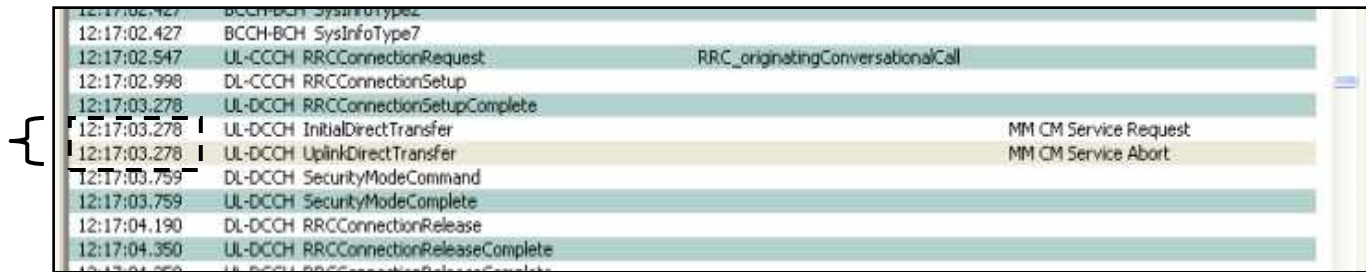


Non Genuine Call Setup Failure Scenarios

- Measurement systems are often not perfect and may introduce errors in data collection or analysis
- Examples of non-genuine failures seen:
 - Uplink: *CM Service Abort* within milliseconds from *CM Service Request*
 - Call attempt during Location Area update ('LA clash')
 - User initiated "UL CC Disconnect"
 - Location Area update interpreted as call setup failure
 - Cell reselection back to 3G from 2G interpreted as call setup failure

Non Genuine Call Setup Failures

- Measurement system failures by drive test tool
 - “CM Service Abort” within milliseconds from “CM Service Request”
 - No time for response from NW



Non Genuine Call Setup Failures

Absolute	RRC	RRC Cause	Layer 3
16:19:48.608	UL-CCCH RRCConnectionRequest	RRC_registration	
16:19:49.029	DL-CCCH RRCConnectionSetup		
16:19:49.319	UL-DCCH RRCConnectionSetupComplete		
16:19:49.319	UL-DCCH InitialDirectTransfer		MM Location Updating Request
16:19:49.479	UL-DCCH MeasurementReport		
16:19:50.050	DL-DCCH ActiveSetUpdate		
16:19:50.050	UL-DCCH ActiveSetUpdateComplete		
16:19:50.090	UL-DCCH MeasurementReport		
16:19:50.250	UL-DCCH MeasurementReport		
16:19:50.330	UL-DCCH MeasurementReport		
16:19:50.441	DL-DCCH MeasurementControl		
16:19:50.441	DL-DCCH MeasurementControl		
16:19:50.591	DL-DCCH ActiveSetUpdate		
16:19:50.611	UL-DCCH ActiveSetUpdateComplete		
16:19:50.631	UL-DCCH MeasurementReport		
16:19:50.791	UL-DCCH MeasurementReport		
16:19:50.831	DL-DCCH DownlinkDirectTransfer		MM Authentication Request
16:19:50.951	UL-DCCH MeasurementReport		
16:19:51.041	DL-DCCH MeasurementControl		
16:19:51.051	DL-DCCH ActiveSetUpdate		
16:19:51.051	UL-DCCH ActiveSetUpdateComplete		
16:19:51.142	UL-DCCH MeasurementReport		
16:19:51.312	UL-DCCH UplinkDirectTransfer		MM Authentication Response
16:19:51.432	DL-DCCH MeasurementControl		
16:19:51.702	DL-DCCH ActiveSetUpdate		
16:19:51.702	UL-DCCH ActiveSetUpdateComplete		
16:19:52.003	DL-DCCH SecurityModeCommand		
16:19:52.003	UL-DCCH SecurityModeComplete		
16:19:52.313	DL-DCCH MeasurementControl		
16:19:52.353	DL-DCCH DownlinkDirectTransfer		MM Identity Request
16:19:52.353	UL-DCCH UplinkDirectTransfer		MM Identity Response
16:19:52.423	UL-DCCH MeasurementReport		
16:19:52.714	DL-DCCH ActiveSetUpdate		
16:19:52.714	UL-DCCH ActiveSetUpdateComplete		
16:19:53.074	DL-DCCH MeasurementControl		
16:19:53.725	UL-DCCH MeasurementReport		
16:19:54.086	DL-DCCH DownlinkDirectTransfer		MM Location Updating Accept
16:19:54.086	UL-DCCH UplinkDirectTransfer		MM TMSI Reallocation Complete
16:19:54.086	UL-DCCH UplinkDirectTransfer		MM CM Service Request
16:19:54.206	DL-DCCH ActiveSetUpdate		
16:19:54.206	UL-DCCH ActiveSetUpdateComplete		
16:19:54.226	UL-DCCH MeasurementReport		
16:19:54.536	DL-DCCH MeasurementControl		
16:19:54.677	DL-DCCH DownlinkDirectTransfer		MM CM Service Accept
16:19:54.677	UL-DCCH UplinkDirectTransfer		CC Setup
16:19:54.997	DL-DCCH DownlinkDirectTransfer		CC Call Proceeding
16:19:55.278	DL-DCCH RRCConnectionRelease		
16:19:55.278	UL-DCCH RRCConnectionReleaseComplete		
16:19:55.358	DL-DCCH MeasurementControl		
16:19:55.408	DL-DCCH RRCConnectionRelease		
16:19:55.428	UL-DCCH RRCConnectionReleaseComplete		
16:19:55.588	UL-DCCH RRCConnectionReleaseComplete		

- Measurement system failures by ***drive test tool***
- Call attempt during Location Area update (LA update clash)

LA Update Request

Call attempt

RRC Release

Non Genuine Call Setup Failures

Measurement system failures by **Actix workbook**

- Successful or failed Location Area update interpreted as call setup failure

Absolute	RRC	RRC Cause	Layer 3
12:12:53.743	BCCH-BCH SysInfoType18		
12:12:53.770	BCCH-BCH SysInfoType11		
12:12:53.770	BCCH-BCH SysInfoType11		
12:12:53.910	UL-CCCH RRCConnectionRequest	RRC_interRAT_CellReselection	
12:12:54.356	DL-CCCH RRCConnectionSetup		
12:12:54.455	DL-CCCH RRCConnectionSetup		
12:12:54.770	DL-DCCH RRCConnectionSetupComplete		
12:12:54.770	DL-CCCH InitialDirectTransfer		MM Location Updating Request
12:12:54.770	DL-CCCH MeasurementReport		
12:12:54.770	DL-CCCH ActiveSetUpdate		
12:12:54.770	DL-CCCH ActiveSetUpdateComplete		
12:12:54.770	DL-CCCH MeasurementControl		
12:12:54.770	DL-CCCH MeasurementControl		
12:12:54.770	DL-CCCH DownlinkDirectTransfer		MM Authentication Request
12:12:54.770	DL-CCCH UplinkDirectTransfer		MM Authentication Response
12:12:56.964	DL-DCCH SecurityModeCommand		
12:12:56.967	UL-DCCH SecurityModeComplete		
12:12:57.279	DL-DCCH DownlinkDirectTransfer		MM Identity Request
12:12:57.281	UL-DCCH UplinkDirectTransfer		MM Identity Response
12:12:59.083	DL-DCCH DownlinkDirectTransfer		MM Location Updating Accept
12:12:59.084	UL-DCCH UplinkDirectTransfer		MM TMSI Reallocation Complete
12:12:59.638	UL-DCCH RRCConnectionReleaseComplete		
12:12:59.802	UL-DCCH RRCConnectionReleaseComplete		
12:13:00.131	BCCH-BCH SysInfoType1		

LA Update Request

RRC Connection for Inter-RAT cell reselection

Non Genuine Drop Call Scenarios

Measurement system failure examples:

- Drive test tool
 - User initiated “UL CC Disconnect”
- Analysis Workbook
 - Inter-Rat cell reselection from 2G to 3G interpreted as drop call
 - Complete (e.g 90 seconds) call on either 3G or 2G
 - No drop in the log file / same drop listed twice

Genuine Call Setup Failure Scenarios

- RF issue
 - Interference / Dominance / Coverage
 - Missing neighbour
- System Issue - BTS
 - No response to “RRC Connection Request”
 - “RRC Connection Reject” to “RRC Connection Request”
- System issue - RNC
 - “CC Disconnect” after “Call Proceeding” due to “DL RRC Connection Release”
- Core NW
 - “CM Service Abort” after “CM Service Request”
- System issue (test number)
 - “CC Disconnect” after “CC Progress”

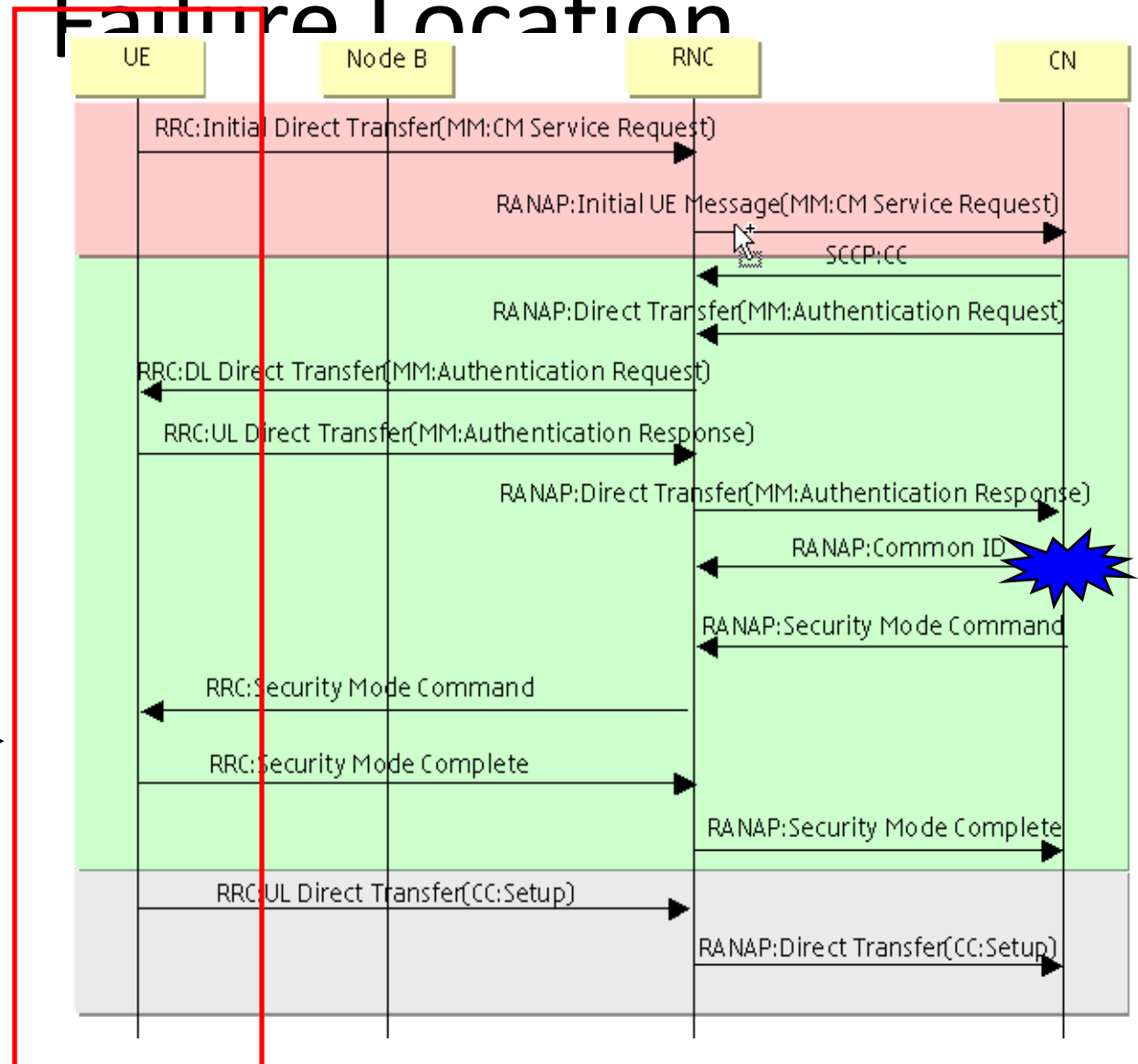
Genuine Drop Call scenarios

- RF issue
 - Interference / Dominance / Coverage
 - Missing Neighbours
- System issue BTS
 - Sudden “CC Disconnect” due to “DL RRC Connection Release”
 - Sudden drop to idle, no disconnect messaging
- System issue RNC
 - Sudden “CC Disconnect” due to “DL RRC Connection Release”

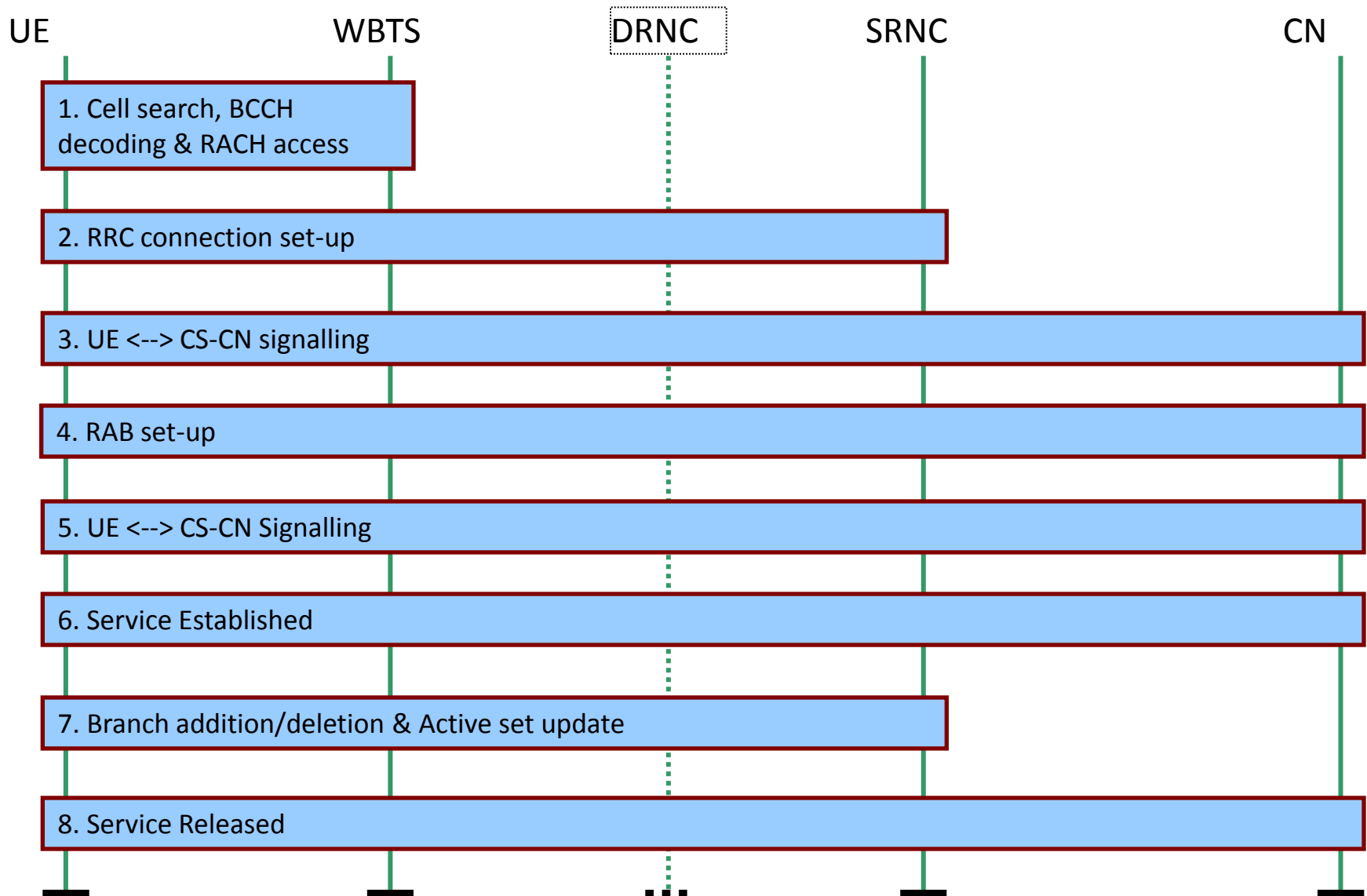
Failure Location

- Analyse the signalling flow to find the location of failure and potential cause

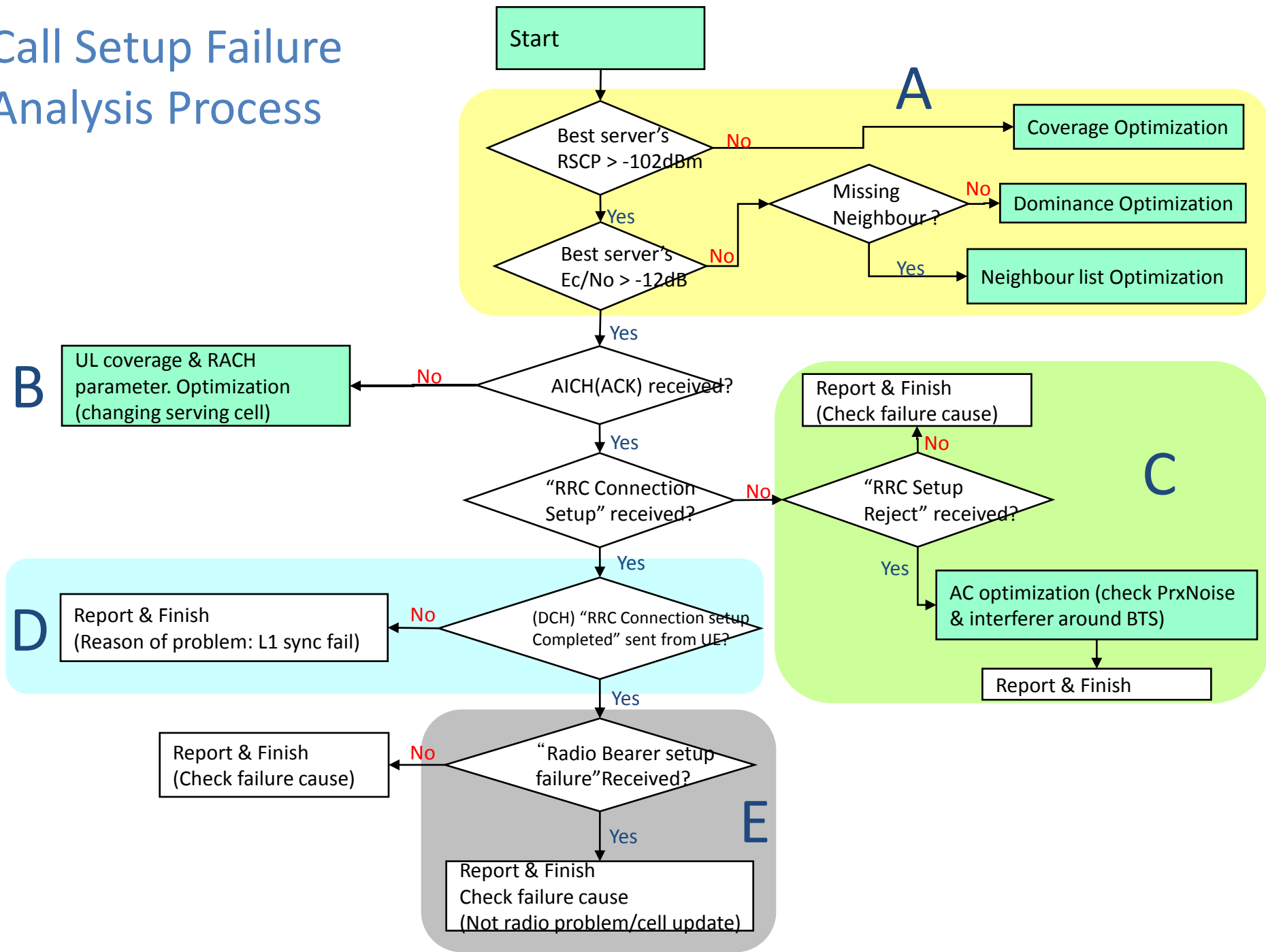
- UE log may only capture some of the messages →



AMR CS Call Phases

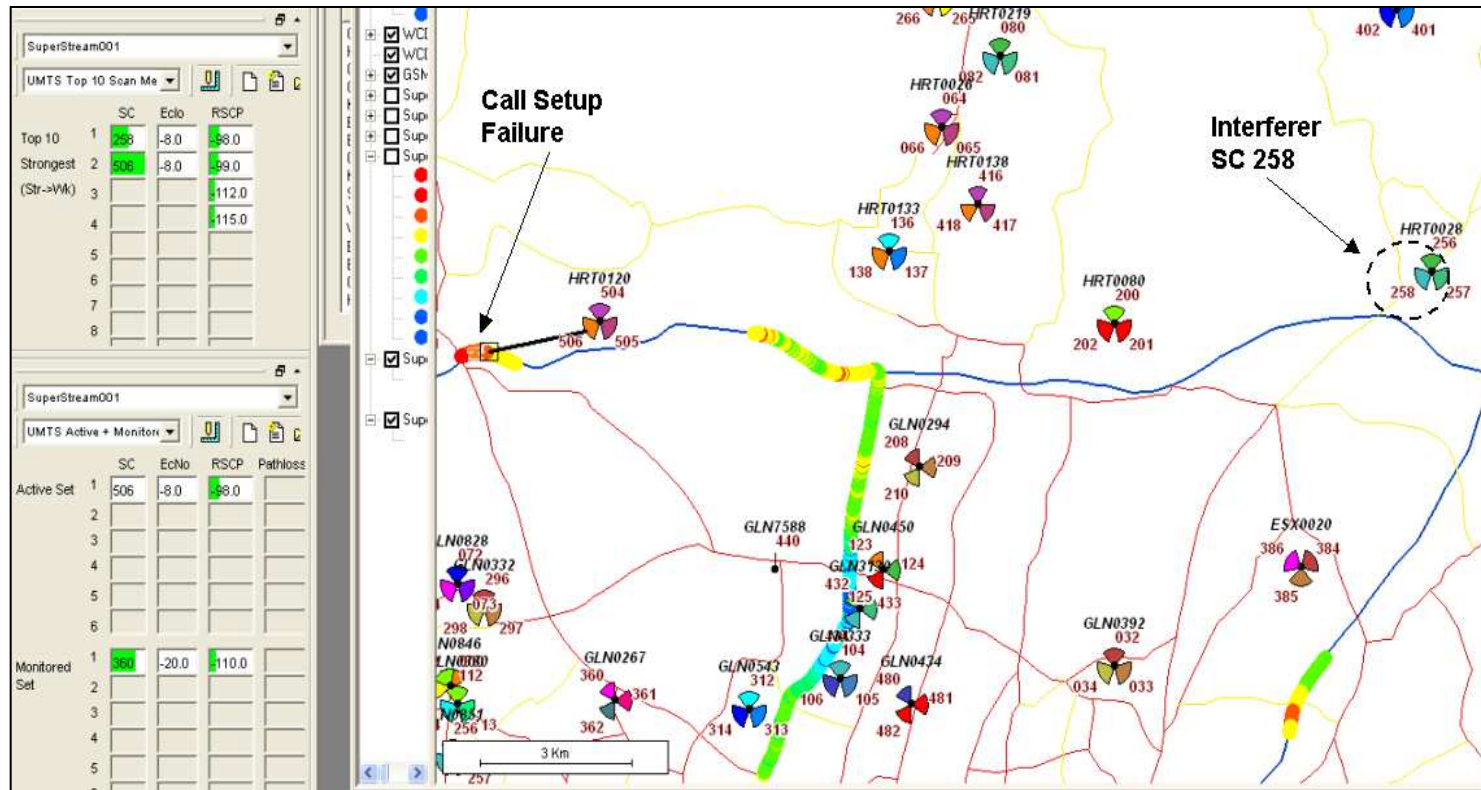


Call Setup Failure Analysis Process



Call setup failures – RF issue

- RF issue? Coverage / Interference / Dominance



See the example in Module 3 – RF Optimisation

Call setup failures – Missing Neighbour



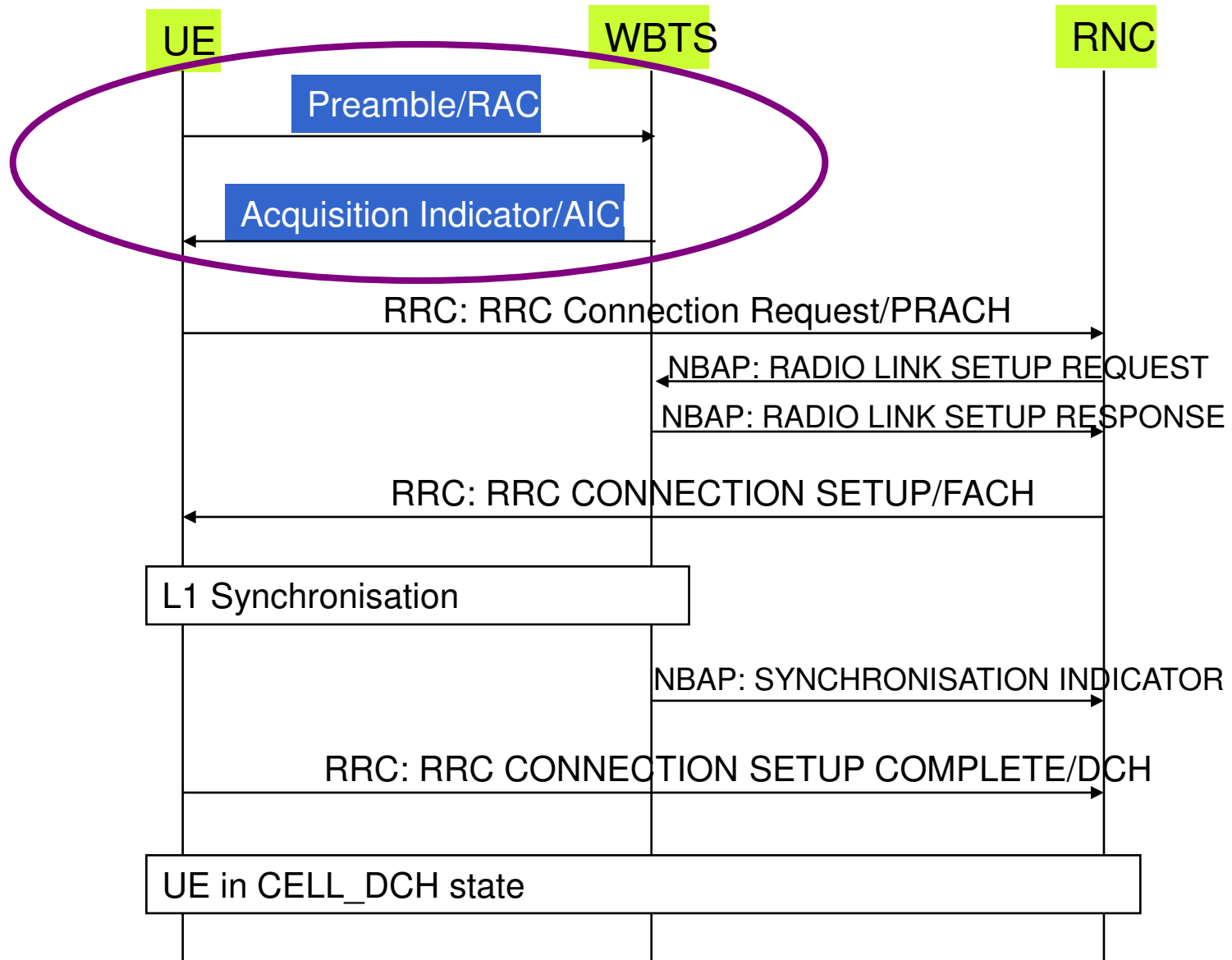
- Missing neighbour analysis over the whole route (3G-3G, 3G-2G)
- Search for failures due to missing 3G-3G neighbours
- Search for failures due to missing 3G –2G neighbours
 - It is suggested to place 2G scanner to the test vehicle

Call Setup Failure Analysis- Block B

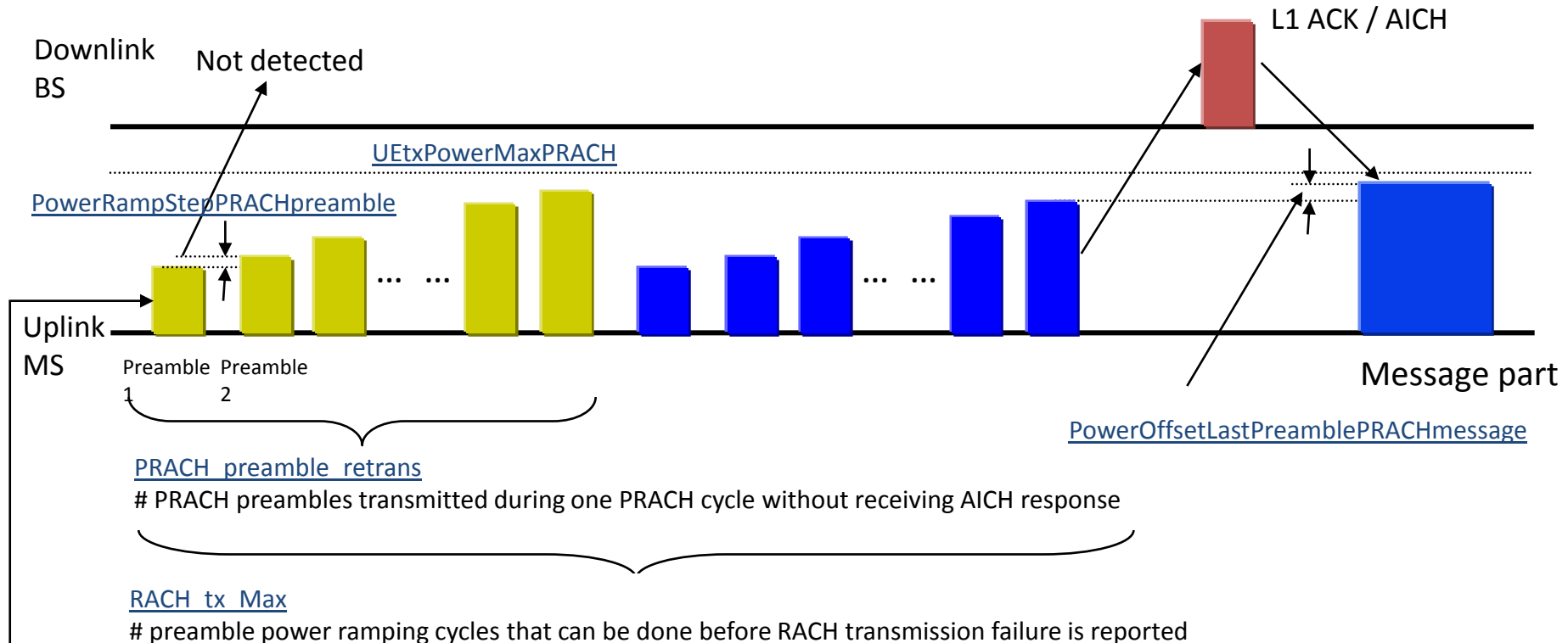
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- The purpose of this activity is to check the Random Access Process is working adequately by investigating whether AI (Acquisition Indicator) has been received through DL AI CH
- If AI CH was not received by UE, the cause of the problem can be classified into:
 - Inadequate RAN parameter related to Random Access: RAN parameter settings for pre-amble transmission or open loop power control information is not correct.
 - UL Coverage limit: UL coverage of UE is smaller compared to serving cells DL coverage so that UE's Tx power cannot reach serving cell.
- The Basic theory for RACH setup procedure

Call Setup Failure Analysis- Block B



RACH Process



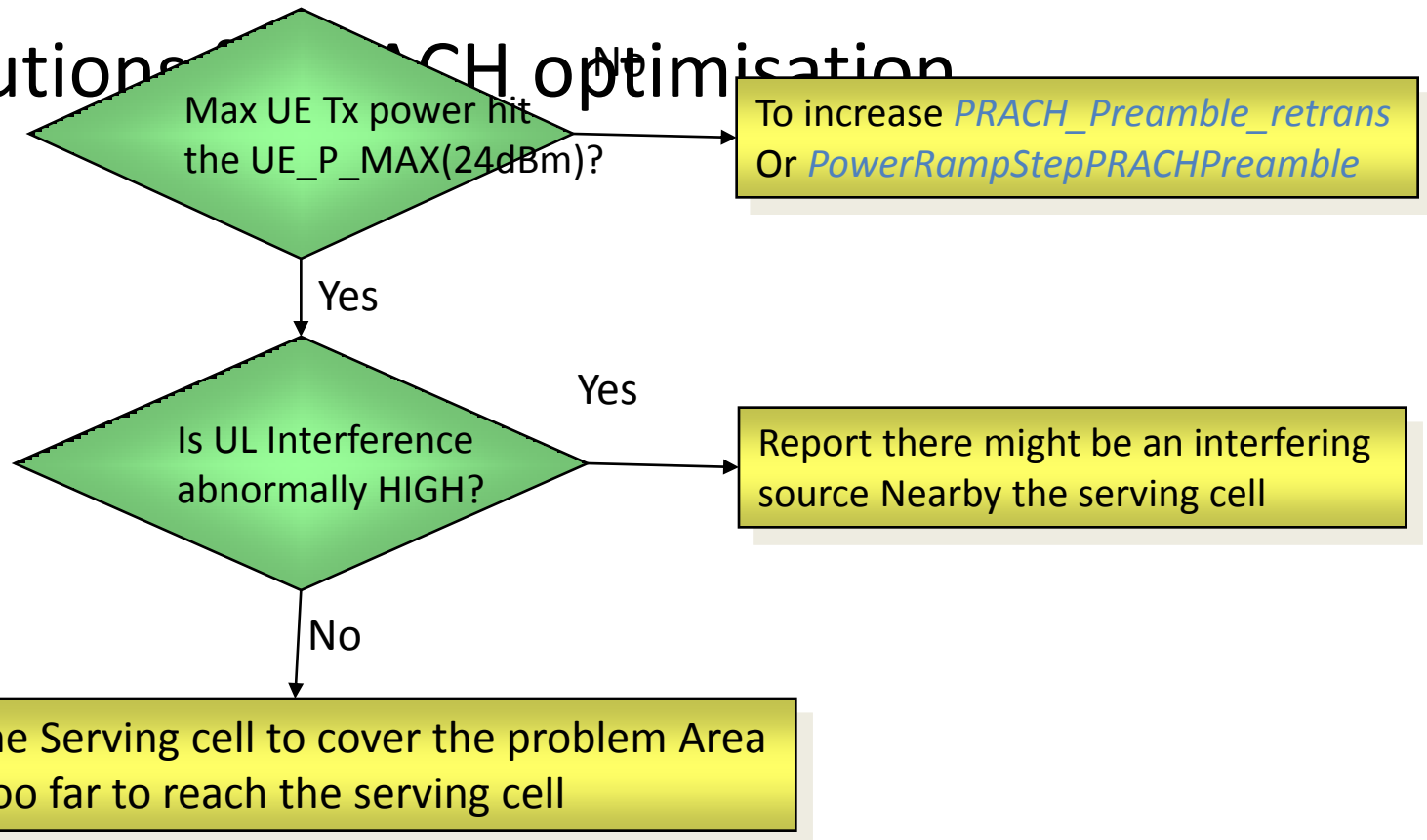
Initial preamble power:

- $P_{tx} = CPICH_{transmissionPower} - RSCP(CPICH) + RSSI(BS) + PRACH_{RequiredReceivedCI}$

Call Setup Failure Analysis- (B)

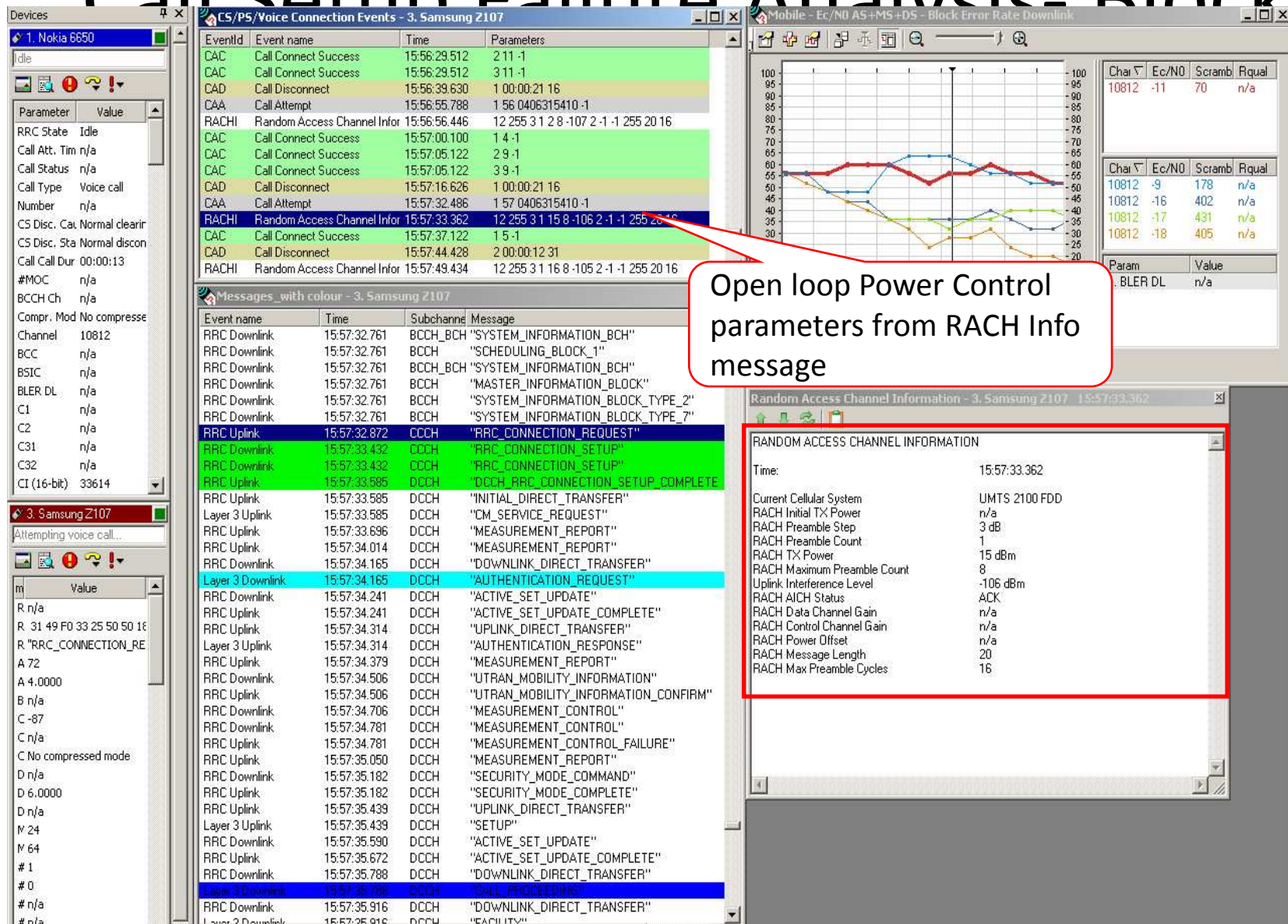
Block B-

- Solutions for PRACH optimisation



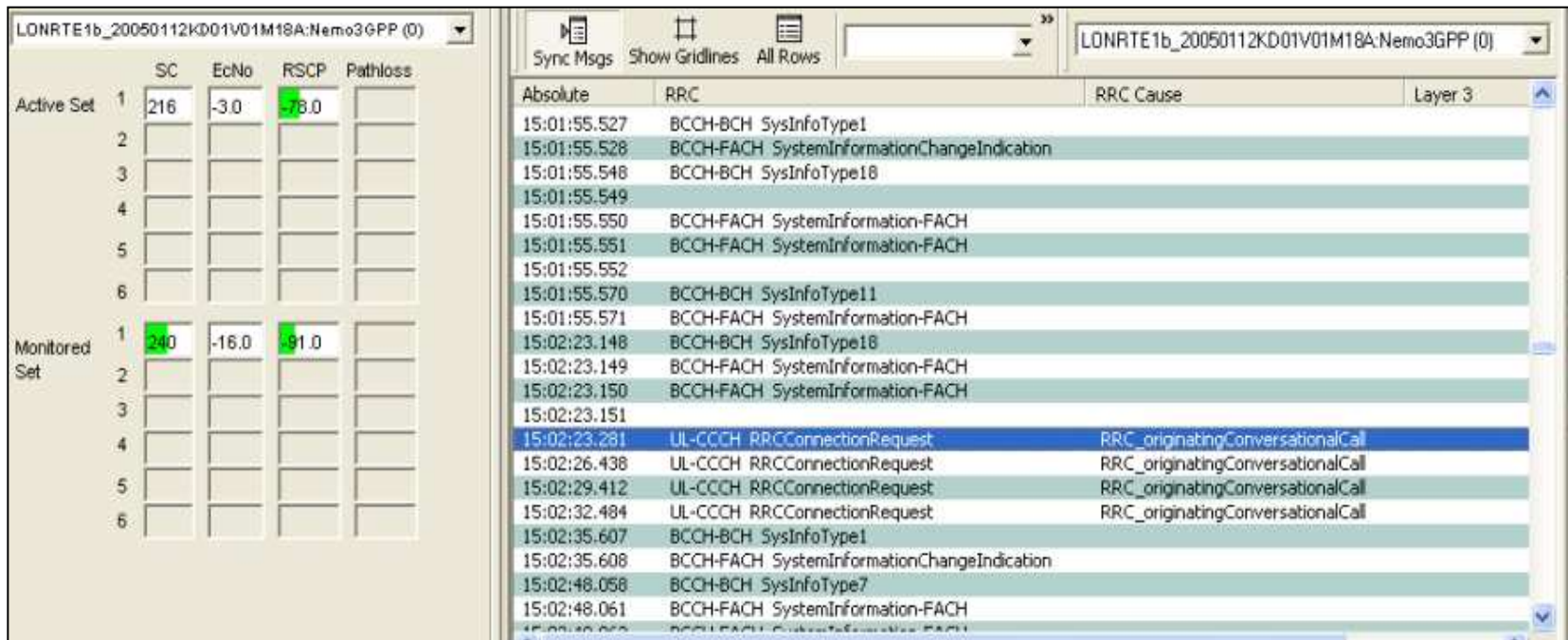
B

Call Setup Failure Analysis- Block B



Call setup failures – System issue

- No response to “RRC Connection Request”
 - Good RF conditions
 - Wrong MHA settings or cable loss settings can cause the site not to “hear” the UE
 - PrxNoise statistics, receive link parameters and HW units to be checked (faulty MHA, wrong MHA parameters, wrong cable / feeder loss parameters, faulty units)



The screenshot displays a network monitoring interface with two main sections. The left section shows RF parameters for an 'Active Set' and a 'Monitored Set'. The right section shows a log of RRC messages.

	SC	EcNo	RSCP	Pathloss
Active Set	1	216	-3.0	-78.0
	2			
	3			
	4			
	5			
	6			
Monitored Set	1	240	-16.0	-91.0
	2			
	3			
	4			
	5			
	6			

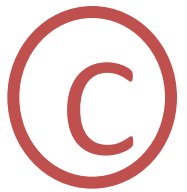
Absolute	RRC	RRC Cause	Layer 3
15:01:55.527	BCCH-BCH SysInfoType1		
15:01:55.528	BCCH-FACH SystemInformationChangeIndication		
15:01:55.548	BCCH-BCH SysInfoType18		
15:01:55.549			
15:01:55.550	BCCH-FACH SystemInformation-FACH		
15:01:55.551	BCCH-FACH SystemInformation-FACH		
15:01:55.552			
15:01:55.570	BCCH-BCH SysInfoType11		
15:01:55.571	BCCH-FACH SystemInformation-FACH		
15:02:23.148	BCCH-BCH SysInfoType18		
15:02:23.149	BCCH-FACH SystemInformation-FACH		
15:02:23.150	BCCH-FACH SystemInformation-FACH		
15:02:23.151			
15:02:23.281	UL-CCCH RRCConnectionRequest	RRC_originatingConversationalCall	
15:02:26.438	UL-CCCH RRCConnectionRequest	RRC_originatingConversationalCall	
15:02:29.412	UL-CCCH RRCConnectionRequest	RRC_originatingConversationalCall	
15:02:32.484	UL-CCCH RRCConnectionRequest	RRC_originatingConversationalCall	
15:02:35.607	BCCH-BCH SysInfoType1		
15:02:35.608	BCCH-FACH SystemInformationChangeIndication		
15:02:48.058	BCCH-BCH SysInfoType7		
15:02:48.061	BCCH-FACH SystemInformation-FACH		

Call setup failures – System issue ©

- “RRC Connection Reject” after “RRC Connection Request”
BTS
 - Good RF conditions
 - Admission Control can reject too many (or admit too many) connection requests due to wrong PrxNoise measurements.

Absolute	RRC	Layer 3
11:18:58.297	BCCH-BCH SysInfoType1	
11:18:58.297	BCCH-BCH SysInfoType2	
11:18:58.299	BCCH-BCH SysInfoType7	
11:18:58.299	BCCH-BCH SysInfoType18	
11:18:58.421	UL-CCCH RRCConnectionRequest	
11:18:58.565	DL-CCCH RRCConnectionReject	
11:19:01.564	UL-CCCH RRCConnectionRequest	
11:19:01.705	DL-CCCH RRCConnectionReject	
11:19:04.704	UL-CCCH RRCConnectionRequest	
11:19:05.090	DL-CCCH RRCConnectionSetup	
11:19:05.385	UL-DCCH RRCConnectionSetupComplete	
11:19:05.389	UL-DCCH InitialDirectTransfer	MM CM Service Request
11:19:05.540	UL-DCCH MeasurementReport	
11:19:06.039	UL-DCCH MeasurementReport	
11:19:06.259	DL-DCCH ActiveSetUpdate	
11:19:06.271	UL-DCCH ActiveSetUpdateComplete	
11:19:06.419	UL-DCCH MeasurementReport	

Call Setup Failure Analysis



- UE has the appropriate DL/UL coverage but if RNC does not allow to set up the RRC connection of the requested RAB (Radio Access Bearer), Call setup will fail.
- Admission Control (AC) is involved in RRC connection setup. AC can reject RRC reject RRC connection Setup due the DL Load, UL load or DL Spreading codes
 - **Marginal Load Area:**
 - If measured UL (PrxTotal) or DL (PtxTotal) load exceeds target thresholds (*PrxTarget* and *PtxTarget*) AC can still admit new RAB to the cell if a new non-controllable load keeps below target thresholds (in practice this means that AC can admit only new controllable load RABs i.e. NRT RABs)
 - **Overload Area:**
 - If measured UL (PrxTotal) or DL (PtxTotal) load exceeds overload thresholds (*PrxTarget* + *PrxOffset* and *PtxTarget* + *PtxOffset*) then AC can't admit more RABs to the cell



Call Setup Failure Analysis

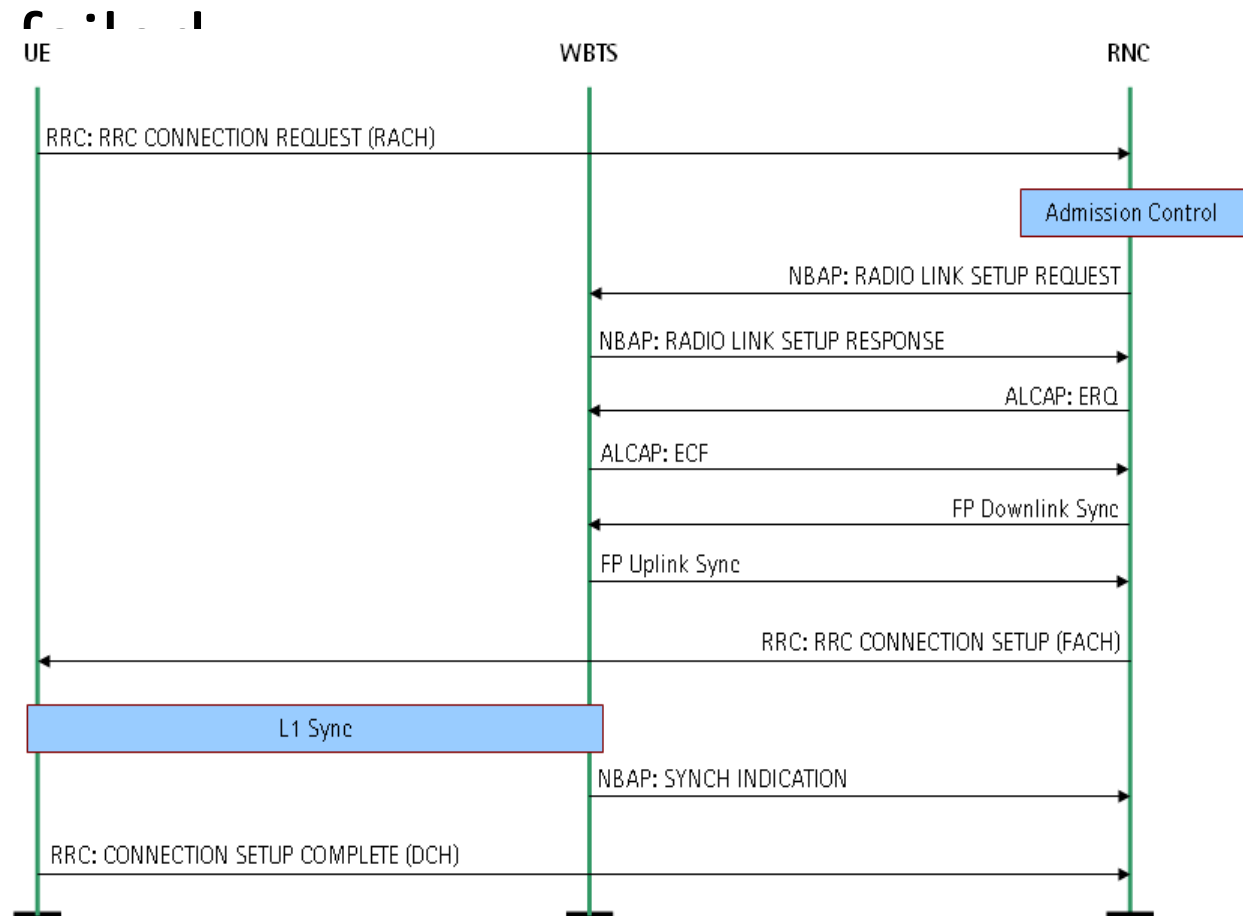
- During the pre-optimization phase it is unlikely that AC will stop an RRC connection setup during the drive testing because there are normally very few UEs in the network. (Traffic loading is trivial)
- However, it should be checked that measured PtxTotal and PrxTotal are less than PtxTarget (e.g. 40dBm) and PrxTarget (e.g. 4dB, 60% loading) respectively.
 - If DL AC does not allow RRC setup check the Tx power of WBTS, # of channels transmitted, Signaling messages.
 - If UL AC does not allow RRC setup: Check out if there is an interfering source nearby the serving cell.

Call Setup Failure Analysis



To check if Layer 1 Synchronization (slot/frame sync) has failed

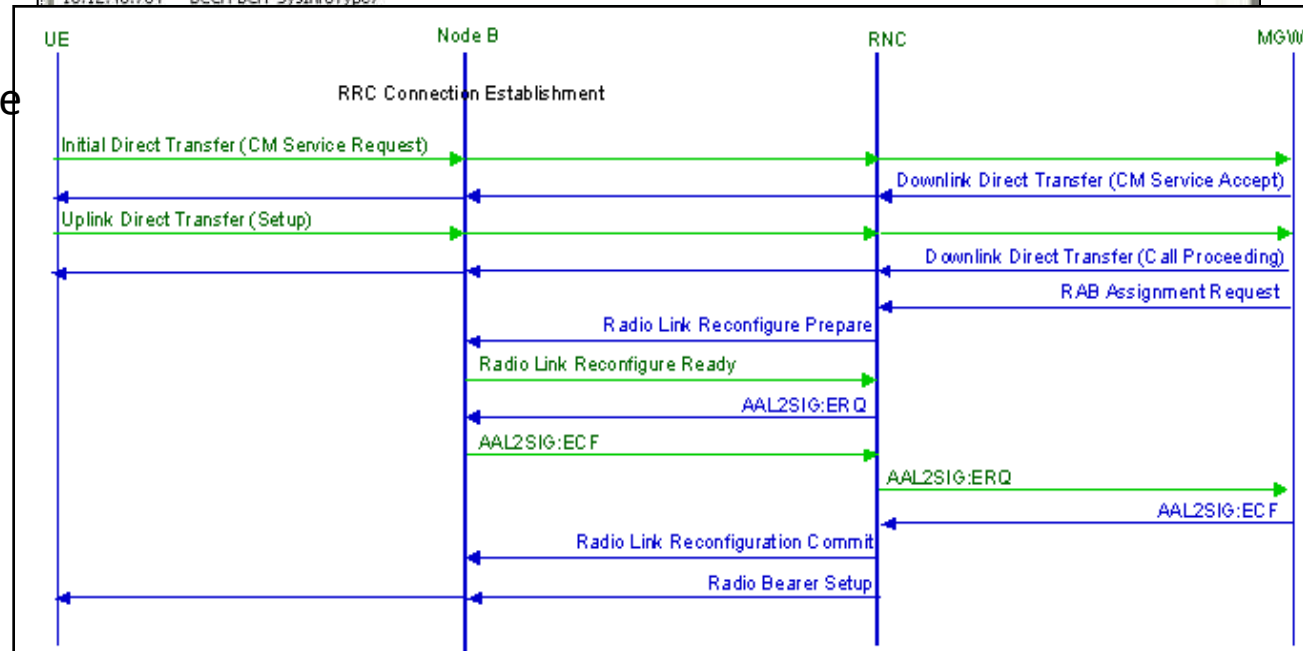
- If “RRC Connection Setup Complete” message is received, the RNC has to check if



Call setup failures – System issue RNC

- “CC Disconnect” after “Call Proceeding”
- Good RF conditions
- Failures in RAB setup occur between the “RAB Assignment Request” being received from Core Network and the RAN sending out Radio Bearer Setup. Therefore the failure is between BTS and Core Network.

Absolute	RRC	RRC Cause	Layer 3
16:12:09.068	UL-DCCH ActiveSetUpdateComplete		
16:12:09.338	DL-DCCH UTRANMobilityInformation		
16:12:09.338	UL-DCCH UTRANMobilityInformationConfirm		
16:12:09.629	DL-DCCH SecurityModeCommand		
16:12:09.629	UL-DCCH SecurityModeComplete		
16:12:09.629	UL-DCCH UplinkDirectTransfer		CC Setup
16:12:10.019	DL-DCCH MeasurementControl		
16:12:10.069	DL-DCCH MeasurementControl		
16:12:10.220	DL-DCCH DownlinkDirectTransfer		CC Call Proceeding
16:12:10.300	DL-DCCH RRCConnectionRelease		
16:12:10.300	UL-DCCH RRCConnectionReleaseComplete		
16:12:10.320	UL-DCCH UplinkDirectTransfer		CC Disconnect
16:12:10.470	UL-DCCH RRCConnectionReleaseComplete		
16:12:10.620	UL-DCCH RRCConnectionReleaseComplete		
16:12:10.620	DL-DCCH MeasurementControl		
16:12:10.901	BCCH-BCH SysInfoType1		
16:12:10.901	BCCH-BCH MasterInformationBlock		
16:12:40.764	BCCH-BCH SysInfoType18		
16:12:40.764	BCCH-BCH SysInfoType2		
16:12:40.764	BCCH-BCH SysInfoType7		



Call setup failures

- “CC Disconnect” after “Call Proceeding” (cont.)
- An example (site shows high values on counter “RAB_STP_FAIL_CS_VOICE_BT S” during the drive test
- In the recent check the counter showed no failures.

057050	15:18:06.544	01:28:08.544	000000	BCCH-BCH SysInfoType2	
057051	15:18:06.544	01:28:08.544	000000	BCCH-BCH SysInfoType7	
057053	15:18:06.684	01:28:08.684	000140	UL-CCCH RRCConnectionRequest	RRC_terminatingConversationalCall
057055	15:18:07.125	01:28:09.125	000441	DL-CCCH RRCConnectionSetup	
057057	15:18:07.405	01:28:09.405	000280	UL-DCCH RRCConnectionSetupComplete	
057060	15:18:07.405	01:28:09.405	000000	UL-DCCH InitialDirectTransfer	MM CM Service Request
057062	15:18:07.565	01:28:09.565	000160	UL-DCCH MeasurementReport	
057064	15:18:08.066	01:28:10.066	000501	UL-DCCH MeasurementReport	
057067	15:18:08.357	01:28:10.357	000291	DL-DCCH ActiveSetUpdate	
057068	15:18:08.377	01:28:10.377	000020	UL-DCCH ActiveSetUpdateComplete	
057070	15:18:08.707	01:28:10.707	000330	DL-DCCH SecurityModeCommand	
057071	15:18:08.707	01:28:10.707	000000	UL-DCCH SecurityModeComplete	
057072	15:18:08.707	01:28:10.707	000000	UL-DCCH UplinkDirectTransfer	CC Setup
057074	15:18:09.168	01:28:11.168	000461	DL-DCCH MeasurementControl	
057077	15:18:09.218	01:28:11.218	000050	DL-DCCH MeasurementControl	
057078	15:18:09.278	01:28:11.278	000060	DL-DCCH DownlinkDirectTransfer	CC Call Proceeding
057080	15:18:09.679	01:28:11.679	000401	DL-DCCH RRCConnectionRelease	
057082	15:18:09.699	01:28:11.699	000020	UL-DCCH RRCConnectionReleaseComplete	
057084	15:18:09.699	01:28:11.699	000000	UL-DCCH UplinkDirectTransfer	CC Disconnect
057086	15:18:09.769	01:28:11.769	000070	DL-DCCH MeasurementControl	
057088	15:18:09.799	01:28:11.799	000030	DL-DCCH RRCConnectionRelease	
057089	15:18:09.849	01:28:11.849	000050	UL-DCCH RRCConnectionReleaseComplete	
057090	15:18:09.999	01:28:11.999	000150	UL-DCCH RRCConnectionReleaseComplete	
057091	15:18:10.289	01:28:12.289	000290	BCCH-BCH SysInfoType7	

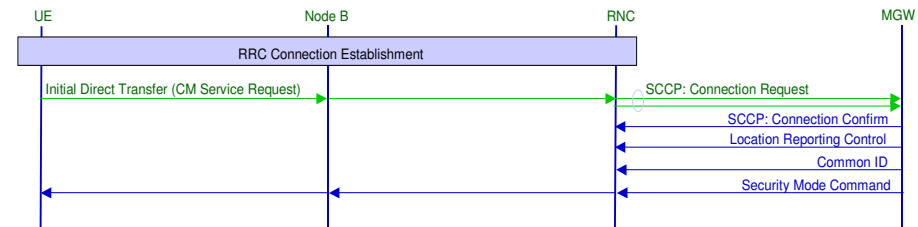


Call setup failures – Core NW



- “CM Service Abort” after “CM Service Request”
- Good RF conditions
- “Security Mode Command”-message not received by UE, thus the failure is believed to be at Core Network.

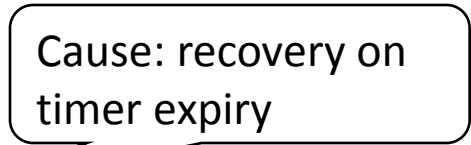
057040	17:26:17.273	01:23:51.273	000000	BCCH-BCH SysInfoType2	
057041	17:26:17.415	01:23:51.415	000140	BCCH-BCH SysInfoType7	
057042	17:26:17.415	01:23:51.415	000000	BCCH-BCH SysInfoType18	
057044	17:26:17.415	01:23:51.415	000000	UL-CCCH RRCConnectionRequest	RRC_originatingConversationalCall
057048	17:26:17.916	01:23:51.916	000501	DL-CCCH RRCConnectionSetup	
057049	17:26:18.226	01:23:52.226	000310	UL-DCCH RRCConnectionSetupComplete	
057052	17:26:18.226	01:23:52.226	000000	UL-DCCH InitialDirectTransfer	MM CM Service Request
057054	17:26:18.386	01:23:52.386	000160	UL-DCCH MeasurementReport	
057057	17:26:18.887	01:23:52.887	000501	UL-DCCH MeasurementReport	
057059	17:26:18.907	01:23:52.907	000020	DL-DCCH ActiveSetUpdate	
057060	17:26:18.917	01:23:52.917	000010	UL-DCCH ActiveSetUpdateComplete	
057062	17:26:19.218	01:23:53.218	000301	DL-DCCH UTRANMobilityInformation	
057063	17:26:19.228	01:23:53.228	000010	UL-DCCH UTRANMobilityInformationConfirm	
057067	17:26:22.302	01:23:56.302	003074	DL-DCCH MeasurementControl	
057069	17:26:22.352	01:23:56.352	000050	DL-DCCH MeasurementControl	
057070	17:26:22.462	01:23:56.462	000110	DL-DCCH RRCConnectionRelease	
057072	17:26:22.462	01:23:56.462	000000	UL-DCCH RRCConnectionReleaseComplete	
057074	17:26:22.482	01:23:56.482	000020	UL-DCCH UplinkDirectTransfer	MM CM Service Abort
057076	17:26:22.623	01:23:56.623	000141	UL-DCCH RRCConnectionReleaseComplete	
057077	17:26:22.673	01:23:56.673	000050	DL-DCCH RRCConnectionRelease	
057078	17:26:22.783	01:23:56.783			
057080	17:26:23.073	01:23:57.073			
057081	17:26:23.093	01:23:57.093			
057082	17:26:23.113	01:23:57.113			
057083	17:26:23.113	01:23:57.113			



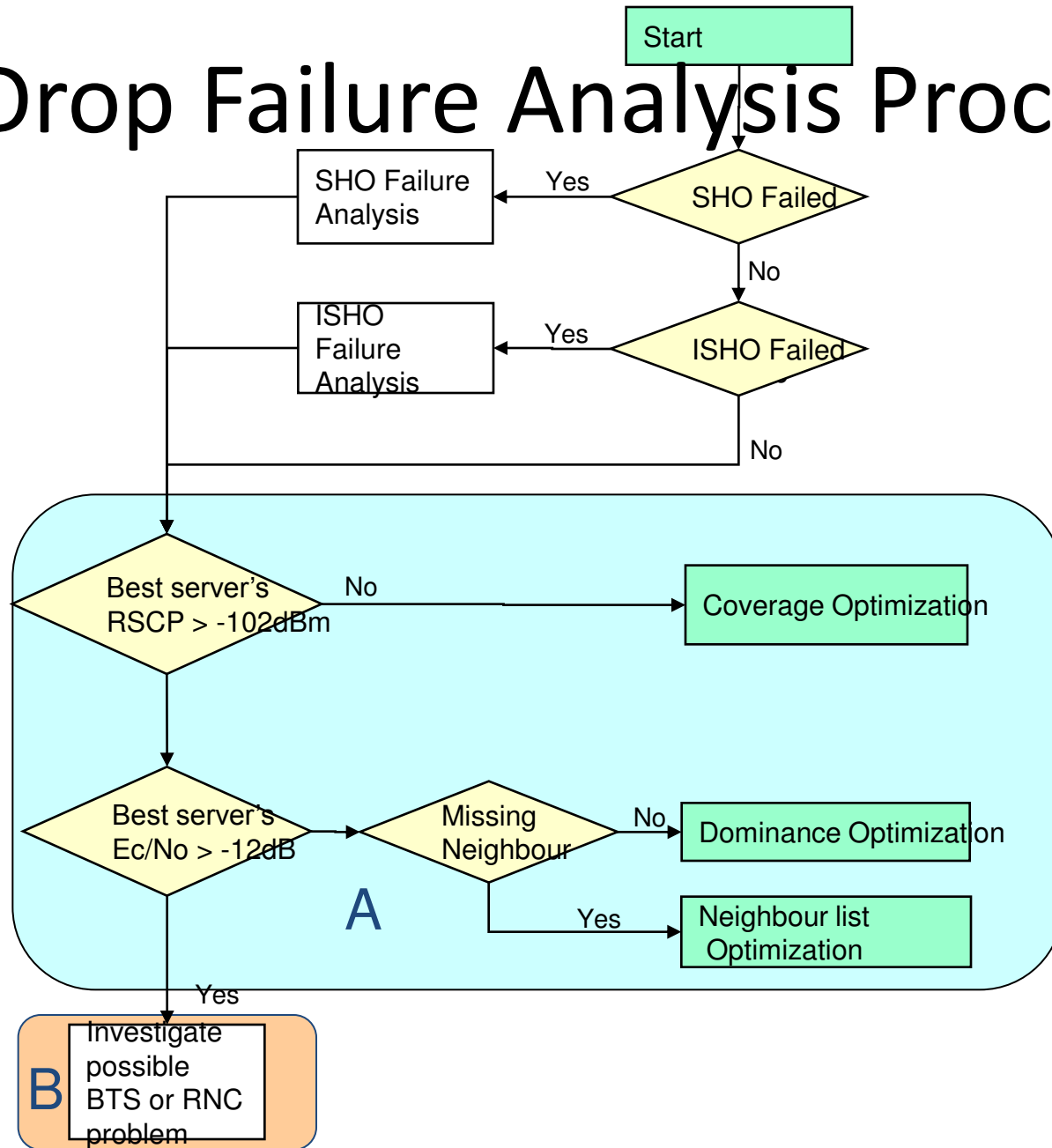
- *RRC: Initial Direct Transfer* message is sent using acknowledged mode RLC to the CS core domain. Routing is to be based upon the local P-TMSI
- The NAS message is not read by the RNC but is forwarded to the multimedia gateway. The NAS message includes the IMSI as a UE identity
- The *SCCP: Connection Request* message establishes the connection orientated signalling link in the same way as it was for the RRC connection phase. This does not reserve any resources for the AMR call itself.
- The *Connection Confirm* message identifies the RNC with a destination local reference which is the same as the source reference within the *Connection Request* message
- The *Connection Confirm* message identifies the CS core with a source local reference
- The CS core sends a *RANAP: Location Reporting Control* message to the RNC requesting information regarding the location of a particular UE
- The *RANAP: Common ID* message specifies the IMSI belonging to the UE
- The *Security Mode Command* message triggers the start or stop of ciphering and integrity protection.

est E

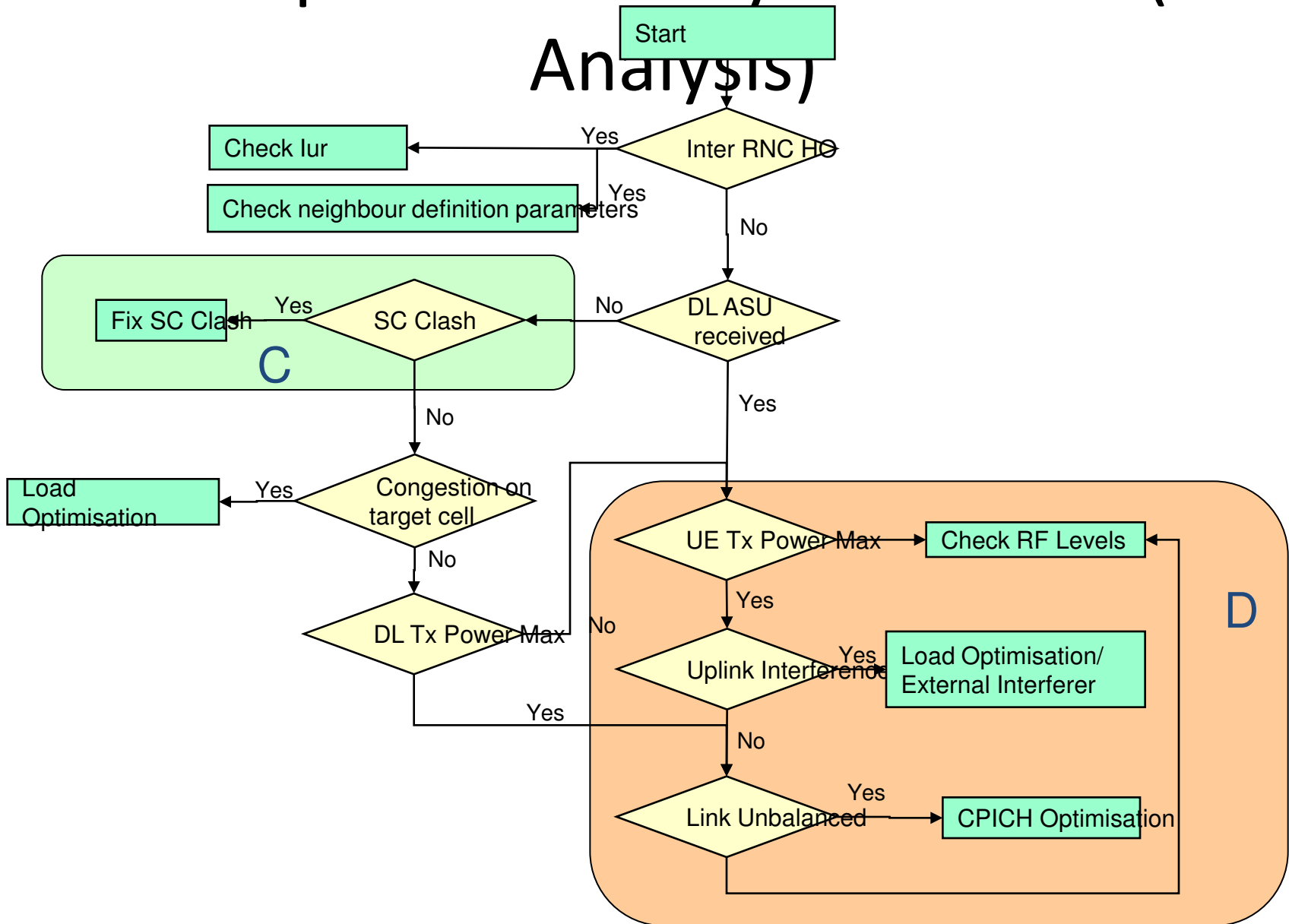
- # num



Call Drop Failure Analysis Process



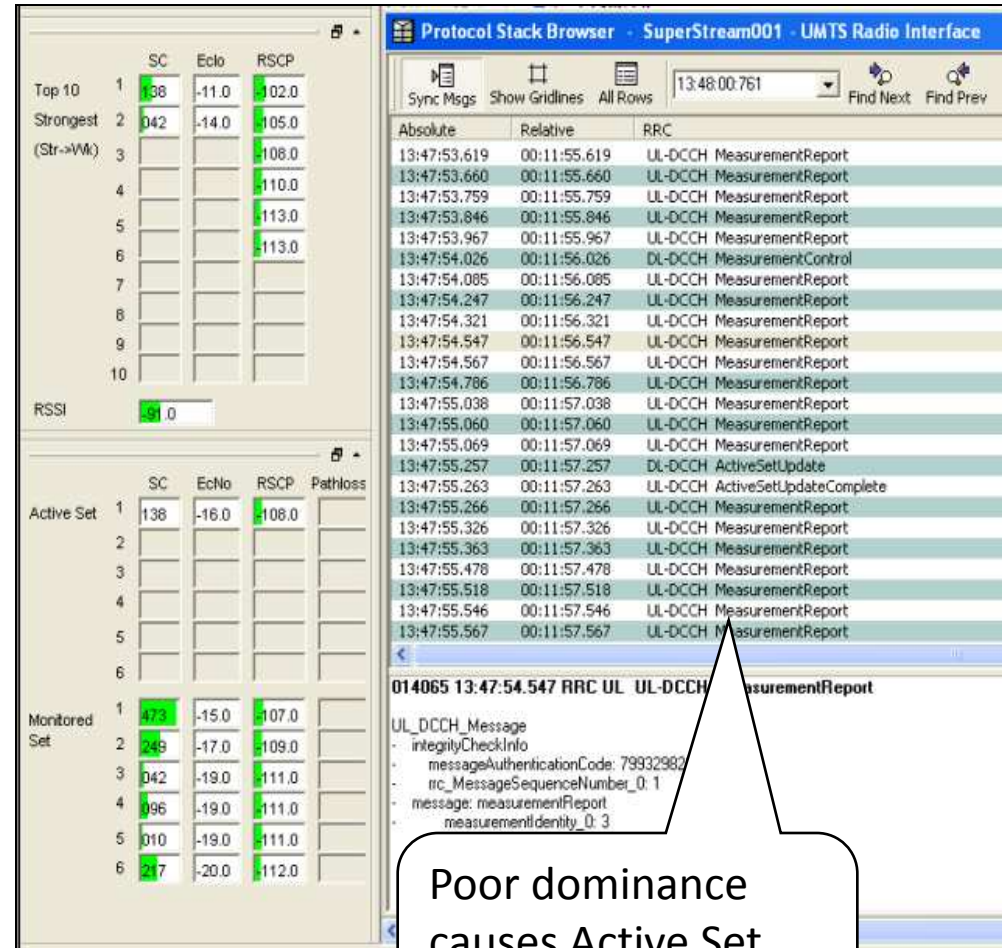
Call Drop Failure Analysis Process (SHO Analysis)





Drop call failures – RF issue

- RF drops mostly due to poor dominance or interference
- Poor coverage could lead to ISHO, although poor dominance or interference can cause ISHO to fail.
- Rapid field drop can cause drop due to coverage
- Poor dominance or interference can cause Compressed Mode (CM) to start even if RSCP is still good.
- In CM UE transmits with higher power (more interference) and spends less time on 3G (less accurate measurement reporting)
- Poor dominance or interference can lead to Active Set update failures and eventually to drop call.





Drop call failures – RF issue

DL synchronisation is lost -> UE has stopped transmitting

TrChAgg and DL DPCCH BER high

Time	Uu_TrCh...	Uu_Pilot...	UE_TxPow
10:28:59.765	99.50		
10:28:59.765		24.90	
10:28:59.878			
10:28:59.878			
10:28:59.939			
10:28:59.939			
10:28:59.951			
10:28:59.985			
10:28:59.985			
10:28:59.985			
10:29:00.088			
10:29:00.088			
10:29:00.318			
10:29:00.318			
10:29:00.449			
10:29:00.501			
10:29:00.501			
10:29:00.501			
10:29:00.702			
10:29:00.702			
10:29:00.767			
10:29:00.767			
10:29:00.767	98.00		
10:29:00.767		25.40	



Drop call failures – RF issue

Fairly good CPICH Pilot EcNo

Transport Channel BER. Btw UE<->RNC (MAC layer)

Sometimes DPCCH BER (btw UE<->WBTS) can be a better indicator of what's happening to the dedicated channel than the CPICH EcNo, in particular in the case that power control may not be tracking well

Top 10	SC	EcNo	RSCP
1	258	-9.0	01.0
2	506	-11.0	03.0
3	302	-17.0	09.0
4	002	-18.0	110.0
5	072	-23.0	115.0

Active Set	SC	EcNo	RSCP	Pathloss
1	506	-10.0	02.0	
2	258	-10.0	02.0	
3				
4				
5				
6				

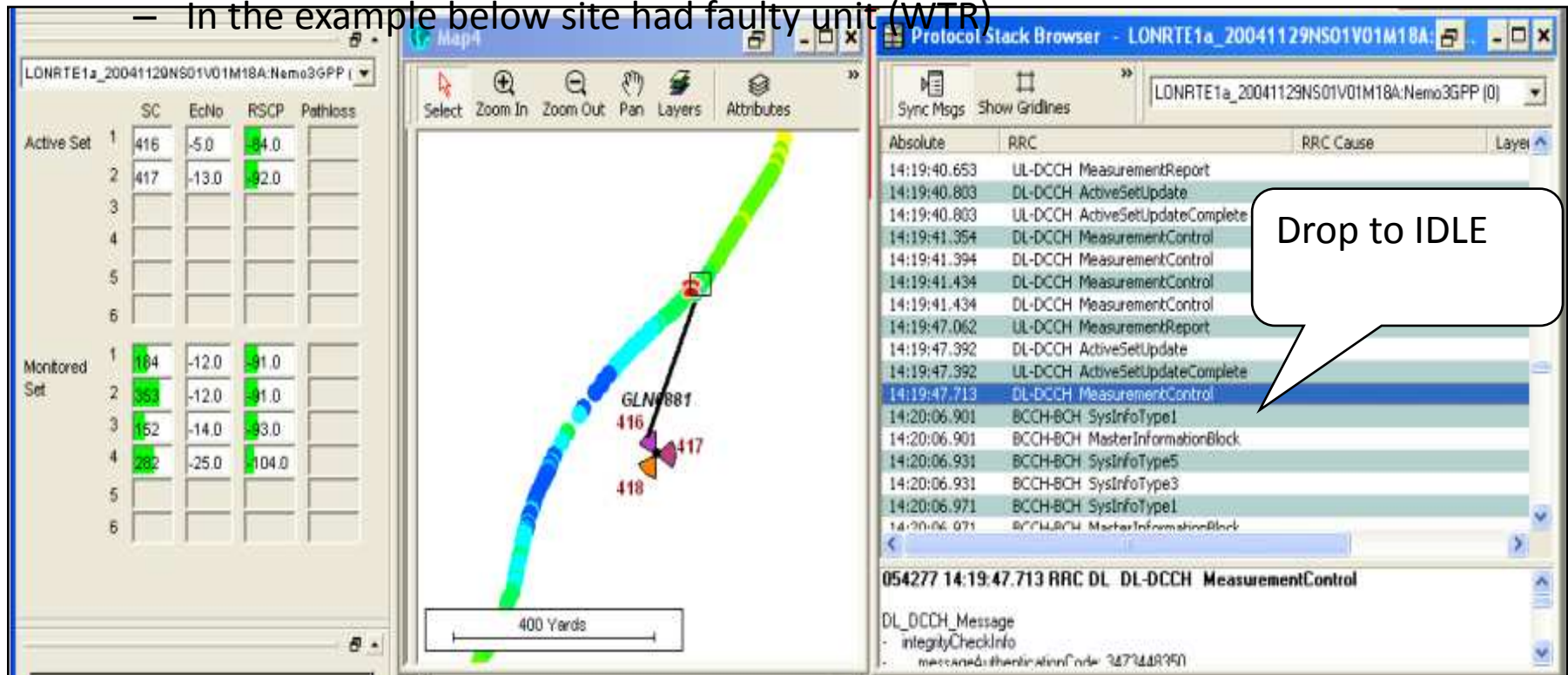
Monitored Set	SC	EcNo	RSCP
1	072	-14.0	06.0
2	302	-17.0	09.0
3	002	-18.0	110.0
4	112	-24.0	116.0
5	185	-24.0	116.0

Time	Uu_TrCh_DownlinkBlerAgg	Uu_Pilot_DownlinkBER
15:10:31:620		
15:10:31:943		
15:10:31:943		
15:10:31:969		
15:10:31:969		
15:10:32:071		
15:10:32:071		
15:10:32:103		
15:10:32:103		
15:10:32:246		
15:10:32:246	100.00	22.00
15:10:32:246		
15:10:32:390		
15:10:32:390		
15:10:32:427		
15:10:32:427		
15:10:32:462		
15:10:32:462		
15:10:32:606		
15:10:32:606		
15:10:32:761		

Drop call failures – System issue BTS

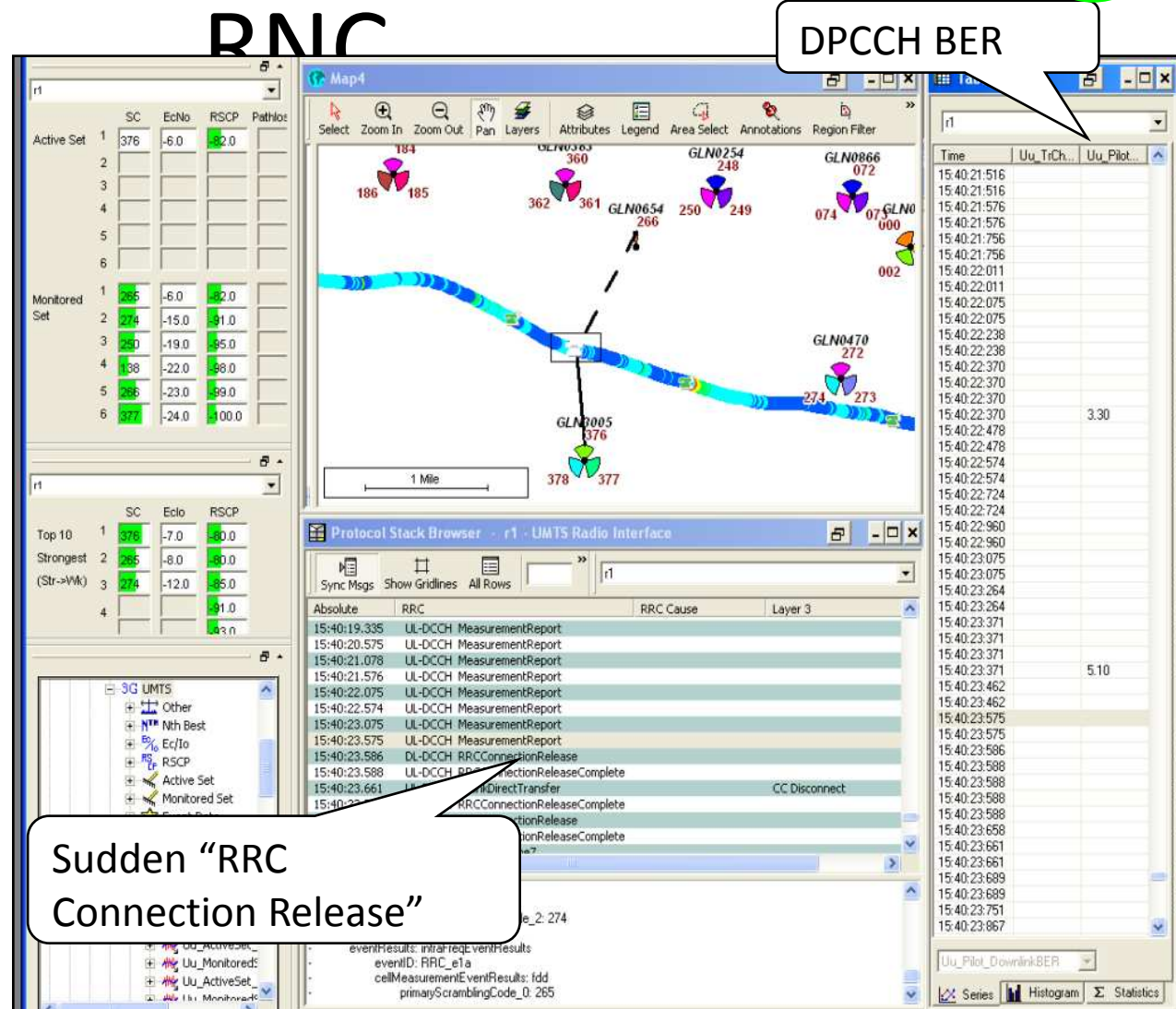
B

- Sudden drop to idle, no disconnect messaging
 - Site malfunctions to be checked
 - In the example below site had faulty unit (WTR)



Drop call failures – System issue B

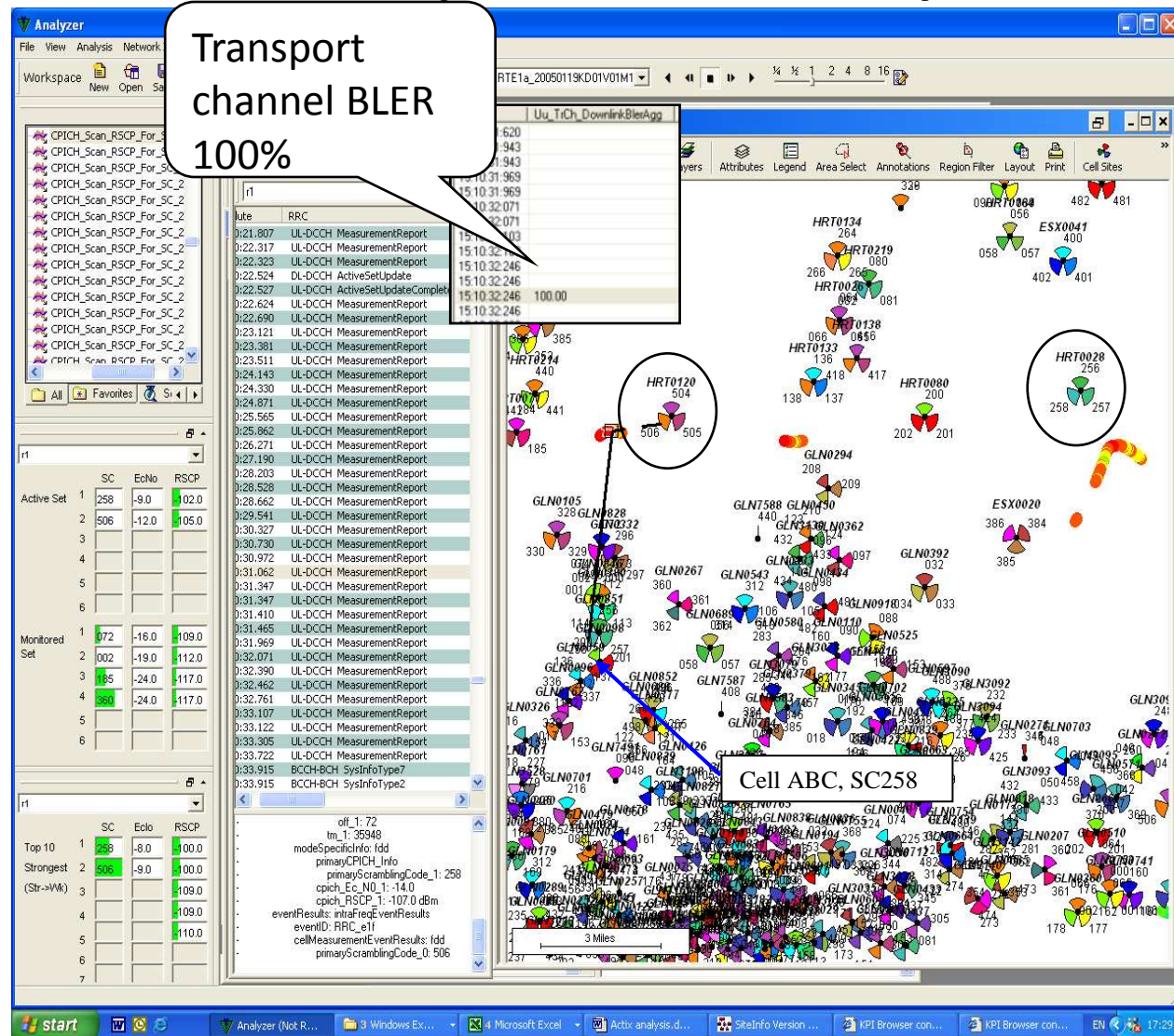
- “CC Disconnect” due to “DL RRC Connection Release”
- No response to UL Measurement Reports
- In the example site had no alarms, good RF & BER
- Not able to add SC265 to Active Set, next call on the same cell => no failure.
- Difficult to troubleshoot if the failure does not happen systematically => follow up in the next weeks drive / do a separate drive test in the area



Drop call failures (SC conflict)



- Sudden drop to idle mode (no disconnect messaging)
- Cause of the failure: overshooting site and SC reuse
- Short term solution to add overshooting neighbour in ADJS definitions



Drop Call - Uplink Interference



Protocol Stack Browser - r1 - UMTS Radio Interface

Sync Msgs Show Gridlines All Rows 15:10:33.915 Find Next

UL interference from the SIB7 message

Active Set	SC	EcNo	RSCP	Pathloss
1	386	-6.0	-91.0	
2				
3				
4				
5				
6				

Monitored Set	SC	EcNo	RSCP	Pathloss
1	153	-13.0	-98.0	
2	385	-14.0	-99.0	
3	152	-14.0	-99.0	
4	224	-15.0	-100.0	
5	232	-16.0	-101.0	
6	041	-25.0	-110.0	

Top 10	SC	EcNo	RSCP
1	386	-7.0	-90.0
Strongest	153	-12.0	-96.0
(Str->Wk)	152	-14.0	-99.0
4	224	-14.0	-99.0
5			-103.0

14:07:47.730 BCCH-BCH SysInfoType1

14:07:47.730 BCCH-BCH SysInfoType2

14:07:47.730 BCCH-BCH SysInfoType7

14:07:47.730 BCCH-BCH SysInfoType18

14:07:47.737 BCCH-BCH SysInfoType11

14:07:47.737 BCCH-BCH SysInfoType11

14:07:47.894 UL-CCCH RRCConnectionRequest RRC_originatingConversationalCall

14:07:48.261 DL-CCCH RRCConnectionSetup

14:07:48.357 DL-CCCH RRCConnectionSetup

14:07:48.664 UL-DCCH RRCConnectionSetupComplete

14:07:48.664 UL-DCCH InitialDirectTransfer MM CM Service Request

14:07:49.247 DL-DCCH SecurityModeCommand

14:07:49.327 UL-DCCH SecurityModeComplete

14:07:49.327 UL-DCCH UplinkDirectTransfer CC Setup

14:07:49.729 DL-DCCH DownlinkDirectTransfer CC Call Proceeding

14:07:50.444 DL-DCCH RadioBearerSetup

14:07:51.470 UL-DCCH RadioBearerSetupComplete

14:07:51.774 DL-DCCH DownlinkDirectTransfer CC Proceed

149578 14:07:47.730 RRC DL BCCH-BCH SysInfoType7

SysInfoType7

- modeSpecificInfo: fdd
- ul_interference: -105
- DynamicPersistenceLevelList_0: 1



Drop Call – Link Balance

- UL & DL Power Control commands can help indicating problems in link balance.
- PC frequency is 1500 Hz, thus ideally the sum of PC commands to increase or decrease power is 1500
- E.g. if the sum of UL PC commands is < 1500, this would indicate UE is starting to loose synchronization
- in Compressed Mode there is less PC commands, UE spends time on 2G

026239 10:28:53.773 Nemo RX Power
Event ID: RXPC, Longitude: -0.4025
Height: 25,
Distance(m): 21675, GPS status: with
Velocity(km/h): 111 kph, Time: 10:28
Cellular System: WCDMA FDD 2100,
RSSI analog (dBm): 255.0 dBm,
RSSI digital (dBm): 255,
SIR target (dB) (N/A if it is < 0 and > 100): 4.4,
SIR current (dB) (N/A if it is < 0 and > 100): 255.0,
BS diversity state: Not active,
Number of Increase DL Power Commands(Mobile->BTS): 1285,
Number of Decrease DL Power Commands(Mobile->BTS): 40,
Percentage of Increase DL Power Commands(Mobile->BTS)
(N/A if it is < 0 and > 100): 97.00,
DPC mode (N/A if it is < 0 and > 100): -1

UE RX power control
message: DL reception
weak -> UE is ordering
WBTS to increase power.

Message Browser - wk03

Sync Events Sync Msgs Find Next Find Prev Stop Find wk03

Event Panel

- 15:22:26.633 Scanning Results
- 15:22:26.633 Rcvd Signal Code Power
- 15:22:26.740 Nemo EC/NO
- 15:22:26.740 Nemo TX Power Control
- 15:22:26.740 Nemo Phy Chan Data Throughput
- 15:22:26.740 Nemo Bit Error Rate
- 15:22:26.764 RRC UL UL-DCCH MeasurementReport
- 15:22:26.764 Nemo SHO Info
- 15:22:26.797 RRC UL UL-DCCH MeasurementReport
- 15:22:26.799 Dedicated Mode: RxLev Full: N/A RxLev Sub: N/A

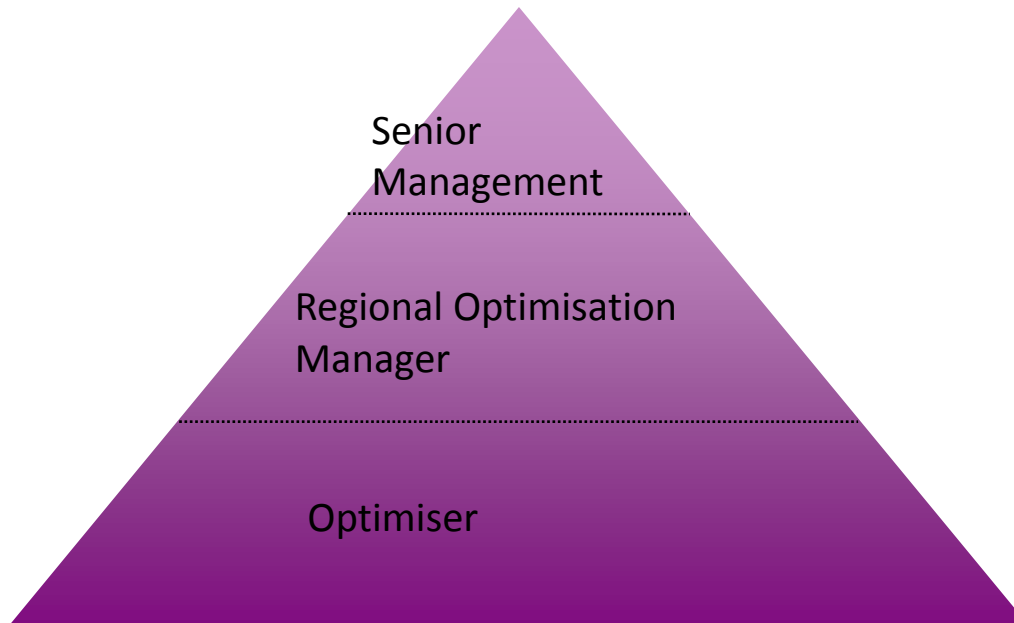
913173 77:41:39.740 15:22:26.740 Nemo TX Power Control
Event ID: TXPC, Longitude: -0.233377, Latitude: 51.597, Height: 58,
Distance(m): 111999, GPS status: with GPS, No. Satellites: 8,
Velocity(km/h): 72 kph, Time: 15:22:26.740
Cellular System: WCDMA FDD 2100,
TX pow (dBm): 9.0 dBm,
TX pow ctrl algo: PC Algo 1,
TX pow ctrl step size (dB): 1,
Compressed mode: Compressed,
Number of Increase UL Power Commands(BTS->Mobile): 648,
Number of Decrease UL Power Commands(BTS->Mobile): 652,
Percentage of Increase UL Power Commands(BTS->Mobile): 49.80
TXPC -0.233377 51.597031 58 111999 1 8 72 15:22:26.740 12 9 0 1 1 648
652 49.8

Sum of UL PC commands <
1500, UE not receiving all
the PC commands.

Drop call failures – System issue RNC or BTS ?

- “CC Disconnect” due to “DL RRC Connection Release” is just a consequence of failure which can be due to different reasons
 - From UE point of view L3-messaging does not identify the point of failure distinctly
 - BTS or RNC failure? => Suspect BTS first, then RNC
- Rule out BTS failures
 - Check the site performance from Counters (Iub, Service level, cell resources SHO, etc) and that site is carrying traffic
 - PrxNoise, receive link parameters, alarms
 - SC-reuse
 - UE performance ?
- Identified causes for Active Set Update failure
 - “Deaf” sites (PrxNoise)
 - Faulty HW
 - SC-reuse

Drive Test Analysis – Reporting Levels



- Very High Level KPIs that give a users perception of the network (Network KPI)
 - KPIs that provide an Engineering view of network performance e.g CSSR, CDR, OCSR, SHO performance. (KPIs required for each optimisers area)
 - Highly detailed KPIs that give a detailed picture of network performance at an Engineering level and allow root cause analysis
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- The different reporting levels may want to see KPIs based on different cuts of the data (e.g. raw or end user)
 - Processing Drive Data to provide the information required at the bottom level means that the higher level information can be easily extracted

KPI reporting

- Non-genuine failures to be removed from the raw KPI's

Call Completion		
Call SetUp Success Rate	97.5%	97.9%
Call Drop Rate	3.1%	2.1%
Overall Call Success Rate	94.5%	95.9%
Call Connection time <= 8s	97.6%	97.6%
No of Call Attempts (within coverage)	637	628
No of Call Setup Failures	16	13
No of Successful Call Setups	621	615
No of Call Drops	19	13
No of Completed Calls	602	602

Non-genuine drops removed

“Final KPI’s”

Call Completion		
Call SetUp Success Rate	98.1%	98.6%
Call Drop Rate	1.3%	0.3%
Overall Call Success Rate	96.8%	98.2%
Call Connection time <= 8s	97.6%	97.6%
No of Call Attempts (within coverage)	630	621
No of Call Setup Failures	12	9
No of Successful Call Setups	618	612
No of Call Drops	8	2
No of Completed Calls	610	610

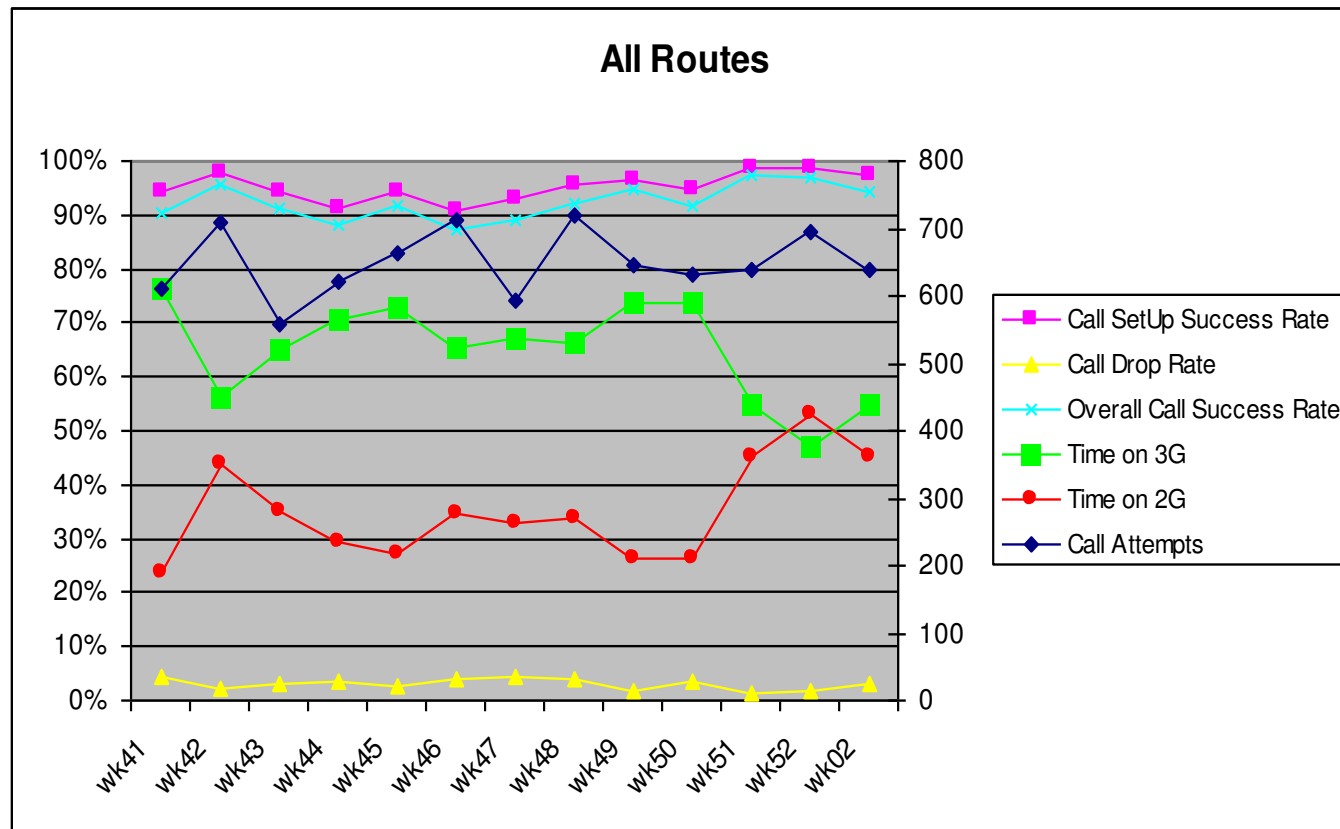
Final KPI's

Call Completion		
Call SetUp Success Rate	97.5%	97.9%
Call Drop Rate	1.3%	0.3%
Overall Call Success Rate	96.2%	97.6%
Call Connection time <= 8s	97.6%	97.6%
No of Call Attempts (within coverage)	634	625
No of Call Setup Failures	16	13
No of Successful Call Setups	618	612
No of Call Drops	8	2
No of Completed Calls	610	610

Non-genuine call setup failures removed

KPI reporting

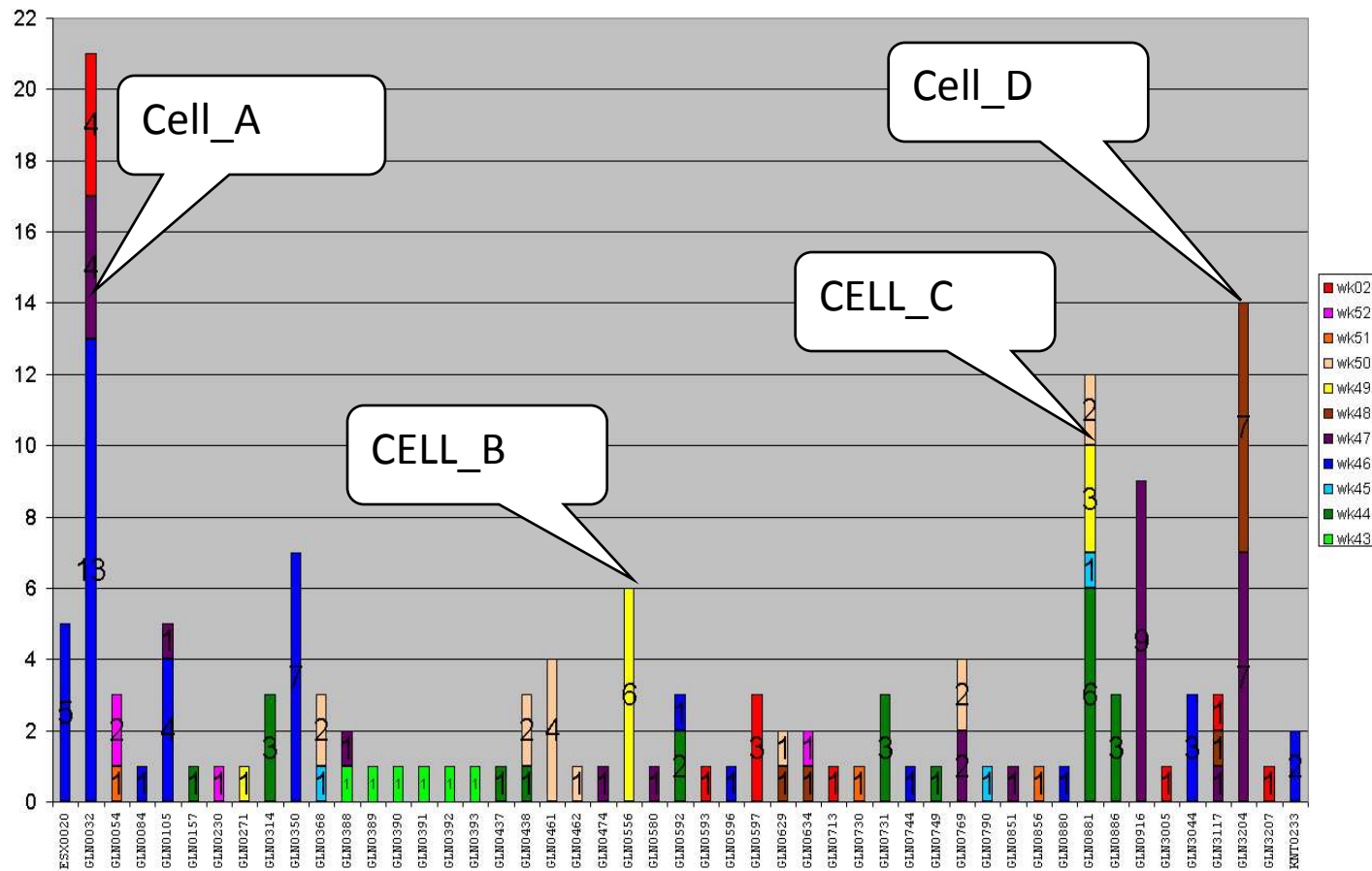
- Weekly KPI trends (non-genuine failures should be excluded)



KPI reporting

BTS failure chart (call setup failure & drops)

- Cumulative number of failures that occurred per site over time
- If the UE is spending only a small percentage of time on 3G problems may not be identified.



BTS failure examples: CELL_A

- Long history of failures (over weeks 46, 47, 02)
- Call Setup failure scenarios:
 - “CC Disconnect” after “CC Call Proceeding”
 - “CM Service Abort” after “CM service Request”
- 3rd sector showing low average PrxNoise –108 dBm Commissioning data (feeder loss) was found incorrect.
- After this site was still failing, not carrying traffic.
 - Alarm “7750 – failure in WCDMA BTS O&M Connection”
 - COCO rebuilt (27.1.05)

BTS failure examples: CELL_B

- Failures only on week 49
- No response to “RRC Connection Request”
- No alarms
- At WBTS: MHA parameters ok
- At RNC: MHA=0, cable loss = 3 dB (DPCCH init pwr)
- PrxNoise checked OK, OMC statistics showed the site carried traffic during the drive.
- No failures in the following weeks drives

BTS failure examples: CELL_C

- Failures over weeks 44, 45, 49, 50
- No response to “RRC Connection Request” most frequent failure, also one case of sudden drop to idle.
- Test calls were made, the counters were not incremented during the test. Protocol analyser proved no activity in lub. The counters were incremented only after site reset.
- Alarm “WSMA RR-bus error”
- The site had faulty WTR, incorrect feeder loss in the commissioning file

BTS failure examples: CELL_D

- Failures on weeks 47 and 48
- No response to “RRC Connection Request”
- Incorrect feeder loss in commissioning data.