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GSM BSS Network KPI (TCH Congestion Rate) Optimization Manual V1.0

(For internal use only)

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GSM BSS Network KPI (TCH Congestion Rate) Optimization Manual

Key words: TCH Congestion Rate

Abstract: This document aims at reducing the congestion rate and improving the call connection rate by analyzing the TCH congestion rate in the traffic measurement of the existing network.

Acronyms and abbreviations

Acronym and Abbreviation	Full Spelling

Preface

This document describes causes and impacts of the TCH congestion rate and provides measures taken to reduce the congestion rate and optimize the KPI.

1 Definition of the TCH Congestion Rate

Definition

The TCH congestion rate is the proportion of the number of TCH assignment failures to the number of TCH seizure requests. If the TCH congestion rate is high, the network service quality deteriorates. In this case, you can expand the capacity to reduce the TCH congestion rate.

Recommended Formula

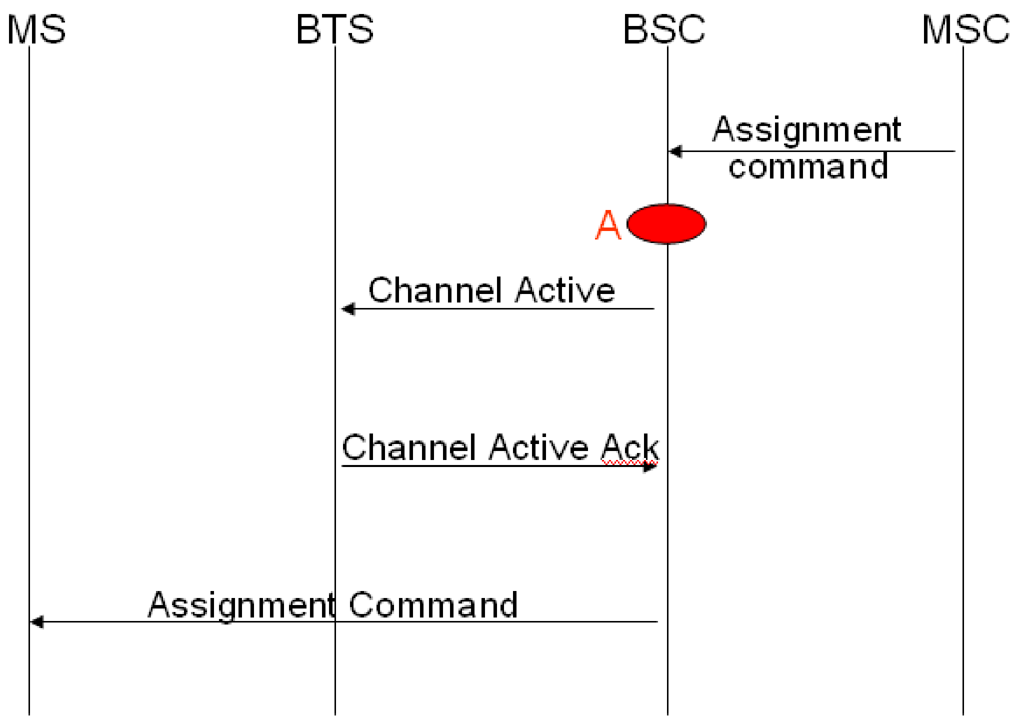
The TCH congestion rate is obtained from the traffic measurement result. The recommended formula is the proportion of Failed TCH Seizures due to Busy TCH to TCH Seizure Requests. The formulas defined for the BSC32 and the BSC6000 are as follows:

1. Defined for the BSC32: TCH Congestion Rate (All Channels Busy) = Failed TCH Seizures due to Busy TCH / TCH Seizure Requests x 100%
2. Defined for by BSC6000: TCH Congestion Rate (All Channels Busy) = [TCH Seizure Requests (Signaling Channel) + TCH Seizure Requests (Traffic Channel) + TCH Seizure Requests in TCH Handovers (Traffic Channel) – Σ (all the TRXs in the cell) Successful Channel Assignments (TCH)] / [TCH Seizure Requests (Signaling Channel) + TCH Seizure Requests (Traffic Channel) + TCH Seizure Requests in TCH Handovers (Traffic Channel)] x 100%]

Note: For the BSC6000, the formula of calculating the congestion rate on TCH per BSC is as follows:
Congestion Rate on TCH per BSC (All Channels Busy) = [Failed TCH Seizures due to Busy TCH per BSC (Signaling Channel) + Failed TCH Seizures due to Busy TCH (Traffic Channel) per BSC + Failed TCH Seizures in TCH Handovers due to Busy TCH per BSC (Traffic Channel)] / [TCH Seizure Requests per BSC (Signaling Channel) + TCH Seizure Requests per BSC (Traffic Channel) + TCH Seizure Requests in TCH Handovers per BSC (Traffic Channel)] x 100%

2 Impacts of TCH Congestion Rate

The TCH congestion rate is measured in the assignment and handover procedures. The measurement points are A, B, and C. The following describes negative impacts brought by TCH congestion in the procedures.



图一：指配流程

In the TCH assignment procedure, the MS receives the Assignment Command message from the BSC at point A. If the TCH is congested, the value of **Failed TCH Seizures due to Busy TCH** increases by one. Then, **Immediate Assignment Success Rate** is decreased.

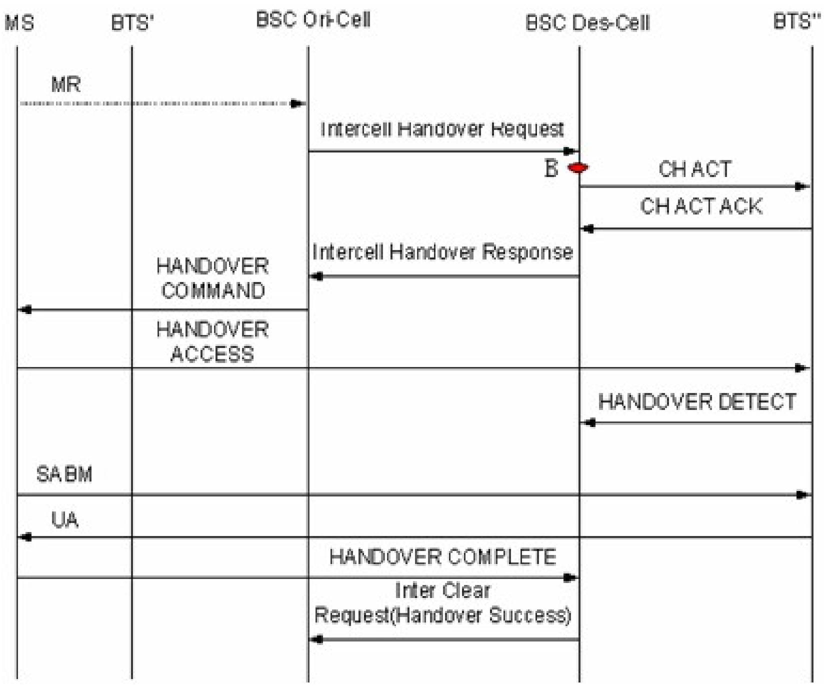


图2 BSC 内切换流程

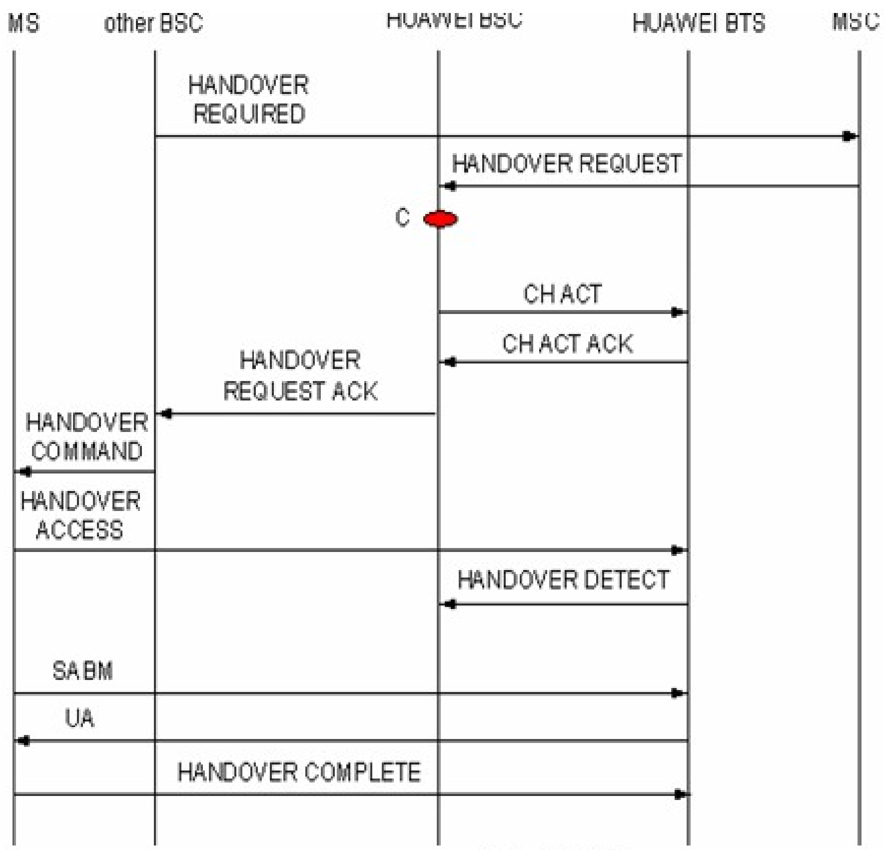


图3 BSC 间切换流程

In assignment and handover procedures, if the TCH congestion leads to the TCH assignment failure, both the immediate assignment success rate and handover success rate decrease. Therefore, reducing the TCH congestion rate optimizes the two counters.

Note

At point A, B, or C in the TCH assignment procedure, if no TCH is idle, **Failed TCH Seizures due to Busy TCH** increases by one.

At point B or C in the TCH assignment procedure, if no TCH is idle, both **Failed Incoming Internal Inter-Cell Handovers (due to busy TCH)** and **Failed Incoming External Inter-Cell Handovers (due to busy TCH)** increase one.

3 Influencing Factors of TCH Congestion Rate

According to actual applications and optimization experience, influencing factors of the TCH congestion rate are as follows:

- Network capacity and traffic distribution
- Faults occurred during equipment installation, transmission, or on the hardware
- Network interference
- KPI measurement problems
- Incorrect parameter settings
- Third-party device problems
- Software version problems

3.1 Network Capacity and Traffic Distribution

In the early period of network deployment, the BTS position and the number of TRXs are designed based on current MS distribution. The coverage capability of certain BTSs fails to meet actual requirements due to changes of traffic distribution. In this case, it is difficult to make a call or there are no signals.

Operators and vendors must take measures to reduce the TCH congestion rate.

3.2 Faults Occurred During Equipment Installation, Transmission, or on Hardware

The traffic absorption is unbalanced in cells of an area because of faults occurred during

equipment installation, transmission or on the hardware or clock. As a result, TCHs in certain cells are overloaded and in some cells are idle. Therefore, resources are wasted.
The cells controlled by the BTS work abnormally due to the followings causes:

- Feeders are installed reversely or damaged.
- The TRX board is faulty.
- The BTS clock is faulty.

This increases the traffic of the neighbor cells and causes congestion.

3.3 Network Interference

Inter-network interference or strong intra-network interference caused by tight frequency reuse due to limited frequency resources affects the normal access of the MS, causes TCH assignment failure, and increases the TCH congestion rate.
The following types of interference may occur:

1. Inter-network interference from scramblers or privately installed antennas
2. Interference from the CDMA network of China Unicom
3. Repeater interference
4. Intermodulation interference from BTSs
5. Intra-network co-channel and adjacent-channel interference

3.4 Incorrect Parameter Settings

Parameter settings on the BSC and MSC affect the handover, load, channel assignment, and cell congestion. The following parameters may cause negative affects:

1. **TCH Traffic Busy Threshold(%)** is incorrectly set.
2. **Tch Traffic Busy Overlay Threshold** and **Tch Traffic Busy Underlay Threshold** are incorrectly set.
3. **Assignment Cell Load Judge Enable** (BSC6000) is invalid.
4. **Directed Retry Load Access Threshold** is invalid.
5. **Balance Traffic Allowed** is not set.
6. **Load HO Allowed** is not set.
7. **Load HO Step Period** is set to a too great value.
8. **RACH Min.Access Level** is set to a too small value.
9. Cell reselection parameters are incorrectly set.
10. **Cell Direct Try Forbidden Threshold** (BSC6000) is incorrectly set.

11. **Direct Retry** is set to **No.**
12. **SDCCH Dynamic Adjustment** is invalid.
13. Flow control parameters are invalid.
14. **Speech Version** is incorrectly set.

3.5 Cooperation with Third-party Devices

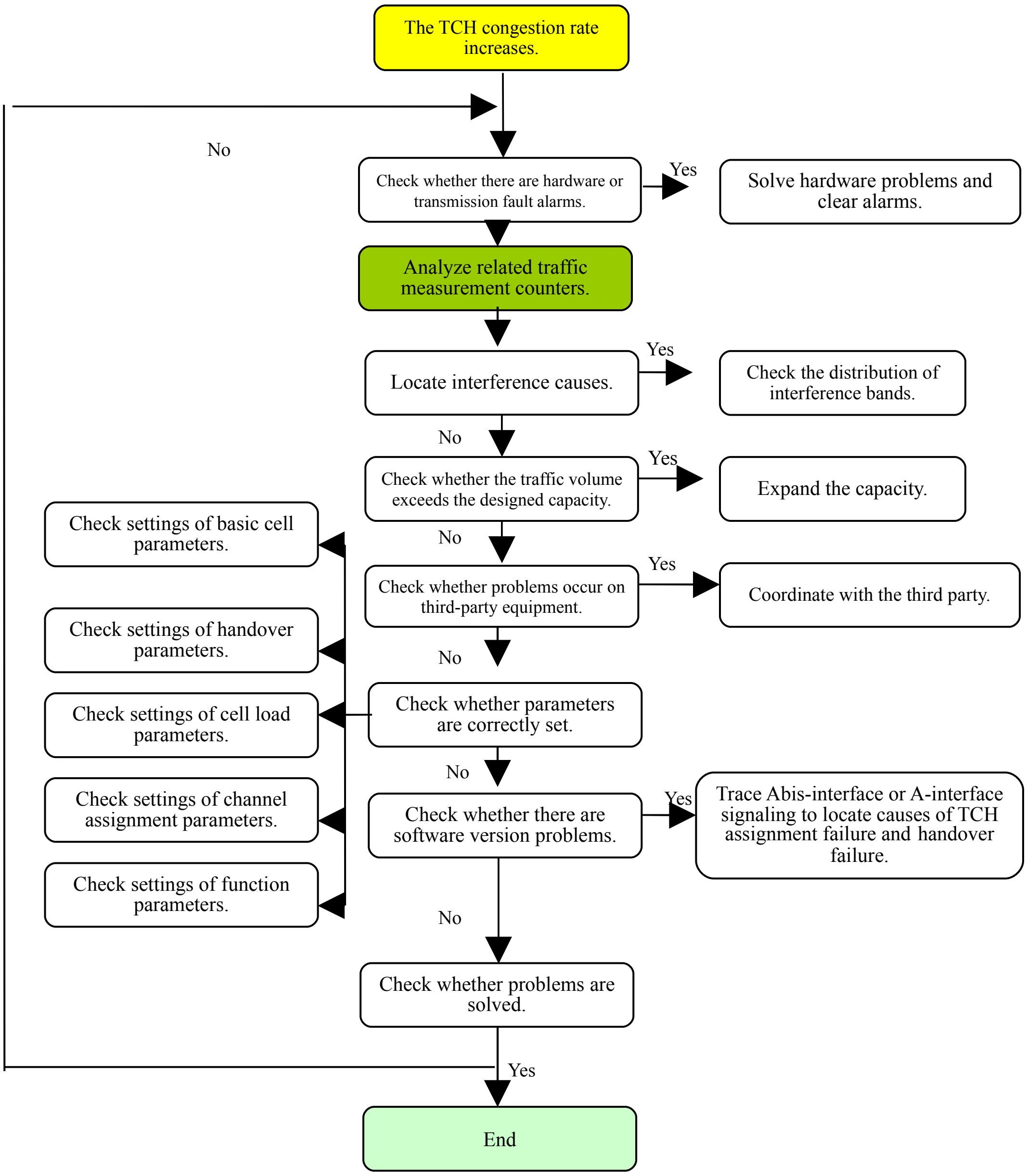
Some problems (for example, the handover or access is abnormal) may arise if third-party devices are introduced such as, the adoption of repeaters or segmental networking or in the border areas of the local network. These problems cause abnormal KPIs (for example, handover success rate) and TCH congestion.

3.6 Software Version Problem

When the BSC is upgraded or a new version is used in the existing network, the software of earlier versions may be incompatible with the new platform (for example, BSC6000) or software bugs may increase the TCH congestion rate. Therefore, we should locate and rectify the fault caused by software problems by taking proper measures.

4 Analysis Procedure and Optimization Method

Because reducing the TCH congestion rate involves a relatively large scope, we can adopt the principle of first solving easy problems and then difficult problems. That is, check the hardware and software to determine whether the problem is common or specific. The process is as follows:



4.1 Network Capacity and Traffic Distribution

4.1.1 Traffic Balancing

Fault Description and Cause Analysis

1. Common Cell

Radio traffic volume depends on the number of BTSs and cells in the network, the number of radio channels configured in each cell, and the coverage of each cell. Currently, channels are restricted by designed network capacity. This is because the radio channel configuration and the coverage is fixed as the number of BTSs and cells is determined in the early period of the network, however, the deviation may exist between the actual network capacity and the required capacity. The TCH congestion occurs in the cells that require greater capacity. With city construction and economic development, changes of user density determined during the network construction cause TCH congestion.

2. Concentric Cell

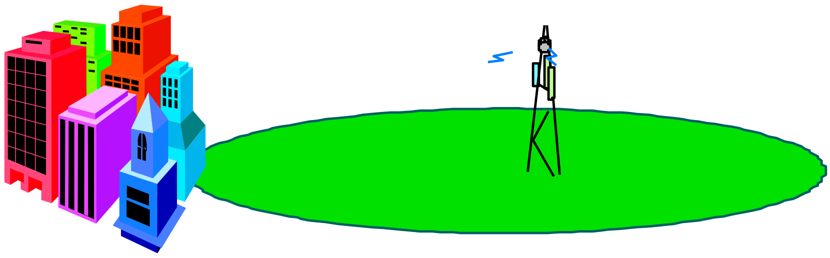
Concentric cells are introduced to solve traffic problems in the overlaid subcell and solve coverage problems in the underlaid subcell. However, in actual applications, unbalanced traffic distribution causes traffic imbalance in overlaid and underlaid subcells. Therefore, the TCH congestion rate in the overlaid subcell is different from that in the underlaid subcell because of the difference of the design and actual application.

Solution

There are two ways to solve these problems. The first method is to solve problems thoroughly. That is, conduct the detailed network evaluation, determine the cells where the TCH congestion occurs, and work out a detailed network capacity expansion solution based on the congestion severity. However, with city construction and further economic development, the capacity expansion is required as the TCH congestion reoccurs. In fact, operators continually optimize networks with the increase of subscribers. The second method is to optimize networks. There are relatively idle cells in the network. You can decrease the TCH congestion rate by adjusting TRX configuration of the idle and busy cells. In addition, you can enable the directed retry, load handover, and cell traffic balancing functions. For operators, each TRX means new investment. Adjusting TRX configuration in a network makes full use of network capacity and optimizes the network. However, the second method has certain limitations. If the actual used capacity is close to the configured capacity in terms of the total amount and capacity distribution, you must expand the network capacity.

4.1.2 Traffic Distribution Environment

In actual applications, it is difficult for the MS that is located on the edge of the area covered by the BTS to make a call due to weak level on the edge. This results in TCH seizure failure and increases the TCH congestion rate. (You may ask: Does this case result in the increase of the TCH congestion rate?) Actually, fewer TCHs are seized in this BTS, as shown in the following figure.



The following table lists the TCH seizure counters in the traffic measurement result.

BSC Level	Cell Level
BSC Measurement -> Access measurement per BSC -> TCH Availability per BSC Configured TCHs per BSC Available TCHs per BSC	KPI Measurement -> TCH Availability Available TCHs Configured TCHs TCH Congestion Rate TCH Traffic Volume TRX Measurement -> Number of configured TRXs in a cell Number of available TRXs in a cell

Solution

Adjust the azimuth angle or tilt of the antenna and set the static transmit power of the BTS to the maximum value. That is, increase the signal strength in this area. In addition, to decrease the TCH congestion rate, you can lower **RACH Busy Threshold** to enable the MS to seize the TCH successfully. If these methods do not take effect, deploy new BTSs near the user group.

Case 1

4.2 Fault Occurred During Equipment Installation and On Hardware

4.2.1 Feeder Installation and Fault

The TCH seizure failure may occur during the installation and configuration of feeders of the BTS due to the following causes.

(1) CDU/SCU configuration

For example, the CDU+SCU combination configuration is adopted in the cell with four TRXs. The TRX carrying the BCCH sends signals to the antennas through the CDU, and other TRXs combine output of signals through the SCU and send the signals through the CDU. In this case, the combination loss of BCCH greatly differs from that of non-BCCH.

Therefore, the transmit power of BCCH is smaller than that of non-BCCH. If the BSC assigns TCHs of the TRX where non-BCCH resides (especially far away from the BTS) when the MS makes a call, the TCH may fail to be sized because of low transmit power of the TRX.

There are two methods to solve this problem. One is to put the TRX carrying the BCCH on the channel passing the SCU. In this case, the TRX has smaller transmit power and TCHs of the TRX where non-BCCH resides can be successfully assigned. The other is to modify the configuration. That is, the dual CDU configuration instead of the CDU+SCU combination is adopted. This ensures the same power consumption of channels where TRXs reside and avoids the TCH seizure failure due to different transmit power of TRXs. The second method is superior to the first one in terms of the performance because the loss of CDU is smaller than that of the SCU. This indicates that the second method features relatively proper coverage distance. However, the configuration cost is higher.

(2) Improper feeder installation

Reverse connections of antennas, transmit antennas, and receive antennas cause serious signal imbalance on uplink and downlink channels. That is, the MS to which the transmit antenna points is back of the receive antenna. If the MS receives the TCH assignment command from the BSC during the call, the TCH fails to be assigned and the TCH congestion occurs due to poor level and quality of uplink signals of the MS caused by small gain of the receive antenna.

To solve this problem, make drive tests or use a signaling analyzer to analyze the level and quality of uplink and downlink signals to check whether signal imbalance exists. If yes, takes proper measures to solve this problem.

If the azimuth and tilt of the main antenna are inconsistent with those of the diversity antenna or the diversity or spacing is small when single-polarized antennas are used in a cell, uplink and downlink signals are inconsistent and TCHs seizure failures tend to occur. The solution to these problems is the same as the preceding one. These problems do not exist in cells that adopt dual-polarized antennas.

Case 6

(3) Feeder fault

In the following cases (such as the feeder is damaged, water runs into the feeder, or the feeder and the connector are not securely connected), the voltage standing wave ratio (VSWR) increases and both the transmit power and receiver sensitivity of the antenna decrease. Thus, the TCH assignment may fail, causing TCH congestion.

To solve these problems, check whether a VSWR alarm is generated on the tower mounted amplifier (TMA), power amplifier, combiner, and feeders. A rough and simple method is to use the test MS to test the actual transmit signals of the BTS on the foot of the BTS. If signal strength ranges from –30 dBm to –50 dBm, it indicates signals are too weak and there may be problems.

If the antenna system has problems, the TCH call drop rate and handover failure rate are high. In addition, the difference between the uplink quality and the downlink quality is great, or both the uplink quality and the downlink quality are poor. You can check whether the antenna system is faulty by viewing the traffic measurement results. The following table lists the traffic measurement counters related to the antenna system.

Cell Level	TRX Level
Call Measurement -> KPI Measurement -> Radio Handover Success Rate Call Measurement -> Outgoing Internal Inter-Cell Handover Measurement per Cell -> Outgoing External Inter-Cell Handover Requests (Uplink Strength) -> Outgoing External Inter-Cell Handover Requests (Downlink Strength)	MR Measurement -> Measurement of Receive Quality MR Measurement -> Uplink/Downlink Balance Performance Measurement

If problems persist, verify that remote BTSs are operational and conduct dialing tests by performing the following steps:

1. Perform local maintenance. Check whether alarms are generated. If yes, clear these alarms immediately.

2. Check whether the uplink or downlink antenna tributary has hardware problems, for example, the connector is loose, antennas are reversely connected, semi-rigid cables are connected incorrectly, or cables are loosely connected to the backplane.

3. Use the test MS to conduct dialing tests on the same location.

- Conduct dialing tests on each channel of each TRX to check whether certain timeslots or boards cannot be assigned.
- Check whether the downlink receive level of each TRX is similar. For the TRX with abnormal level, replace the board and uplink or downlink antenna system to identify the cause.
- Note that if the cell adopts frequency hopping (FP), change the FH mode of the cell to Non-FH by using parameters of the command line to facilitate dialing tests.

4. Conduct driving tests by using the network optimization software ANT-PLOT. Then, check whether there are abnormal handover relationships and downlink interference and find ways to reduce the congestion rate.

5. Use a spectrum analyzer to further locate the interference source.

6. Check whether the area covered by the BTS features complex terrain.

4.2.2 Board faults

Faults occurred on the TRX board are the most typical ones. There is obvious difference between the TCH seizure failure caused by the board fault and that caused by the feeder installation or fault. The former fault causes poor channel availability and the latter does not affect the channel availability.
The problem is easy to solve. Use a signaling analyzer to trace message over the Abis interface in the cell with higher TCH congestion rate. Then, use the filter of the signaling analyzer to list the Assignment Failure message. In this message, the cause value is the equipment failure. Use the call trace function to list the entire message procedure. Find the Assignment Command message. Then, open the message and obtain the TRX number of the faulty TRX board or MAIO (of the FH channel). Therefore, the fault is concerned with the TRX. You can replace the TRX or unblock the TRX temporarily.

Case 2

4.2.3 Transmission and Clock Problem

Generally, the upper-level clock is locked by the BTS. However, due to objective reasons or maloperations, transmission problems such as PCM out-of-synchronization of the A interface, intermittent LAPD links, free oscillation and clock problems may occur. At this time, the TCH fails to be seized by the MS, causing higher TCH congestion rate.
To solve this problem, check the alarm information and the status of the BTS clock displayed on the LMT and determine whether the transmission or the clock is faulty. Then, correctly set the status of the clock or contact related department to rectify the transmission fault.

4.3 Interference Causes

4.3.1 Inter-Network Interference

In the on-site deployment, invalid inter-network frequencies generate interference on our network. The interference affects the TCH seizure success rate, call drop rate, and handover success rate. If the BSC assigns a TCH affected by interference for a call, the assignment may fail and the TCH congestion occurs.
For inter-network interference, the traffic measurement shows that the TCH congestion rate is higher in interference bands four and five. The uplink interference is only for reference. Eliminating the interference requires the coordination with the local government. Disable the affected frequencies. Use the spectrum analyzer and high-gain directional antenna to locate the interference source. Then disable the interference source. The inter-network interference is difficult to analyze. It is not described in detail here.

Case 9

4.3.2 Improper Frequency Planning

In actual networks, frequency resources are limited. Therefore, frequencies must be reused to meet requirements of the network capacity. From this point of view, network capacity is always incompatible with network performance. If the frequencies are improperly planned, the requirement for the carrier-to-interference ratios (CIRs) fails to meet and co-channel interference or adjacent-channel interference is generated. The co-channel interference or adjacent-channel interference produces the same effect as the inter-network interference. That is, the TCH assignment may fail and the TCH congestion occurs.

It is easier to analyze and eliminate the interference caused by improperly planned frequencies. Uplink and downlink frequencies are paired. Therefore, we can check the information about interference bands in the traffic measurement results. First, find out the cells with high mean number of SDCCHs in interference bands four and five. Then, check the frequency planning and the topology of the BTS. Find intra-frequency or inter-frequency neighbor cells in opposite directions, readjust the frequency planning, and eliminate the interference. In addition, if the antenna is installed reversely though the frequency planning is properly formulated, interference is also generated. In this case, you cannot solve this problem by referring to the frequency planning and network topology. Therefore, perform a large quantity of drive tests in the cells with high mean number of SDCCHs in interference bands four and five. Check the actual distribution of signals to determine whether the interference exists. Then, modify the antenna planning or frequency planning.

4.4 KPI Measurement Problems

There are differences between traffic measurement counters because each vendor calculates these counters by using self-defined counters. It is difficult to find traffic measurement problems causing high TCH congestion rate. For the BSC of earlier versions, the TCH seizure failure index (numerator of the formula for calculating the TCH congestion rate) increases by one if the Assignment Complete message (rather than the Assignment Failure message) is not received after the BSC delivers the Assignment Command message. Then, a statistical error is generated, and the calculated TCH congestion rate is higher than the actual rate.

This problem is complex because a network involves multiple cells and TCH congestion occurs in many cells due to various causes: such as high traffic or radio link failure (due to the preceding causes), including statistical errors. The typical situation is that the call is released once the MS initiates the call. The cause may be that after reporting the Disconnect message, the MS receives the Assignment Command message from the BSC, and then reports the Status message carrying the cause value indicating message type mismatch. After receiving the Status message, the MSC releases this call. Therefore, neither the Assignment Complete message nor the Assignment Failure message exists in the message procedure. For the BSC of earlier versions, the TCH

seizure failure counter increases by one. There are many cases in a large GSM network. Therefore, the calculated TCH congestion rate is higher than the actual rate. Currently, the method of measuring the TCH seizure failure is changed. The counter increases by one when the Assignment Failure message is received.
For the formula definition and recommended formula, refer to the *GSM BSS Network KPI (TCH Call Drop Rate) Baseline*.

Parameter Settings

Parameter settings may lead to the TCH congestion due to various causes. Generally, the parameter settings may affect the TCH congestion rate in all the cells in the entire network or certain cells. In the case of the former situation, check whether important parameters and then less important parameters are correctly set because of multiple cells involving the TCH congestion and great on-site pressure.

4.5.1 Channel Assignment Parameters

[TCH Traffic Busy Threshold(%)]
For Huawei channel assignment algorithm II, when the TCH assignment rate reaches or exceeds the threshold, the BSC assigns TCHHs for the dual-rate call. Otherwise, TCHFs are assigned. Obviously, this parameter determines whether TCHHs or TCHFs are assigned. Therefore, if the TCH congestion rate is higher, set the parameter to a small value to assign TCHHs. This increases the channels usage ratio. However, the speech quality degrades, for example, MOS tests may be affected.

[Tch Traffic Busy Overlay (Underlay) Threshold]
The BSC assigns channels in the overlaid subcell to the MS in a concentric cell. If the channel seizure ratio of the overlaid subcell is greater than the value of this parameter, TCHHs are assigned. Otherwise, TCHFs are assigned. The impacts of this parameter are the same as those brought by **TCH Traffic Busy Threshold(%)**, that is, channels are utilized fully, but the speech quality degrades.

[Fix Abis Prior Choose Abis Load Threshold(%)]
This parameter specifies the static Abis resource load threshold. When the static Abis resource load is lower than the value of **Fix Abis Prior Choose Abis Load Thred(%)**, the TCHF is preferentially assigned. Otherwise, the TCHF or TCHH is preferred according to the dynamic Abis resource load.

[Flex Abis Prior Choose Abis Load Threshold(%)]
When the static Abis resource load is higher than the value of **Fix Abis Prior Choose Abis Load Threshold(%)** and the dynamic Abis resource load is higher than the value of **Flex Abis Prior Choose Abis Load Threshold(%)**, the TCHH is preferred. Otherwise, the TCHF is preferred.

[Balance Traffic Allowed]
If this parameter is set to **YES**, the start of the channel traverse is selected randomly. If this parameter is set to **NO**, the next channel of the assigned channel is selected as the start of the channel traverse.
Generally, this parameter is set to **YES** to ensure that the start point of the channel traversal is selected randomly and ensure the channel load sharing.

Case 3

4.5.2 Call Control Parameters

[Assignment Cell Load Judge Enable (BSC6000)]
When **Assignment Cell Load Judge Enabled** is set to **Yes**, the directed try procedure is started if the following two conditions are met: The cell supports directed try. The load of the cell is greater than or equal to the value of **Cell Direct Try Forbidden Threshold**.

[Directed Retry Load Access Threshold (BSC6000)]
This parameter is used to adjust candidate target cells for directed retry.
During directed retry, only the cells whose loads are smaller than or equal to the value of **Directed Retry Load Access Threshold** are selected as candidate target cells.
If the parameter value is too high, the cells with heavy loads are selected as candidate target cells so that the handover does not make sense. If the value of the parameter is too low, it is difficult to select candidate target cells.

[TCH Immediate Assignment]
If the parameter is set to **Yes**, the BSC assigns TCHs immediately if no SDCCHs are available during the processing of access request. If the parameter is set to **No**, the BSC can only assign SDCCHs. This parameter is used to relieve congestion and increase the channel assignment success rate.

[Load HO Allowed]
This parameter specifies whether a traffic load-sharing handover is enabled.
Load sharing helps to reduce cell congestion, increase success rate of channel assignment and balance the traffic load among cells, thus improving network performance. The load handover functions between the TCHs within one BSC or the TCHs in the cells of the same layer.
The load handover is used as an emergency measure instead of a primary measure to adjust abnormal traffic peak in certain areas. If load handovers occur frequently in a local network, you must adjust the TRX configuration of the BTS and the network layout.

[Load HO Step Period and Load HO Step Level]
When the load of the cell is equal to or greater than the value of **Load HO Threshold**, all

the calls served by the cell may send handover requests simultaneously, and the load on the CPU increases rapidly as a consequence. In some cases, call drops may occur due to traffic congestion in the cell. Therefore, the BSC adopts the hierarchical load handover algorithm to control the number of calls to be handed over at each level.
This parameter specifies the period required for performing the load handover at a level.
In the hierarchical load handover, the load handover strip increases by one **Load HO Step Level** for every **Load HO Step Period**, starting from the value of **Edge HO DL RX_LEV Threshold**. The handovers are performed as such until all the calls whose receive levels are within the range of (Edge HO DL RX_LEV Threshold, Edge HO DL RX_LEV Threshold + Load HO bandwidth) are handed off the current serving cell.
The value of **Load HO Step Level** must be smaller than that of **Load HO Bandwidth**.
0–63 corresponds to –110 dBm to –47 dBm.

[Direct Retry and Cell Direct Try Forbidden Threshold (BSC6000)]
If **Assignment Cell Load Judge Enable** is set to **Yes**, the directed try procedure is started to assign channels for the MS if the following two conditions are met: The cell supports the directed try procedure. The load of the cell is greater than or equal to the value of **Cell Direct Try Forbidden Threshold**. This parameter decreases TCH accesses of the source cell and reduces TCH congestion through increases the call drop rate.

[AMR TCH/H Prior Allowed]
This parameter specifies whether TCHHs are preferentially assigned on the basis of the channel type and current service channel seizure ratio that are allowed by the MSC.
During TCH assignment, TCHFs or TCHHs are required and TCHHs are preferentially in the following conditions: TCHHs and TCHFs are allowed to be assigned by the MSC, **AMR TCH/H Prior Allowed** is set to **Yes**, and the percentage of seized TCHs in the cell is greater than the value of **AMR TCH/H Prior Cell Load Threshold**. In other cases, TCHFs or TCHHs are required and TCHFs are preferentially.

4.5.3 Handover Parameters

[PBGT HO Threshold]
When the handover is performed between neighbor cells, improper parameter settings cause outgoing inter-cell handover or incoming inter-cell handover to fail. This leads to unbalanced traffic distribution and congestion.

[Parameters related to edge handover]
When the receive level drops greatly, an edge handover cannot be performed in time in any of the following conditions: The parameter **Edge HO UL RX_LEV Threshold** or **Edge HO DL RX_LEV Threshold** is set to a small value; the parameter **Inter-cell HO Hysteresis** is set to a great value; the parameters **Edge HO Watch Time** and **Edge HO**

Valid Time are set to great values. As a result, congestion occurs. To reduce the TCH congestion rate, you can appropriately set these parameters so that edge handovers can be performed in time.

[Parameters related to BQ handover]
When the signal quality deteriorates, a BQ handover cannot be performed in time in any of the following conditions: The parameters **UL Quality Limit for Emergency Handover (AMR/AMRFR/AMRHR)** and **DL Quality Limit for Emergency Handover (AMR/AMRFR/AMRHR)** are set to great values; the parameter **BQ HO Margin** is set to a small value; the parameter **Inter-cell HO Hysteresis** is set to a great value. As a result, call drops occur. To reduce the TCH congestion rate, you can appropriately set these parameters so that BQ handovers can be performed in time.

[Parameters related to interference handover]
If the parameters **RXQUAL1** to **RXQUAL12** are set to great values or if the **RXLEVOff** parameter is set to a great value, interference handovers cannot be performed in time when strong interference occurs. As a result, the congestion occurs. To reduce the TCH congestion rate, you can appropriately set these parameters so that interference handovers can be performed in time to prevent congestion. If the parameters **RXQUAL1** to **RXQUAL12** are set to small values, the number of handovers due to other causes increases greatly, thus affecting the handover success rate.

[T3103 and T3107]
T3103 and T3107 are timers for the handover and assignment respectively. If either timer is set to a great value, the time for waiting the handover/assignment complete message is too long after the handover/assignment command is delivered, causing congestion.

[F2H HO th/ H2F HO th]
When an AMR call occupies a TCHH, an intra-cell TCHH to TCHF handover is triggered if the radio quality indication (RQI) remains lower than the configured H2F HO Threshold for a predefined period. This parameter is used with **Intracell F-H HO Stat Time (s)** and **Intracell F-H HO Last Time (s)**.

[Parameters related to concentric cell handover]
A call at the edge of the overlaid subcell cannot be handed over to the underlaid subcell in any of the following conditions: For a normal concentric cell, the parameters **RX_LEV Threshold** and **RX_LEV Hysteresis** are set to great values; for an enhanced concentric cell, the parameter **OtoU HO Received Level Threshold** is set to a great value. As a result, TCH congestion occurs. If the TCH congestion rate in the overlaid subcell is high, you can appropriately set these parameters so that calls at the edge of the overlaid subcell can be handed over to the underlaid subcell in time.
If **RX_QUAL for UO HO Allowed** is set to **Yes** and **RX_QUAL Threshold** is set to a great value, a call in the case of interference cannot be handed over from the underlaid

subcell to the overlaid subcell. Thus, TCH congestion occurs. If the TCH congestion rate in the underlaid subcell is high, you can set these parameters properly so that the interfered calls can be handed over to the overlaid subcell in time.

Case 5

4.5.4 Basic Cell Parameters

[RXLEV_ACCESS_MIN]
This parameter specifies the minimum receive level of an MS to access the BSS. If this parameter is set to a too small value, some MSs with low receive levels may access the network and TCH congestion is likely to occur. You can set this parameter to a great value to reduce the TCH congestion rate. The counters such as call setup success rate and the counters related to traffic volume, however, are accordingly affected.

[SACCH Multi-Frames and Radio Link Timeout]
If the traffic volume is very heavy (in cities), it is recommended that the value of **SACCH Multi-Frames** ranges from 20 to 32. In the areas where the traffic volume is very heavy (generally covered by micro cells), it is recommended that this parameter value ranges from 4 to 16. In the cells where some areas are not covered or call drops occur frequently, this parameter must be set to a larger value so that conversations can resume. Therefore, if the parameter is improperly set during heavy traffic volume, the TCH congestion is likely to occur.

[RACH Min Access Level]
This parameter specifies the level threshold for the MS access. If this parameter is set to a too small value, some MSs with low signal levels may access the network and TCH congestion is likely to occur. You can set this parameter to a great value to reduce the TCH congestion rate. The counters such as call setup success rate and paging success rate, however, are affected.

Parameters related to cell reselection
Improper settings of cell reselection parameters affect the selection of the network on which the MS camps during cell reselection, for example, improper parameter settings during the dual-network coverage affect network selection and cause TCH congestion.

[SDCCH Dynamic Adjustment]
When there is a substantial user increase in a cell, some users may not be able to access the network because they cannot obtain SDCCHs. In this case, you need to convert some TCHs to SDCCHs to ensure that all the users can access the network. When the traffic volume decreases, the TCHs used as SDCCHs are converted back to TCHs. The dynamic conversion of SDCCHs can increase the system capacity and lower the requirement for the accurate number of required signaling channels.

[Flow Control]
There are multiple flow control parameters. To relieve TCH congestion, the system starts the flow control. However, this affects TCH access and cause message loss.

[Speech Version]
This parameter can be set to one of the following values: half-rate version 3, half-rate version 2, half-rate version 1, full-rate version 3, full-rate version 2, and full-rate version 1. If this parameter does not support half-rate versions, the BSC assigns TCHFs instead of TCHHs. As a result, TCH congestion occurs.

4.6 Third-Party Device Problems

4.6.1 Repeater Problems

Currently, repeaters (FH repeaters or optical repeaters) are adopted to solve the problem of insufficient indoor coverage. It is difficult for FH repeaters to obtain signal resources. The implementation principle of the FH repeaters is that the FH repeater amplifies signals received by the main antenna of the optical repeater and transmits these amplified signals to the areas with poor coverage. In other words, the coverage of the cell is expanded. Therefore, the traffic volume increases. If the traffic volume exceeds the system capacity, the TCH congestion rate increases.
Check whether the parameter **Directly Magnifier Site Flag** is set to **Yes** in the data configuration on the LMT. If this parameter is set to **Yes**, you can infer that the cell is configured with repeaters. If this parameter is set to **No**, check whether other operators' repeaters are installed near the cell.
If repeaters are installed, check whether they are wide-frequency repeaters. If yes, check whether the uplink/downlink amplification coefficient is too great. Ensure that the amplification coefficient is properly set. If a repeater has a great impact on the call drop rate, switch off the repeater.
If repeater problems exist in a cell, the TA distribution varies greatly in the traffic measurement results. The following table lists the traffic measurement counters related to repeaters.

Cell Level	TRX Level
None	MR Measurement -> Number of MRs Based on TA

Case 7

4.6.2 Compatibility with Non-Huawei Equipment

In the existing network, there are certain overlapped areas, for example, boundary between two provinces and rural-urban fringe zone covered by equipment of different vendors but the same operator. Cooperation of equipment from different vendors requires the inter-MSN handover. Different policies or parameter settings may cause the traffic to increase but fail to be handed over immediately. As a result, the TCH congestion rate increases.

If the problem occurs, check the success rate of outgoing BSC handovers and distribution of outgoing handover failure causes to identify the main causes. The following table shows related traffic measurement counters.

Cell Level	TRX Level
None	Call Measurement -> Outgoing External Inter-Cell Handover Measurement per Cell

4.6.3 2G/3G Interoperability

With the development of 3G networks, certain high-end MSs adopts the dual transfer mode. Therefore, the MSs can be reselected from 2G networks to 3G networks and 2G/3G Interoperability exists. With the increase of such MSs, the congestion may occur in the 2G and 3G systems if parameters are incorrectly set.

For example, normally, an MS in the 2G network is reselected to the 3G network. However, neighbor cells in the 900M-network and 3G network are set to unidirectional adjacent cells. Therefore, the MS is reselected to the 2G network rather than the 3G network, causing congestion in the 2G network.

2G/3G Interoperability problems increase with the development of 3G networks. The 3GPP protocols specify 2G/3G handovers of R99 and later versions rather than handovers of earlier versions. Therefore, if problems occur, check whether the handover is limited by the version, and then check the handover, reselection, configuration of neighbor cells, and parameter settings to locate the problem.

For parameter settings, refer to those related to reselection, handover, and 3G external cells.

Note: Currently, the BSC6000 supports 2G-to-3G inter-RAT handovers such as TA emergency handover, BQ emergency handover, rapid level drop handover, interference handover, and edge handover.

Currently, the BSC6000 does not support the GSM-to-TD-SCDMA algorithm for the inter-RAT load-based handovers and service-based handovers. However, inter-RAT handovers based on certain conditions can be realized in later versions.

4.7 Software Version Problem

Recently, Huawei requires to implement multiple migration and upgrade projects in the 2G network. During the migration, early products of Huawei requiring to be replaced such as BTSs of earlier version deployed on the BSC32 may be incompatible with the BSC6000. As a result the TCH congestion rate increases or other such problems occur.

Solution

1. You require to devote more energies to analyze such problems. It is recommended to check the precaution, find possible problems before the upgrade, and analyze cases to obtain the solution and processing mechanism adopted in the old version.
2. On the remote LMT, check whether software of each board of the BTS is compatible and perform version upgrade according to the version notice on the http://support.huawei.com site. On the remote LMT, block TCHs of the TRX board in turn in the cell with high congestion rate. Then, check whether the congestion rate is relevant to the TRX board of the cell and then adopt the following principles.
   - If yes, it indicates that the congestion rate is concerned with the TRX board. Check whether co-channel interference exists, and then check the performance of uplink and downlink hardware and the TRX board.
   - If not, the interference exists in the entire cell or the congestion rate is subject to the terrain.
3. Signaling tracing and analysis

Use a signaling analyzer to trace messages over the Abis interface in the cell with high congestion rate. Then, compare tracing results with measurement items in the call procedure and measurement counters relating to the TCH assignment failure. The following figure displays the message tracing results by using the MA10 signaling analyzer.

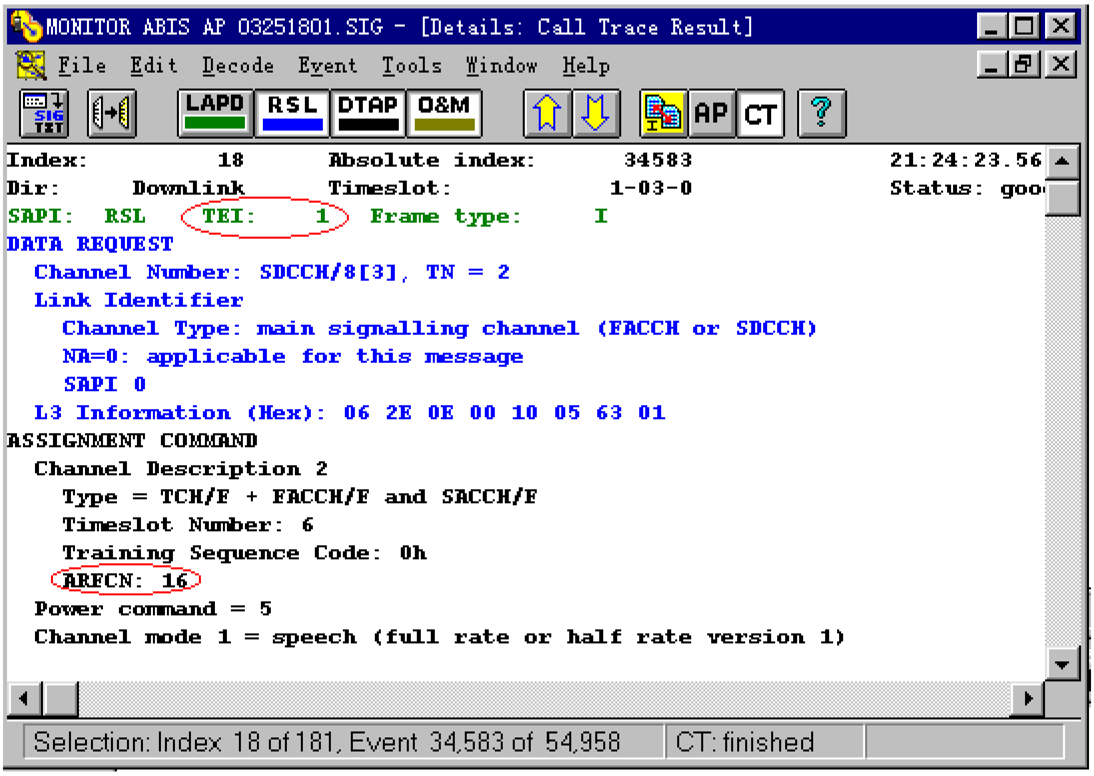
Checking the **Assignment CMD** command delivered on the SDCCH, you can see that **TEI** determines the TRX board where the SDCCH resides, and **ARFCN** specifies the TRX board where the TCH resides. Check whether the assignment failure occurs on a certain TRX board. Then, locate specific causes based on the TA value of the MS, uplink/downlink level, and uplink/downlink signal quality included in the measurement report and make dialing test locally.

The assignment failure occurred on a TRX board may be caused by one of the following reasons:

(1) The TRX board is faulty or the performance is unstable.

(2) Uplink and downlink levels are not balanced or uplink or downlink antenna tributary has hardware problems.

(3) Uplink and downlink signals are of poor quality. Check the channel on which the interference exists by considering the TA value.



If assignment failures randomly distribute on TRX boards in the entire cell, the failures may be caused by one of the followings through the measurement report analysis:

(1) The areas covered by the BTS feature the complex terrain.

(2) The frequency interference exists in the entire cell, for example, interference from repeaters.

5 Test Method

The TCH congestion rate is one of the KPIs to evaluate network access performance, which can be obtained through the registration or reporting of the related KPIs. At present, vendors and mobile operators use different formulas to calculate the TCH congestion rate, thus leading to different values of this counter. In actual measurement, you should register the specific counters and use an appropriate formula to calculate the value of the counter.

6 Appendix Check Items on TCH Congestion Rate

Check Item	Remarks	Purpose
Version information	Version information about the BSC, PCU, and BTS	To check the version matching relationship.
Frequency multiplexing mode	1800M, 900M	To check the frequency configuration.
Data configuration table	*.dat file	To check the settings of the network optimization parameters, neighbor cell relations, and power configuration
Alarm information	Hardware, clock, and transmission alarms (self-check)	To check whether these alarms are generated in the cell. Handle the alarms if they are generated.
Traffic measurement	KPI Measurement per Cell	To compare the number of SD/TCH requests, SD/TCH seizure success rate, and traffic volume to check whether the cooperation with the neighbor BTS is normal.
	Intra-cell Handover Measurement per Cell	To compare the number of incoming inter-cell handovers and the number of outgoing inter-cell handovers respectively before and after network replacement to check whether the cooperation with the neighbor BTS is normal.
	Incoming/Outgoing Internal/External Inter-Cell Handover Measurement per Cell	
Driving test data	*.log (*.cell site) or *.ant file	To identify the coverage problem by comparing the coverage before and after network replacement.
Others	Engineering parameter table and electronic map	To check the geographical information through the NASTAR software.

7 Typical Cases

Case 1: TCH Congestion Caused by Terrain Reasons

Description

The TCH congestion rate of a certain omnidirectional cell is 3%–10%.

Troubleshooting

Analyzing Abis-interface signaling, you can find that the congestion reason is that the level is too low and the bit error rate increases. In addition, the TA value of the MS the distance between the MS and the BTS is 25.6 km to 31.1 km. Obvious, the TCH assignment fails because the MS is far away from the BTS. Make on-site driving tests, and then you will find that an isolated BTS is deployed here and the area features complex terrain. Therefore, the congestion of the BTS cannot be solved temporarily due to environment limitations

Handling Proposal

To solve the cell congestion problem caused by large coverage and complex terrain, operators are advised to do the followings: Add BTSs to implement continuous coverage. Change the omnidirectional BTS to the directional BTS, adjust the azimuth and tilt of the antenna, and enhance transmit level. In addition, prevent cross-area coverage.

Case 2: High TCH Congestion Rate Caused by Fault of TRX Board

Description

The BTS adopts the S6/4/2 configuration. One day, the traffic measurements suggest that the TCH overflow rate is high in cell 1 with six TRXs and the TCH congestion rate reaches 20%. The traffic on TCH in the cell is low, generally, 0.8Erl during busy hours. In addition, the TCH seizure failure due to busy TCH is 0. Channels on all the BTs in cell 1 are in the idle state. The baseband attribute and RC attribute are normal. There is no abnormality on the LMT.

Troubleshooting

1. On the LMT, query the status of channels on BTs by using the preceding method. You can conclude preliminarily that the TCH fails to be seized on BT4 and BT5 in cell 1.
2. If you block BT4, BT5, RC4, and RC5, there is no TCH congestion all day. Then, you can inter that RC4 and RC5 are faulty.
3. If you unblock BT4, BT5, RC4, and RC5 and reset RC4 (TRX4) and RC5 (TRX5), high congestion rate persists.
4. Insert and remove TRX4 and TRX5 on the field. After making dialing tests (on TRX4 and TRX5) after frequency lock, the TCH still fails to be seized. Exchange slots of TRX4 and TRX5 and make dialing tests (on TRX4 and TRX5) after frequency lock. In this case, the TCH still fails to be seized.
5. Make dialing tests (on TRX4 and TRX5) after frequency lock after replacing TRX4 and TRX5. Then, the TCH is successfully seized and the TCH congestion is released.

Case 3: Static TCHH Congestion Caused by Insufficient TCHFs

Description

Previously, several BTSs adopting the static half-rate function were added to the BSC (G3BSC32V300R002C10). In subsequent days, however, the congestion rate of the several BTSs in busy hours in the evening is high (over 10%). Instead, the traffic volume is not very high. Obvious, the abnormality occurs.

Cause Analysis

1. Checking parameter settings, you will find that **TCH Rate Adjust Allowed** of each cell is disabled and static TCHHs are configured in these cells. Only one or no TCH is

configured in these cells.

2. Checking the TCH performance measurement, you will find that only one or two TRXs are configured in the congested cell.

3. Recording the performance counters in cell performance measurement 2, you will find that **CELL ALLOC FAIL TIMES FR** is much greater than **ALLOC FAIL TIMES FR**. **Maximum Number of Busy TCHFs** is greater than the number of configured TCHFs. **Maximum Number of Busy TCHHs** is smaller than the configured number. Checking the status of TCHs in busy hours, you will find that all the TCHFs of these cells are occupied and some TCHHs are in the idle state.

4. These cells are located in rural areas or suburbs and multiple MSs can only use TCHFs because TCHHs are not supported. In addition, insufficient TCHFs result in TCHH congestion.

Troubleshooting

1. Increase two or three TCHFs for each cell according to **Traffic Volume on TCHF** and **Traffic Volume on TCH/H** and the number of TCHHs configured in ERLANG B.

2. Observe the traffic measurement result after modifying these parameters. Then, you can find that the TCH congestion rate of each cell is greatly reduced, nearly zero.

Handling Proposal

Significant modifications are made in the half-rate algorithm adopted in C13 and later version. If TCHHs must be supported, it is recommended that the algorithm version is upgraded to C13 or later. In C13 version, after the TCH rate adjustment is enabled, you can set the traffic busy threshold to control the type of preferred TCHs. Then, the preceding problems are solved.

For the congestion of the cell in which half-rate service is enabled, check whether dynamic TCHH adjustment is allowed. Then, locate the main cause and take proper measures accordingly.

7.4 Case 4: Increase of TCH Congestion Rate Caused by Improper Half-Rate Parameters after Upgrade from BSC C10 to BSC C13

Description

In an area, the TCH congestion rate increases after BSC C10 is upgraded to BSC C13 and the half-rate traffic absorption decreases.

Cause Analysis

BSC C10 does not support real-time conversion of TCHHs. Therefore, before upgrade, TCHHs are configured in the network and **TCH Rate Adjust Allow** is disabled, that is, dynamic adjustment of TCH rate is unallowed. In BSC C10, if the assignment request of the MSC is TCHF preferred or TCHH preferred, the BSC checks whether the number of idle TCHFs is greater than the value of **Preferred TCHF Idle Threshold** and assigns appropriate channels. The channel configuration remains unchanged after upgrade and

TCHH parameters use default values in C13 version. However, the half-rate algorithm adopted by BSC C13 greatly differs from that of BSC C10. In BSC C10, **TCH Rate Adjust Allow** is disabled. Therefore, TCHFs fail to be coverted to TCHHs and the TCH congestion rate increases.

Troubleshooting

Set the TCH type to **TCH Full Rate** and **TCH Rate Adjust Allow** to **Yes**. After the dynamic adjustment of the TCH rate is allowed, the congestion rate decreases and half-rate traffic absorption increases. Then, problems are solved.

Handling Proposal

BSC C13 optimizes the half-rate algorithm and realizes the real-time dynamic adjustment of the TCH rate. Focus on the impact imposed on the traffic absorption and the TCP congestion rate by the modification of the half-rate algorithm after and before the upgrade of the BSC version.

7.5 Case 5: Increase of TCH Congestion Rate Caused by Modification of Default Value of Handover Threshold

Description

In a site, if BSC6000 is upgraded from V9R1C01B086 to V9R1C03B104, the traffic measurement result reveals that the number of TCH congestion is much greater than that (nearly zero) before the upgrade. In addition, the higher traffic volume in the cell, the more serious the congestion is. The traffic volume, however, does not increase sharply.

Troubleshooting

First, the main cause is not the traffic volume because the traffic measurement shows no obvious changes of traffic volume before and after congestion.

Second, the traffic measurement suggests that the interference band is normal. Therefore, you can infer that there is no uplink interference.

Third, the congestion occurs suddenly in a great number of cells and the TRX seizure is normal in the cell with serious congestion. Therefore, you can infer that there are no implicit faults of the board.

Fourth, there are no parameter modifications recently. Then, the congestion cause cannot be the manual parameter modification.

Then, you can determine that the congestion is caused by upgrade. According to technical support engineers and R&D personnel, the P/N parameter of the PBGT handover does not bring any impact before upgrade whether this parameter is set to any value (By default, P = 3 and N = 3). After upgrade, the P/N parameter setting (P = 3 and N = 2) takes effect. The number of handover requests is multiplied several times due to the decrease of the handover threshold.

Handling Proposal

This case provides new thoughts for network optimization: To reduce the TCH congestion rate, you can increase the handover threshold and reduce the number of handovers in the complex downtown area with dense signals. If this method is applied to the rural area with poor signals, some risks may exist, such as call drop occurs and the speech quality deteriorates (the handover cannot be performed till the coverage level is in poor quality).

7.6 Case 6: Increase of TCH Congestion Rate Caused by Reverse Connections of Antennas

Description

The customer complains that the coverage of a BTS decreases and call setup is difficult; however, no alarm is found on the LMT.

Troubleshooting

Reverse connections of antennas, transmit antennas, and receive antennas cause unbalanced signals on uplink channels and downlink channels. That is, the user to which the transmit antenna points is back of the receive antenna. If the MS receives the TCH assignment command from the BSC during the call, the TCH fails to be assigned and the TCH congestion occurs due to poor level and quality of uplink signals of the MS caused by small gain of the receive antenna.

Handling Proposal

To solve this problem, make driving tests or use a signaling analyzer to analyze the level and quality of uplink and downlink signals to check whether signal imbalance exists. If yes, takes proper measures to solve this problem.

If the azimuth and tilt of the main antenna is inconsistent with those of the diversity antenna or the diversity or spacing is small when single-polarization antennas are used in a cell, uplink and downlink signals are inconsistent and TCHs seizure failures tend to occur. There are no such problems in cells that adopt dual polarization antennas.

7.7 Case 7: High TCH Congestion Rate Due to No Capacity Expansion of Repeaters after BTS Capacity Expansion from O2 to O4

Description

After the capacity of a BTS is expanded from O2 to O4, the congestion rate increases, reaching up to 40%.

Troubleshooting

1. If the latter two TRXs are blocked on the remote LMT, the TCH congestion rate is dramatically reduced to the normal level. Then, you can infer that the main cause is the two TRXs.

2. Tracing and analyzing Abis-interface signaling, you can find that the assignment failure occurs on the two new TRXs. When the assignment failure occurs, the measure report of SDCCHs suggests that the level on the SDCCH is normal and the TA value is relatively

greater. Then, you can determine that the failure occurs on a remote area. However, there are no SACCH (TCH) measurement reports. It is estimated that uplink or downlink tributaries of the two TRXs may be faulty. In some cases, the TCH assignment is successful on the two TRXs. Then, the two TRXs cannot be faulty.

3. There are no faults occurred on antenna and feeder hardware because this cell adopts the four-in-one combiners and one-to-four dividers. In addition, there are no hardware problems on the semi-rigid cables connecting TRX boards to combiners and dividers.

4. According to the maintenance engineers, this cell is installed with a repeater. Before capacity expansion, two TRXs are configured in this cell and two frequencies are locked by the repeater. After capacity expansion, no frequencies are locked for the two TRXs. Therefore, to solve the problem of high TCP congestion rate, you must solve the frequency problem of the repeater.

Cause Analysis

The coverage of the latter two TRXs differs from that of former two TRXs due to the deployment of repeaters. This causes TCH assignment failure.

Case 8: Interference Caused by Repeaters

Description

In cell 3 of a BTS, the call drop rate reaches 10%; traffic volume is low; the TCH congestion rate is high. In cell 1 and cell 2, however, the call drop rate and TCH congestion rate are normal.

Troubleshooting

1. The TCH congestion rate remains high no matter how to block TCHs of the TRX in the cell. It is estimated that interference exists or the area covered by the cell features complex terrain.

2. According to the traffic measurement data, idle TCHs fall in interference band 4 or 5 in cell 3 in daytime and in interference band 1 or 2 from 23:00 in the night to 7:00 in the morning. There is regularity between the TCH congestion rate and call drop rate and the interference band.

3. Check whether co-channel interference exists. Change the frequency of cell 3 so that the spacing between the frequency and the original one is at least 1 meter. The interference, however, persists. Therefore, the probability of co-channel interference and adjacent-channel interference is eliminated.

4. Check whether the equipment is faulty. Exchange antenna feeders of cell 3 and cell 1. The interference, however, still exists in cell 3. Therefore, you can infer that the equipment is in the normal state. Then, check whether external interference exists.

5. Use a spectrum analyzer to make frequency sweep tests on the divider port. Then, you will find that a signal similar to the signal from an analog spectrum (the central frequency is 904.14 MHz and the spectrum bandwidth is 300 kHz) exists continuously. The strength of the signal at the divider port of cell 3, cell 2, and cell 1 is –27 dBm, –40 dBm, and –60 dBm respectively, and the signal strength is consistent with the interference level.

Through the spacing between the frequency and the original one is 10 meters, the frequency outputs continuous signals. In this case, collision and intermodulation with other signals tend to occur. Some intersected signals may fall in the receiving band, causing interference. The traffic volume in daytime is higher than that in the night. Therefore, intersected signals are more and the interference is more serious. Huawei reaches an agreement with operators that there is no 904.14 MHz interference source. Put the spectrum analyzer in the car to make driving tests. At this time, however, no 904 MHz interference source is found. Then, make driving tests on the roof. At last, the fault is considered to be concerned with the unimportant little antenna. Subsequent signal interruption tests prove this hypothesis. After the antenna is powered off, the interference is eliminated and measurement counters of BTS A become normal.

Case 9: TCP Congestion Caused by External Interference

Description

A cell encounters TCH congestion caused by external interference.

Troubleshooting

Three radars are deployed in the BTS about one kilometer away from the downtown area. For the #27 radar whose operating frequency band is similar to GSM frequency band, the operating frequency band is 900–999MHz and the transmit power is 580KW. The standby time is long. Long-time tests and analysis show that the radar cause serious interference. The receiver of the BTS features high receive background noise that reaches a maximum of –80dBm. Then, uplink signals transmitted from the MS with low power may be overwhelmed by noise signals. At this time, it is difficult for subscribers to make a call. In addition, there is no prompt sound. As a result, the TCH congestion occurs. You can reduce the interference by decreasing the antenna tilt.