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OPTIMIZATION OF QUASI FAST RETURN TECHNIQUE IN TD-SCDMA

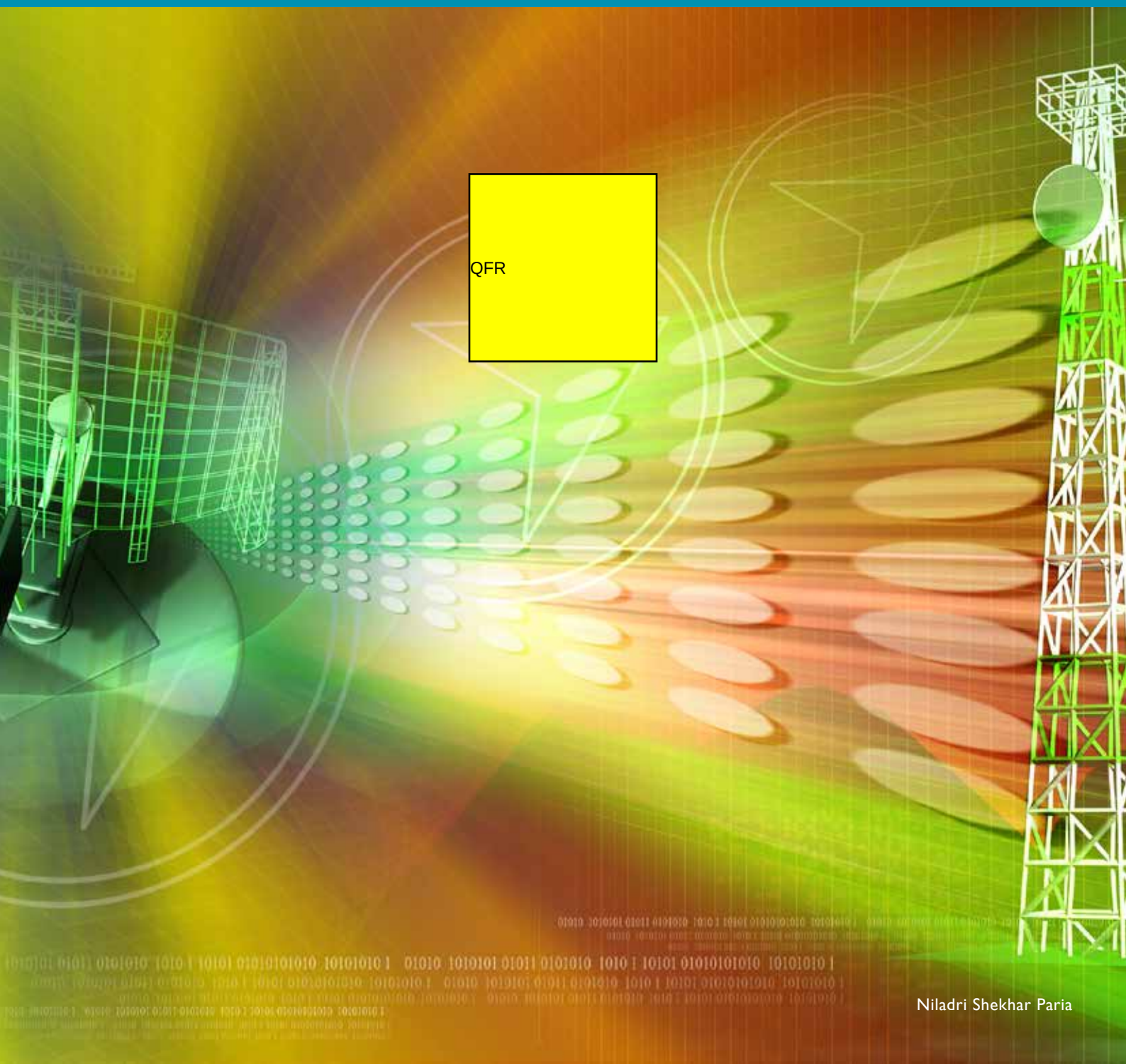

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Table of Contents

03 ..... Abstract

03 ..... Overview of QFR Technique

05 ..... Problem in Existing QFR Technique

05 ..... Proposed Solution

06 ..... Conclusion

06 ..... Reference

Abstract

The TD-SCDMA [Time Division-Synchronous Code Division Multiple Access] wireless standard was developed by 3GPP which was then enhanced by CCSA [China Communications Standards Association] for 3G mobile services in China.

Hybrid Networks supports both TD-SCDMA and GSM (Global Mobile Communication). GSM is best for voice service (CS-Circuit Switch Service) and TD-SCDMA can provide best 3G data service (PS - Packet Switch). Hence, to deliver high quality voice and data services, users need to quickly switch between these two standards when transferring from a voice call to data services and vice-versa.

Quasi Fast Return (QFR) method was introduced in TD-SCDMA system to achieve fast switching between the two standards. The effectiveness of this method depends on its success rate. When the QFR method fails, it triggers traditional time consuming TD-SCDMA cell selection process which can result in a host of undesirable outcomes including loss of voice and data connectivity.

This white paper explores the drawbacks in existing QFR technique and also proposes solution which can improve QFR success rate.

Overview of QFR Technique

Currently both GSM and TD-SCDMA network are present in field. TD-SCDMA provides high speed data service and GSM provides best quality voice service. Operators always want User Equipment to stay in TD-SCDMA as much as possible to provide continuous high speed data services. It helps User Equipment to stay connected with high speed data network for personal or business purposes. When User Equipment starts voice call in TD-SCDMA network, operator tries to switch User Equipment to GSM network. After voice call ends User Equipment needs to switch back to TD-SCDMA network. But re-selection to TD-SCDMA network takes long time (approximately 10 sec). UE is not able to respond for any network paging during this long period. To overcome this problem UE needs a rapid switching technique which can move UE to TD-SCDMA network very quickly after it has finished voice call in GSM network.

QFR is a method for rapid switching to TD-SCDMA network from GSM network. This method is useful for User Equipment which requires high speed business data services from the TD-SCDMA network. User Equipment receives TD-SCDMA frequency information and RSCP [Received Signal Code Power] threshold from network during TD-SCDMA Idle Mode. After the voice call is established in TD-SCDMA network, User Equipment moves to GSM for better voice service by a handover. During Handover process from TD-SCDMA to GSM, TD-SCDMA frequency list and RSCP threshold is transferred to GSM. User equipment continuously measures for the list of TD-SCDMA cells received from networks during voice call. After voice call ends User Equipment directly selects the best TD-SCDMA cell from its measurement result. It helps quick TD-SCDMA cell selection.

Technical details of QFR technique:

- In IDLE mode, User Equipment receives TD-SCDMA System Information Blocks (SIB) from network. UMTS Network sends cell selection and reselection related parameters in SIB3. For TD-SCDMA, networks add QFR related information element in SIB3 (SIB3 -> Cell Selection Reselection Info) along with other information. UE extracts frequency list and Received Signal Code Power (RSCP) threshold information from SIB3 for QFR.
- After UE starts the voice call, it hands over to GSM cell for better CS (Circuit-Switched) service. Received frequency list and RSCP threshold is sent to GRR [GSM Radio Resource Controller] along with the GSM handover command.
- UE performs Inter Radio Access Technology measurement (TD-SCDMA) during CS call (in GSM). In connected mode UE measures all TD-SCDMA frequencies received in SIB3.
- After CS call ends, UE can reselect to TD-SCDMA cell which has highest RSCP from the list of measured cells. Selected cell's RSCP should be higher than threshold.
- UE executes traditional method of switching GSM to TD-SCDMA network, if none of the frequency's RSCP is higher than the threshold or if the reselection to TD-SCDMA fails.

This process is represented in Figure 1: QFR Mechanism

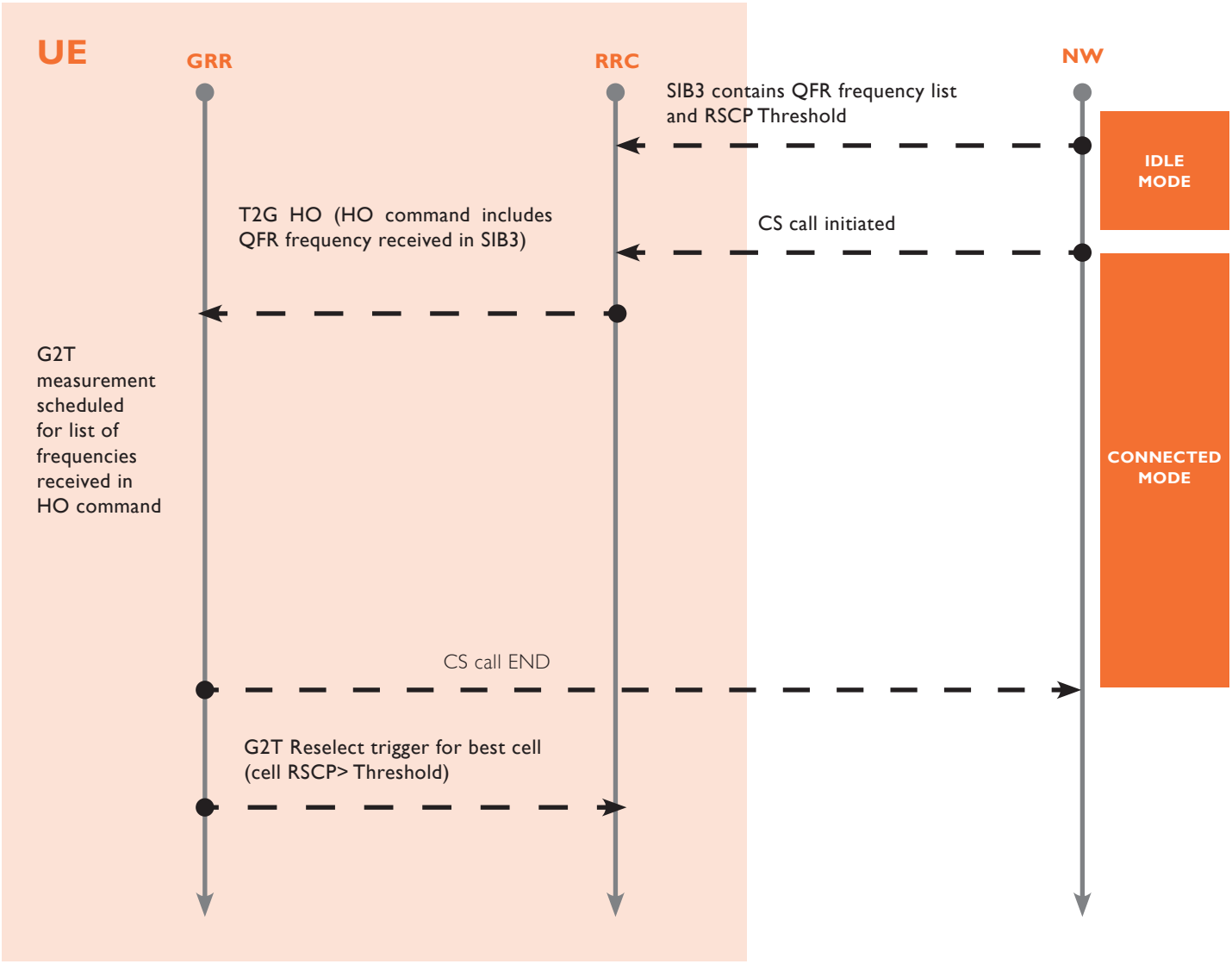

Figure 1: QFR Mechanism

Problem in the Existing QFR Technique

In today's world, users and industries require:

- High speed data service (data streaming, video call, video on demand, multimedia services, webcast, real time video, web browsing, database retrieval, etc.)
- Always connected (ON) mode for data service
- Best quality voice service
- No paging miss (if there are networking paging misses, User Equipment will not able to answer to incoming calls)

3G standard (TD-SCDMA or WCDMA) mainly address the first two goals and GSM can provide the best quality voice service. So, fast switching between TD-SCDMA and GSM is the key to fulfill user requirement seamlessly. QFR technique provides a way for quick movement from GSM to TD-SCDMA networks. But everything depends on the QFR success rate. If QFR technique fails, User Equipment needs to select TD-SCDMA using traditional technique. Traditional way of selection is a slow process which can cause user equipment to miss network paging. This results in users being unable to receive incoming calls or even access 3G services for a considerable period of time. Hence, the QFR success rate is critical in meeting user expectations.

QFR technique often fails in the below conditions:

- In field, high mobility of UE is expected. User Equipment can start a voice call while traveling in high speed bullet train. It is observed that QFR method has high failure rate in reselecting TD-SCDMA if the UE is moving at a high speed during long duration CS call. In such cases UE need to perform traditional reselection to TD-SCDMA cell which is much more time consuming and leads to network paging misses.
- TD-SCDMA network can use different frequencies in different geographical location. User Equipment receives TD-SCDMA frequency lists in IDLE mode. During voice call UE handovers to the GSM network and can move to different geographical location, where different sets of TD-SCDMA frequency may exist. TD-SCDMA frequency list received in SIB3 may not be suitable or would be very weak in the new location. Due to weak signal or unavailability of those TD-SCDMA frequencies, QFR measurement result will not be able to satisfy the cell reselection criterion. So UE goes for the traditional cell search procedure to camp on TD-SCDMA network.

Proposed Solution

To provide customers and businesses with a seamless user experience, operators need to roll-out high quality data and voice services consistently. To achieve that, User Equipment needs to switch between GSM and TD-SCDMA network very quickly depending upon the user requirement. QFR success rate is a key factor to achieve GSM to TD-SCDMA switching rapidly.

A minor modification in Radio Resource Control layer can solve problems with the existing QFR technique. UE would be able to select proper TD-SCDMA cell using QFR method if it is able to include more TD-SCDMA cells/frequencies (in its search list) which are having good signal strength in the new region. It can be achieved through the below solution:

- Radio Resource Control layer (RRC) needs to store below frequency information from following sources in local data base associated with aging timer
  - » Frequencies present in SIB3 (QFR frequencies)
  - » Frequencies present in Measurement Control messages (inter-frequency measurement)
  - » Hand Over frequencies (during TD-SCDMA connected mode)
  - » Serving cell frequency
  - » RRC will have a limit on maximum number of stored frequencies depending on its capability of scheduling those frequencies for measurement during CS call in GSM. During CS call in GSM, UE performs measurement on frequencies received during TD-SCDMA to GSM Handover
  - » Now GRR can cover most of the available TD-SCDMA frequencies in that region. After CS call ends UE can select the best TD-SCDMA cell to reselect and start its PS data services.

Instead of providing frequencies which are received only in SIB3 if RRC includes above all frequencies during TD-SCDMA to GSM handover from its database, QFR success rate can increase drastically.

Conclusion

QFR method makes very fast reselection to TD-SCDMA network. So, the probability of missing the network paging reduces drastically and high speed business user can get back their 3G services quickly. This enables a continuous delivery of high speed data services to users.

Field research has indicated that this new proposed technique can boost the QFR success rate (which is currently estimated to be around 55-60%) by about 25-30%. This will help operators considerably improve their live KPIs and take customer satisfaction to new levels.

Reference

[1] Method and system for rapidly switching to TD-SCDMA (Time Division-Synchronous Code Division Multiple Access) network - Patent Application Number CN 201010508878

About the Author

Niladri Shekhar Paria is an industry expert in the Cellular Wireless connectivity domain and currently works as a Lead Architect in Wipro Technologies. He has over 10 years of experience in the wireless telecom industry in WCDMA, TD-SCDMA, GSPS (Satellite Phone Standard) modem software development for mobile devices, and WiMAX software development for base station.

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