Simulation and Analysis of EVDO Network for Mobile Internet Traffic Behavior

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Abstract. In recent years, the popularity of intelligent terminals and diversification of data applications become a great impetus for mobile internet. Undoubtedly, the success of mobile internet brings the benefits for operators, but it makes wireless networks encounter the unprecedented challenges and impacts. This article is based on the newly developed simulation platform which is oriented for mobile internet traffic behavior, and the problems about "signaling storm" and "mobile data bearing value" of EVDO network are studied.

Keywords: EVDO, signaling storm, control channel, access channel, simulation.

1 Introduction

In the EVDO PS domain, the problem about wireless resource occupation when no data is transferring is solved through introducing the dormant state, which makes a data transfer goes through following procedures: air interface connection establishment, data transferring, dormancy time and air interface connection release. With the mobile network development and the influx of internet applications, the traffic behavior such as small burst data and periodic heartbeat mechanism are more notable. Can those applications bring additional value for operators, and what is "mobile data bearing value". At the same time, it should be evaluated that whether it will cause more overload for control channel and access channel of the mobile network, leading to signaling storm. In the traditional simulation platform, only capability of traffic channels is considered, which cannot meet simulation need for mobile internet traffics. From the above, the new simulation platform development should be in first place.

2 Simulation Process of the New Platform

The new simulation platform is based on traditional timeslot-driven traffic channel simulation process. The simulation input will be single-user real test trace which fits for statistical characterisation of traffic scenarios defined by 3GPP. Reasonable separation of simulation process of forward link and reverse link is achieved by adding judgment

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of state transition between forward link and reverse link. Then, simulation process of forward control channel and reverse access channel will be introduced.

In the simulation process of forward link, three channels are considered. Synchronous Control channel is used to send sync message, quick-config message, sector parameter message, paging message, etc. Sub-Synchronous Control channel is used to send paging message, etc. Asynchronous Control channel is used to send traffic channel assignment message、UATI assignment message, etc.

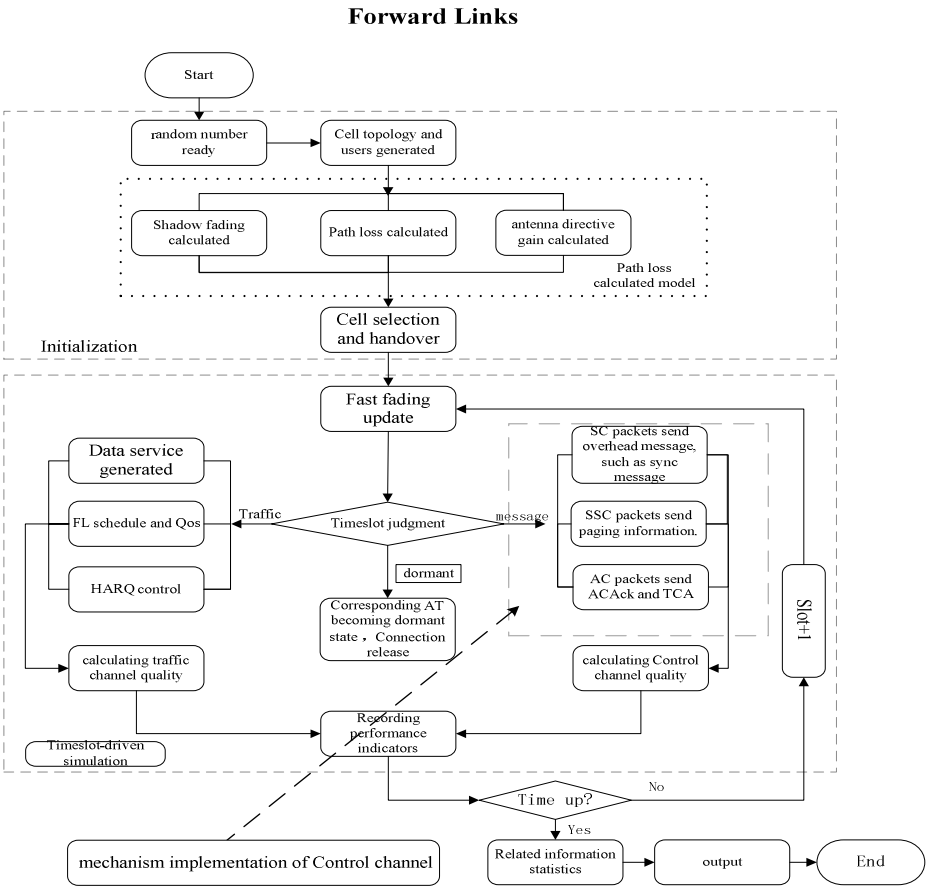

Fig. 1. Simulation procedure of forward link

In the simulation process of reverse link, access sequence, access probe, conformance testing and collision detection which are related with access process are introduced.

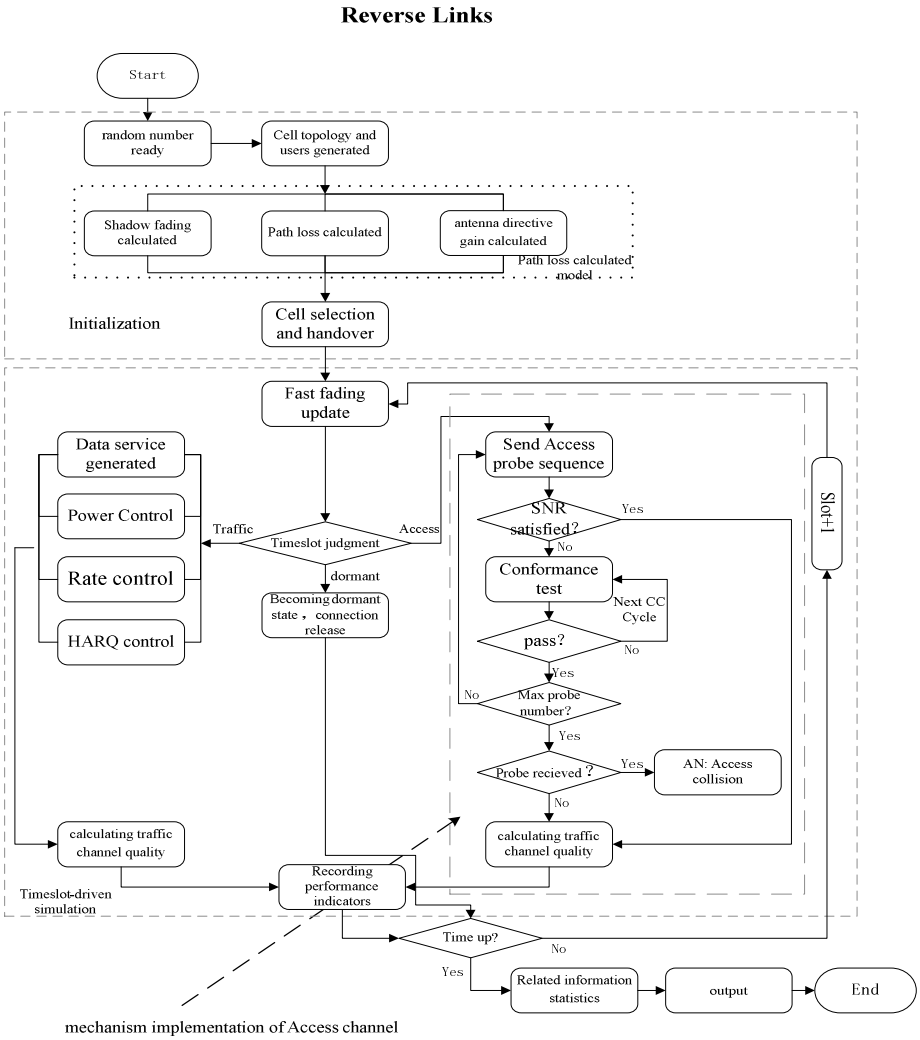

Fig. 2. Simulation procedure of reverse link

3 Simulation Conditions

Resource consumption of wireless network is evaluated for QQ and Microblog. Restricted factors of bearer capability for different traffic scenarios are estimated.

Table 1. Simulation conditions

parameter	value
Number of Timeslot	120000（200s in real system）
Number of Sector	57（19*3）
Equivalent User number per Sector	40~320
Scheduling algorithm	Proportional Fair
Dormancy timer	MO：10s　MT：5s
Downlink MacIndex assignment	114
Paging cycle	5.12s
Paging policy	Once in 5.12s, paging again in another cycle when failed

4 Simulation Result

Bearing capability for QQ and Sina MicroBlog in single sector under multiple cells scenario is measured by several important factors of network capacity in the simulation. Those factors are MacIndex usage of forward link, Control channel load, noise floor rising of reverse channel, access count.

Forward traffic channel capability　　Forward control channel capability

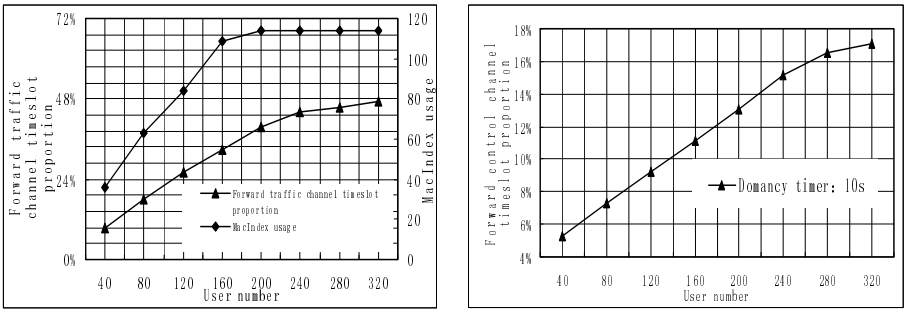

Fig. 3. Simulation results for QQ

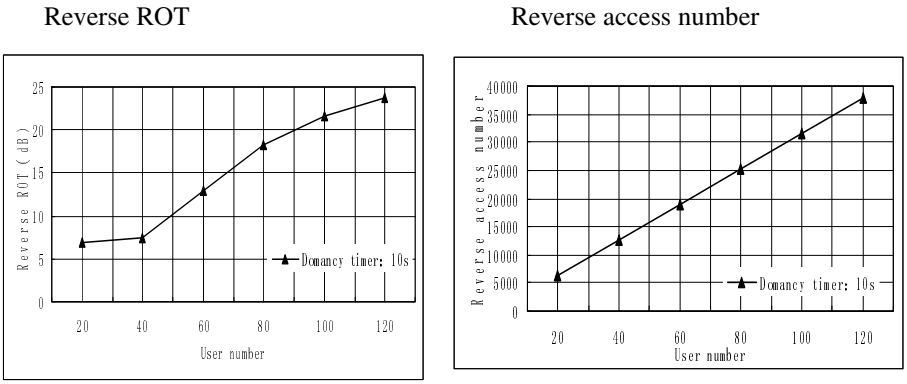

Fig. 3. *(Continued)*

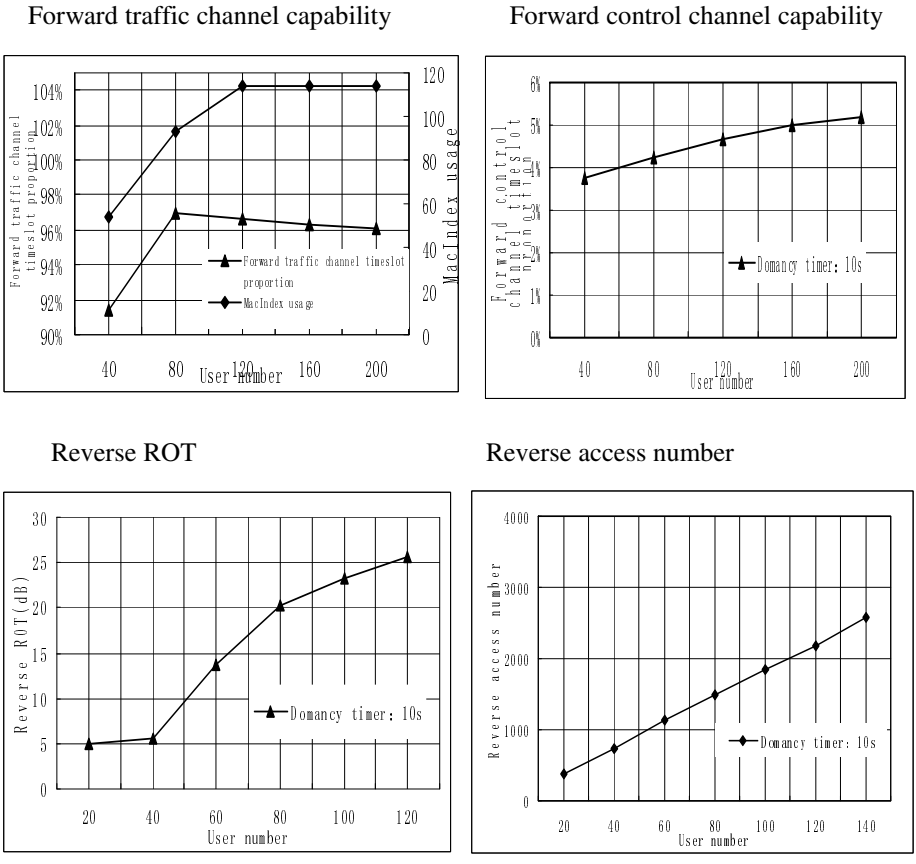

Fig. 4. Simulation results for Sina Microblog

By analyzing simulation results, bearing capability for QQ and Sina MicroBlog in EVDO is limited by reverse link. After the users in reverse link increase, if noise floor in reverse link has exceeded the RAB threshold, BS will send busy indicator and begin uplink access control. Under this condition, it will increase ROT if access process continues. In reverse link simulation, the max user number is determined when ROT is raised by 15dB. It still needs to be studied that how to improve interference cancellation capability in reverse link in CDMA. Accordingly, forward link control channel load threshold is that Control channel timeslots account for less than 20% of total timeslots, and reverse channel load threshold is that reverse channel access timeslots account for less than 40% of total timeslots in engineering.

Table 2. Simulation result

Application	**direction**	**Max user number**	**Limitation**	**Control timeslot proportion when limited**	**Traffic timeslot proportion when limited**	**Bearer Capability（considering forward and reverse link）**
QQ	forward	180	MacIndex	6.5%	80%	65
	reverse	65	ROT	1.5%		
Sina MicorBlog	forward	80	Traffic timeslot proportion	5.45%	94%	60
	reverse	60	ROT	1.15%		

In EVDO, the dormancy timer is a key parameter which balance the load between traffic channel and signaling channel(including control channel of forward link and access channel of reverse link). The dormancy timer for QQ is set to 2s, 5s and 10s in the simulation, the simulation results are listed below.

Whatever the dormancy timer is 2s, 5s or 10s, bearing capability of network is limited by reverse link ROT. In EVDO, reverse link interference is the first-come restriction and “signaling storm” will not come before that. Sometimes, “signaling storm” may happen for a short time when application servers of a popular service shut down causing many terminals keep connecting to the servers.

In order to evaluate “mobile data bearing value”, FTP is simulated and FTP model use Full buffer model which is defined in 3GPP2.

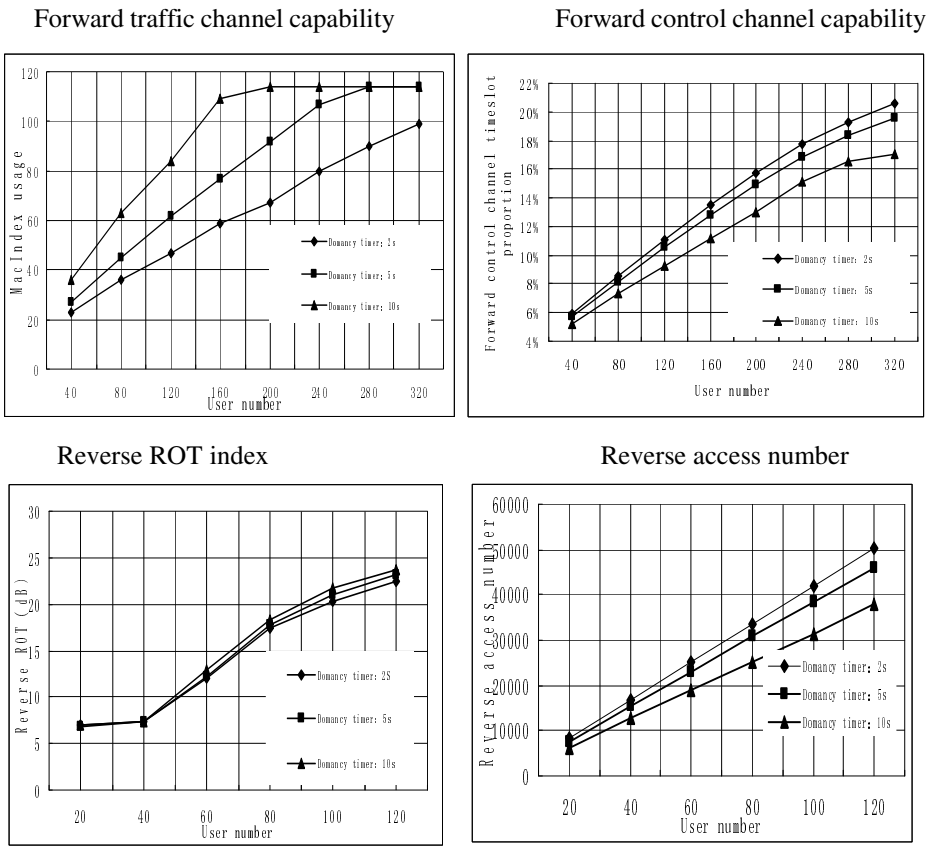

Fig. 5. Simulation results of different dormancy timer configuration (QQ)

Table 3. Throughput per sector when reaches their max capability for three services traffics

Application	Throughput per sector when reaches max capability
QQ	65 users, Forward 30kbps, Reverse 20kbps
Sina MicroBlog	60 users, Forward 300kbps, Reverse 96kbps
FTP	Forward 920kbps, Reverse 436kbps

Simulation results reveal that throughput of FTP is larger than that of QQ using the same bearing resources, which means FTP has a higher "mobile data bearing value". For operators, the bigger challenge than "signaling storm" is how to solve the problem

of “mobile users increasing without corresponding profit” which mobile internet traffic brings.

5 Conclusion

The essence of the “signaling storm” approaching our EVDO network appears not to be limited by time-slot occupation of forward control channel and reverse access channel, reverse interference and forward traffic channel time-slot occupancy are more severe for EVDO network. To solve this problem and improve system capacity for mobile internet services, the carriers could take methods via various aspects of the system, such as wireless network, core network, platform, terminal, and service. But we need to bear in mind that the mobile network doesn’t match the Internet services spontaneously. The structure of the air interface of mobile networks was designed about 10 years ago, when all today’s popular mobile Internet services didn’t exist. Therefore the mobile network was not designed to satisfy these services. And if we take a look at these services, we would find most of them are based on IP, a protocol come from fixed line network with no consideration of mobile network scenario. Mobile network use centralized resource scheduling because of the consideration of limited wireless resource, but internet is designed differently because they think every end point should have equal usage of bandwidth. To make things worse, both mobile communication technology and IP technology are too popular today to make any big change to fit with each other. Thus we could conclude that current solutions for mobile internet performance optimization can only temporarily relieve the network pressure, and the industry is waiting for a revolution to solve the problem completely.

References

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