Case Title	WCDMA Power Calculation Guide
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The Related Project	WCDMA Network Up gradation Project

WCDMA Power Calculation Guide

Abstract : The abstract of this guide is related to Power calculation including Max Power of Cells and all associated common control channels in UMTS. The reason for writing this guide as it would be very helpful when you will upgrade your software version like from R14 to R15 or later, to avoid upgrade fails because the maximum transmit power of a cell is lower than the sum of the transmit power of channels in the cell. Also it will give you a better understanding of power which is shared among many channels.

We have to upgrade our software version from V900R014C500 to V900R015C00 so we have to check in the said UMTS Network that the comparision of CellMaxTxPower to Total number of downlink Channels powers before execution.

This guide contains the idea behind how the calculation has been done in all our network to avoid activity failure and give good perception of Power in WCDMA.

Keywords: Power, Control channels, Radio, Planning, Optimization, RF, Upgrade

1. Situation

There are total 1147 sites in this UMTS network and different Maximum transmit powers are set in the network. The power

calculation has to be done on every cell which requires some strategy to quickly complete this task effeciently. All this mentioned in the later part of this guide how calculation done and what was the criteria.

Before going in the details here is the information of all the channels which have been used in the calculation.

- Maximum Transmit Power of Cell

  Sum of the maximum transmit power of all DL channels in a cell.

  To fetch this information from M2000 the command is as follows

  ```
  LST UCELL: LstType=ByCellId, CellId=11234;
  ```

- P-CPICH Transmit Power of Cell

  TX power of the P-CPICH in a cell. This parameter should be set based on the actual system environment such as cell coverage (radius) and geographical environment. For the cells to be covered, the downlink coverage must be guaranteed. For the cells requiring soft handover area, this parameter should satisfy the proportion of soft handover areas stipulated in the network plan.

  The value of this parameter must satisfy the following relationship: "Min Transmit Power of PCPICH" <= "PCPICH Transmit Power" <="Max Transmit Power of PCPICH"

  To fetch this information from M2000 the command is as follows

  ```
  LST UPCPICH: CellId=11234;
  ```

  Note: The P-CPICH transmit power must be higher than the minimum pilot power and lower than the maximum pilot power.

- PICH Power Offset and AICH Power Offset

  PICH Power Offset is the difference between the transmit power of PICH and that of PCPICH

AICH Power Offset is the difference between the transmit power of an AICH and that of PCPICH.

To fetch this information from M2000 the command is as follows

```
LST UCHPWROFFSET: CellId=11234;
```

- BCH Transmit Power

  This is the Offset of the BCH transmit power from the P-CPICH transmit power in a cell. If the value is set too small, the UEs on the cell edge cannot receive the system messages properly. This problem affects the coverage of the downlink common channel and furthermore the coverage of the cell. If the value is set too great, it causes interference to other channels, occupies the downlink transmit power, and affects the cell capacity.

  To fetch this information from M2000 the command is as follows

```
LST UBCH: CellId=11234;
```

- PSCH Transmit Power

  This is the Offset of the PSCH transmit power from the P-CPICH transmit power in a cell. If the value is excessively low, UEs at the edge of cells fail in network searching, resulting in influence on coverage of the downlink common channel. This finally affects the cell coverage. If the value is excessively high, the power resources are wasted, and other channels are interfered seriously, thus the cell capacity is influenced.

  To fetch this information from M2000 the command is as follows

```
LST UPSCH: CellId=11234;
```

- SSCH Transmit Power

This is the offset of the SSCH transmit power from the P-CPICH transmit power in a cell. If the value is excessively low, UEs at the edge of cells fail in network searching, resulting in influence on coverage of the downlink common channel. This finally affects the cell coverage. If the value is excessively high, the power resources are wasted, and other channels are interfered seriously, thus the cell capacity is influenced.

To fetch this information from M2000 the command is as follows

```
LST USSCH: CellId=11234;
```

- PCH Transmit Power

  This is the offset of the PCH transmit power from the PCPICH transmit power in a cell. If the value is set too small, the UEs on the cell edge cannot receive the paging message properly. This problem affects the coverage of the downlink common channel and furthermore the coverage of the cell. If the value is set too great, it causes interference to other channels, occupies the downlink transmit power, and affects the cell capacity.

  To fetch this information from M2000 the command is as follows

```
LST UPCH: CellId=11234;
```

- Maximum FACH Transmit Power and FACH IDs

  This is the offset between the FACH transmit power and P-CPICH transmit power in a cell. If MaxFachPower is set excessively low, a UE positioned at the cell edge may fail to receive the services and signaling carried over the FACH, in a correct way. This will impact the downlink common channel coverage and thus the cell coverage.

If MaxFachPower is set excessively high, other channels will be interfered and more downlink power resources will be occupied. This will consequently impact the cell capacity.

FACH ID is used to uniquely identifying a FACH bearing the common transport channel in a cell.

To fetch this information from M2000 the command is as follows

```
LST UFACH: CellId=40011;
```

- Number of AICHs.

  The defined number of AICHs can be identied through AICHID.

  To fetch this information from M2000 the command is as follows

```
LST UAICH: CellId=11234;
```

- Maximum Transmit Power and Minimum Transmit Power of P-CPICH

  Maximum TX power of the PCPICH in a cell. This settings should be set based on the actual system environment such as cell coverage (radius) and geographical environment, and the cell total power. When the ratio of soft handover areas keeps the same, the downlink coverage cannot be promoted by the increase of PCPICH power.

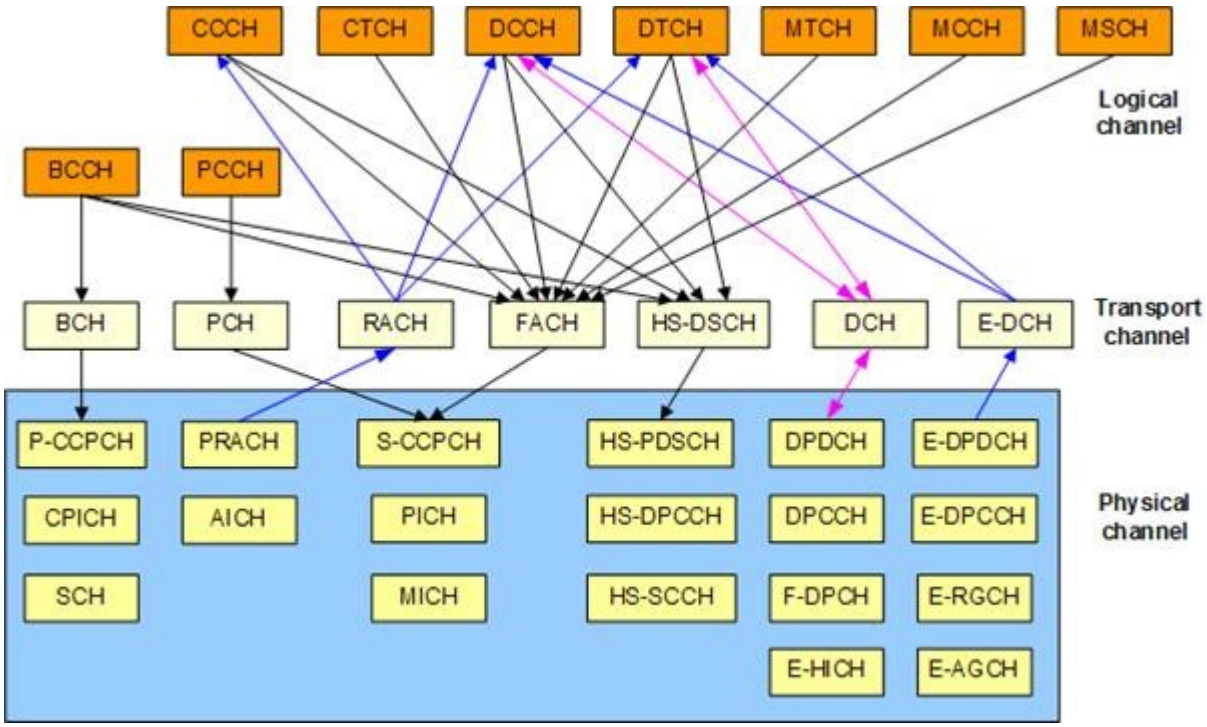
  Minimum TX power of the PCPICH in a cell. This parameter should be set based on the actual system environment such as cell coverage (radius) and geographical environment. Ensure that MinPCPICHPower is set under the condition of a proper proportion of soft handover area, or under the condition that no coverage hole exists.

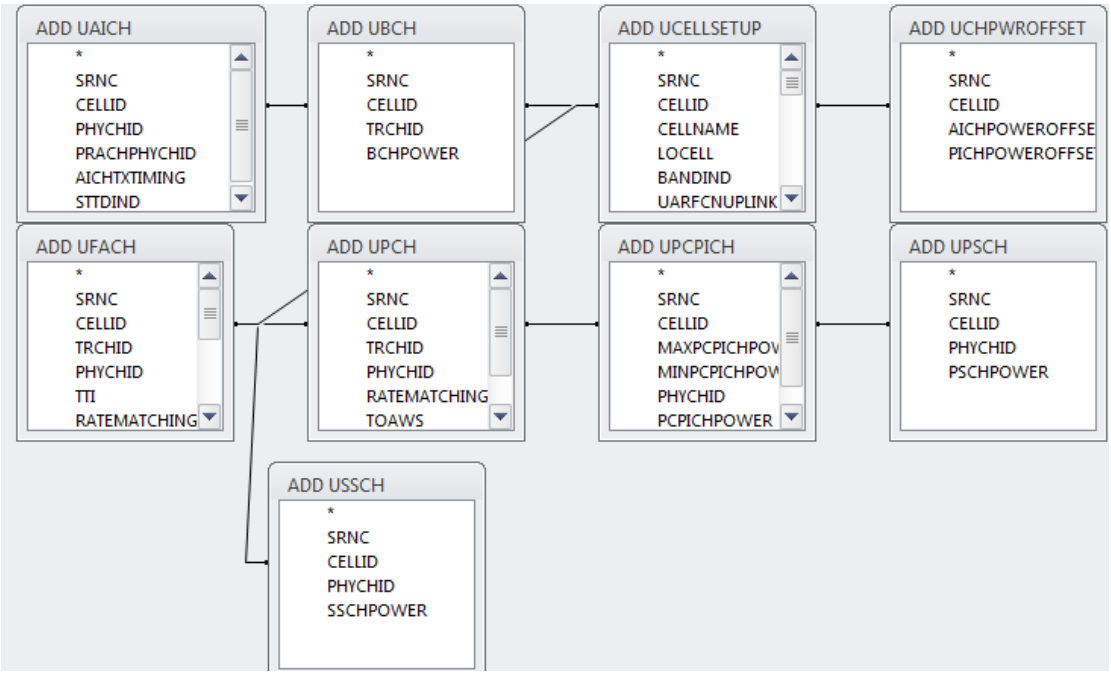
  To fetch this information from M2000 the command is as follows

```
LST UPCPICH: CellId=11234;
```

2. Analysis

As I mentioned above to avoid discrepancy in power calculation the strategy has been developed which divided in different combinations according to the defined Maximum transmit power settings which has been discussed in the later part. In this part the formulas has been mentioned which have been used in the calulation. This all is based on Downlink channel mapping based on the below diagram.





Formulas Used

Below are the formulas which has been used in the calculation, refer attached excel also in case of any confusion.

CELL MAXIMUM TRANSMIT POWER → POWER (10,(MAXTXPWR/10)/10)
PCPICH → POWER (10,(PCPICH/10)/10)
PICH → POWER(10,(PICH+CPICH/10)/10)
AICH → POWER(10,(AICH+CPICH/10)/10)*Num of AICH
BCH → POWER(10,(((MAX(BCH,PSCH,SSCH)+PCPICH))/10/10))
FACH → POWER(10,(((MAX(FACH,PCH)+PCPICH))/10/10))*Num of FACH
TOTAL COMMON CHANNEL POWER → PCPICH+PICH+AICH+BCH+FACH
COMPARE CELL MAXIMUM TRANSMIT POWER WITH TOTAL COMMON CHANNEL POWER

IF MAXIMUM TRANSMIT POWER >= TOTAL COMMON CHANNEL POWER → PASS
IF MAXIMUM TRANSMIT POWER < TOTAL COMMON CHANNEL

POWER → FAIL

Power_Formula.xlsx

3. Working Strategy

The mapping between Maximum Transmit Power and all downlink channel power has been done with different combinations or scenarios.

The different combinations are based on Maximum transmit power which are currently using in this UMTS network.

First all the relative data of all sites has been gathered in one sheet by different commands as mentioned above through latest CFGMMLs of all RNCs. Below mentioned depicts the same.

SRNC	CELLID	MAXTXPOWER	PCPICHPOWER	AICHPOWEROFFSET	PICHPOWEROFFSET	BCHPOWER	PSCHPOWER	SSCHPOWER	PCHPOWER	FACHID	MAXFACHPOWER	AICHID	MAXPCPICHPOWER	MINPCPICHPOWER
501	10005	430	230	-6	-7	-20	-50	-50	-20	5	10	6	360	40
501	10005	430	230	-6	-7	-20	-50	-50	-20	4	10	6	360	40
501	10006	430	330	-6	-7	-20	-50	-50	-20	5	10	6	346	313
501	10006	430	330	-6	-7	-20	-50	-50	-20	4	10	6	346	313
101	10011	460	360	-6	-7	-20	-50	-50	-20	5	10	6	378	342
101	10011	460	360	-6	-7	-20	-50	-50	-20	4	10	6	378	342
101	10012	460	300	-6	-7	-20	-50	-50	-20	4	10	6	310	290
101	10012	460	300	-6	-7	-20	-50	-50	-20	5	10	6	310	290
101	10013	460	360	-6	-7	-20	-50	-50	-20	4	10	6	378	342
101	10013	460	360	-6	-7	-20	-50	-50	-20	5	10	6	378	342
101	10015	460	360	-6	-7	-20	-50	-50	-20	4	10	6	378	342
101	10015	460	360	-6	-7	-20	-50	-50	-20	5	10	6	378	342
101	10016	460	300	-6	-7	-20	-50	-50	-20	4	10	6	310	290
101	10016	460	300	-6	-7	-20	-50	-50	-20	5	10	6	310	290

In the above diagram the columns highlighted with yellow are constant in

this network and set on one value only.

After processing the above data it has been observed that there were 8 different types of MaxTXPower set in the network so we need at least 8 combinations to cross check whether the maximum transmit power of all cells is greater or equal to other common channels.

Further calrify here that every time the MaxTXPWR will be change and correspondingly the maximum power of the other downlink channels and max number (FACH & AICH ID) will be selected.

Combination – 01

In combination 1 the highest set power has been taken which is 490 dBm correspondingly the cell whose CPICH power is highest according to this filter which is 360 has been taken, the reason to select the highest CPICH Power is because of this has the highest weightage in the power calculation means this will consume max power also the same strategy has been setup with other channel powers to check the peak case.

After calculation as per the above formulas it has been concluded that Cell Maximum transmit power is greater than the total channel power as reflecting in the below table.

Power Of Cell(dBm)		Result（mV）
CellMaxTxPower	490	79432.82347
PCPICH	360	3981.071706
PICH	-7	794.3282347
AICH	-6	1000
BCH	-20	2511.886432
FACH	10	10023.74467
PSCH	-50	
SSCH	-50	
PCH	-20	
Num of AICH	1	
Num of FACH	2	
Max of PCPICH	390	
Min of PCPICH	370	
Total of Channels		18311.03104

Combination- 02

The same strategy we use in the next round select the next MaxTXPower of 478 and selecting its corresponding max values of CPICH power PICH, AICH, BCH, FACH and other common channels.

One thing which is significant to notify here that the Number of FACH and Number of AICH is important in the calculation as if their number is any combination their weight age will be high in the calculation which is prominent in overall affect.

Power Of Cell(dBm)		Result（mV）
CellMaxTxPower	478	60255.95861
PCPICH	380	6309.573445
PICH	-7	1258.925412
AICH	-6	1584.893192
BCH	-20	3981.071706
FACH	10	15886.56469
PSCH	-50	
SSCH	-50	
PCH	-20	

Num of AICH	1	
Num of FACH	2	
Max of PCPICH	313	
Min of PCPICH	346	
Total of Channels		29021.02845

Other Combinations

Other all remaining 6 combinations has mentioned below based on changing max tx power and its corresponding maximum values of other common channels.

The result is based on above mentioned formulas.

Power Of Cell(dBm)		Result（mV）
CellMaxTxPower	460	39810.71706
PCPICH	390	7943.282347
PICH	-3	3981.071706
AICH	-6	1995.262315
BCH	-20	5011.872336
FACH	10	20000
PSCH	-50	
SSCH	-50	
PCH	-20	
Num of AICH	1	
Num of FACH	2	
Max of PCPICH	470	
Min of PCPICH	370	
Total of Channels		38931.4887

Power Of Cell(dBm)		Result（mV）
CellMaxTxPower	448	30199.5172
PCPICH	360	3981.071706
PICH	-7	794.3282347
AICH	-6	1000
BCH	-20	2511.886432
FACH	10	10023.74467

PSCH	-50	
SSCH	-50	
PCH	-20	
Num of AICH	1	
Num of FACH	2	
Max of PCPICH	378	
Min of PCPICH	342	
Total of Channels		18311.03104

Power Of Cell(dBm)		Result（mV）
CellMaxTxPower	447	29512.09227
PCPICH	370	5011.872336
PICH	-7	1000
AICH	-6	1258.925412
BCH	-20	3162.27766
FACH	10	12619.14689
PSCH	-50	
SSCH	-50	
PCH	-20	
Num of AICH	1	
Num of FACH	2	
Max of PCPICH	400	
Min of PCPICH	350	
Total of Channels		23052.2223

Power Of Cell(dBm)		Result（mV）
CellMaxTxPower	430	19952.62315
PCPICH	360	3981.071706
PICH	-7	794.3282347
AICH	-6	1000
BCH	-20	2511.886432
FACH	10	10023.74467

PSCH	-50	
SSCH	-50	
PCH	-20	
Num of AICH	1	
Num of FACH	2	
Max of PCPICH	378	
Min of PCPICH	350	
Total of Channels		18311.03104

Power Of Cell(dBm)		Result（mV）
CellMaxTxPower	370	5011.872336
PCPICH	260	398.1071706
PICH	-7	79.43282347
AICH	-6	100
BCH	-20	251.1886432
FACH	10	1002.374467
PSCH	-50	
SSCH	-50	
PCH	-20	
Num of AICH	1	
Num of FACH	2	
Max of PCPICH	278	
Min of PCPICH	242	
Total of Channels		1831.103104

Power Of Cell(dBm)		Result（mV）
CellMaxTxPower	330	1995.262315
PCPICH	260	398.1071706
PICH	-7	79.43282347
AICH	-6	100
BCH	-20	251.1886432
FACH	10	1002.374467
PSCH	-50	

SSCH	-50	
PCH	-20	
Num of AICH	1	
Num of FACH	2	
Max of PCPICH	278	
Min of PCPICH	242	
Total of Channels		1831.103104

From all the above calculations it has been depicted that Maximum transmit power is greater in every scenario from the total channel power hence all the results are in pass category.

In case if you find the Maximum transmit power of a cells is less than common control channel power then either you have to increase the maximum transmit power or you have to reduce CPICH power to avoid any issue.

4, In a Nutshell - Summary

Here I would like to mention that this guide would be very helpful while doing some immense activities to avoid failure. Also you can have the better understanding of Power configuration in WCDMA which will give you good visibility during optimization and planning phases that tuning of power and its consumption.

I hope this guide book will be helpful and interesting for all concerned colleagues.