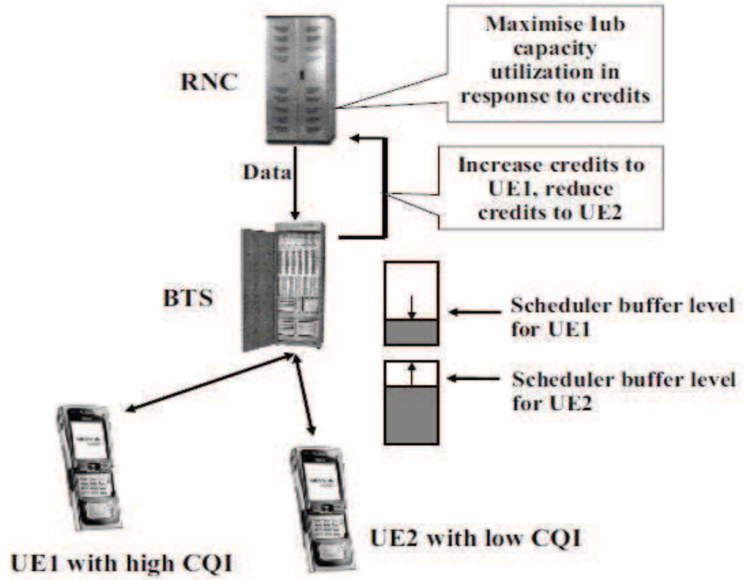
CQI Basic's



Channel quality information (CQI), respectively, tells the base station scheduler the data rate the terminal expects to be able to receive at a given point in time.

- The CQI value that the terminal reports *does not just correspond to the Ec=N0* or the signal to interference ratio (SIR) the terminal is experiencing.

- Instead, the value reported is the *function of* the
  - *multipath environment,*
  - *terminal receiver type,*
  - *ratio of the interference of the own base station compared with others*
  - *expected BTS HSDPA power availability.*

- **Benefit of the approach** is that the solution defined will automatically accommodate the various possible receiver implementations and environment variations and, thus, gives an **indication of the best data rates needed by the terminal to cope with the environment** in question.

CQI Basic's

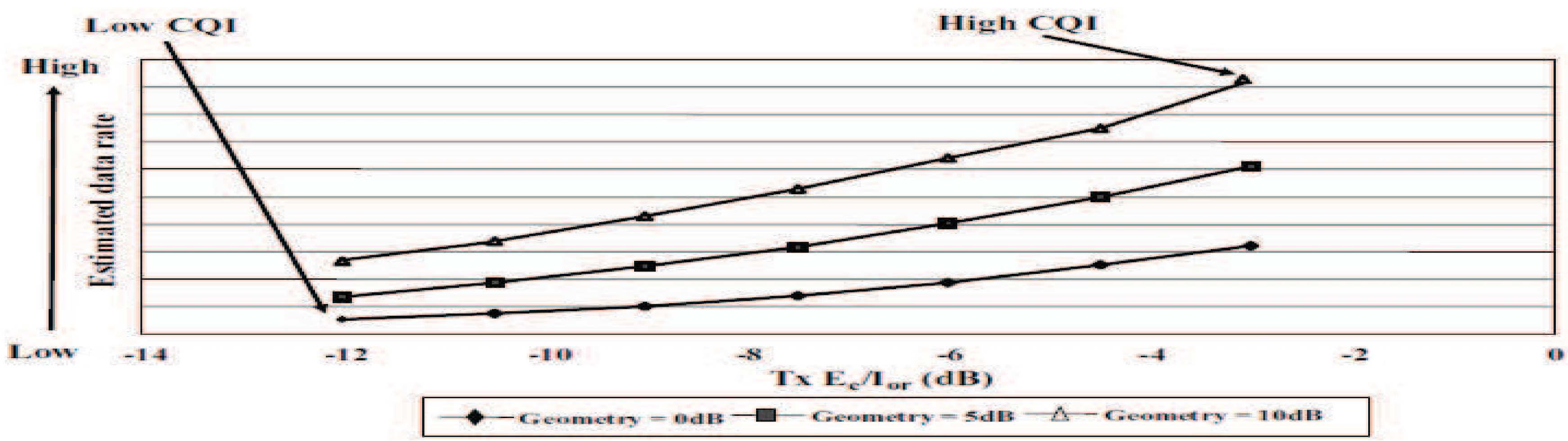


Figure 4.15 Example CQI curves for different geometry values.

This removes the need from the network end to have to consider, say, the delay profile characteristics of the cell/sector in question.

The only input value from the network is the HS-DSCH power allocation value the terminal may assume to be used in the network. Should this change, then the network can easily compensate for this as the terminal's assumption is known to the base station.

CQI reporting is illustrated in Figure 4.15,

- When the terminal is close to the base station and assumes high HS-DSCH power allocation (based on the value given by the network), a high CQI value is reported.
- Respectively, when the terminal is closer to the cell edge (the lowest curve) then the reported CQI is much lower, especially if the expected HSDPA Node B power allocation is low as well.
- When at or close to the cell edge, most of the interference comes from other cells and, thus, the representative geometry value is low – around 0 dB – or in some cases the value is negative.

CQI Basic's

16QAM terminals with 10 codes

CQI value	Transport block size	Number of HS-PDSCH codes	Modulation	Reference power adjustment Δ
0	N/A	N/A		
1	137	1	QPSK	0
2	173	1	QPSK	0
⋮				
14	2583	4	QPSK	0
15	3319	5	QPSK	0
16	3565	5	16QAM	0
⋮				
24	11418	8	16QAM	0
25	14411	10	16QAM	0
26	14411	10	16QAM	-1
27	14411	10	16QAM	-2
28	14411	10	16QAM	-3
29	14411	10	16QAM	-4
30	14411	10	16QAM	-5

QPSK-only terminals with 5 codes

CQI value	Transport block size	Number of HS-PDSCH codes	Modulation	Reference power adjustment Δ
0	N/A	N/A		
1	137	1	QPSK	0
2	173	1	QPSK	0
3	233	1	QPSK	0
⋮				
14	2583	4	QPSK	0
15	3319	5	QPSK	0
16	3319	5	QPSK	-1
17	3319	5	QPSK	-2
18	3319	5	QPSK	-3
⋮				
29	3319	5	QPSK	-14
30	3319	5	QPSK	-15

Figure 4.19 Example CQI tables for categories 7/8 and 11/12.

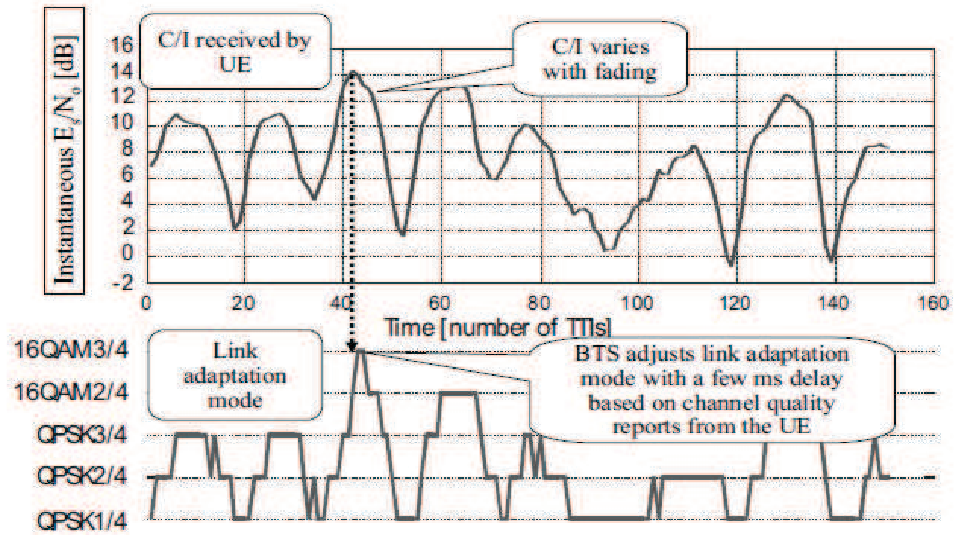
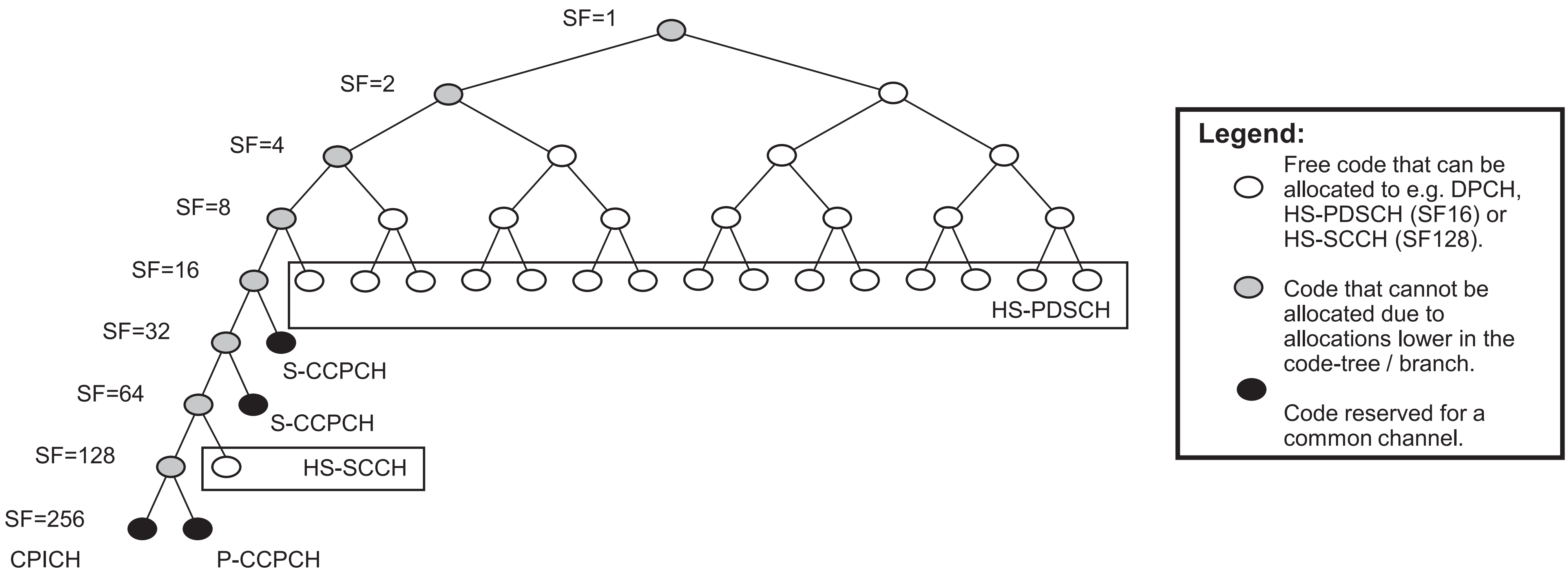


Figure 4.18 Link adaptation.

Link adaptation itself is based on CQI information that also takes other aspects into account besides just the signal strength or C/I.

By just changing from QPSK to 16QAM there is a difference of a few decibels – depending on the environment – and by playing with the coding rates and the number of codes the total dynamic range can reach 30 dB.

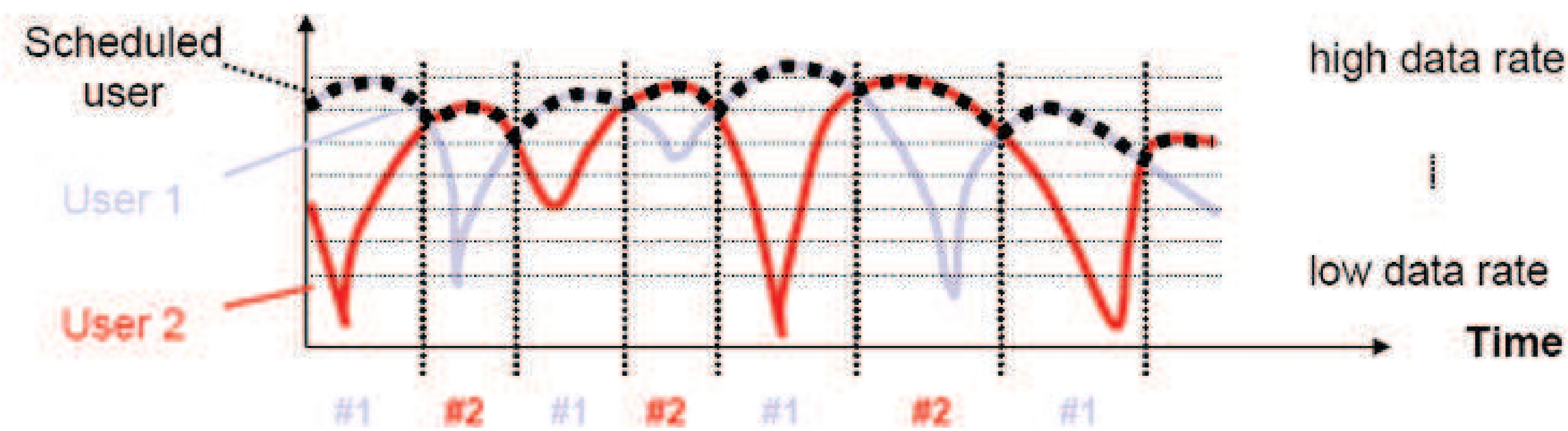
CQI Basic's



- SF16 codes assigned to HS-PDSCH, 5, 10 or 15 (3GPP)
- SF128 assigned to the HS-SCCH (3GPP) (up to 4)
- Maximum of 15 codes in Ericsson and Nokia
- HS-PDSCH code resources are assigned to one user at a time

Proportional Fair Scheduler

- Schedules users based on
  - CQI
  - Average throughput
  - Retransmission (time between NACK reception and retransmission)
  - Delay (time since last scheduled)



Sum it up together-HSDPA

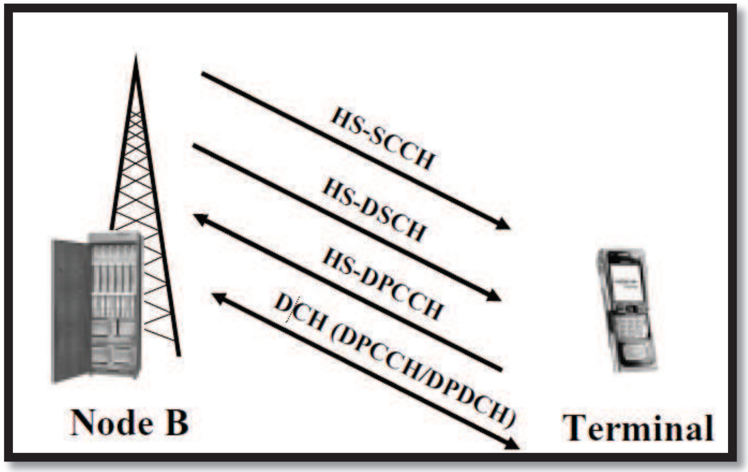


Table 4.1 Comparison of fundamental properties of the DCH and HS-DSCH.

Feature	*DCH*	*HS-DSCH*
Variable spreading factor	No	No
Fast power control	Yes	No
Adaptive modulation and coding	No	Yes
Multi-code operation	Yes	Yes, extended
Physical layer retransmissions	No	Yes
BTS-based scheduling and link adaptation	No	Yes

Sum it up together-HSDPA

- HSPA+ Lack of fast power control.
- Support of higher order modulation than the DCH.
- User allocation with base station based scheduling every 2 ms.
- Use of physical layer retransmissions and retransmission combining.
- Lack of soft handover. Data are sent from one serving HS-DSCH cell only.
- Lack of physical layer control information on the HS-PDSCH.
- Multicode operation with a fixed spreading factor. Only spreading factor 16 is used,
- With HSDPA only turbo-coding is used, while with the DCH convolutional coding may also be used.
- No discontinuous transmission (DTX) on the slot level. The HS-PDSCH is either fully transmitted or not transmitted at all during the 2-ms TTI.

Sum it up together-HSDPA

- Data Throughput depends on following
    - Residual power available for HSDPA.
    - Codes Available
    - Number of T1.
    - Scheduler performance
    - Terminal type & Capability.
    - Radio Condition for terminal.