HSPA
Technology Overview

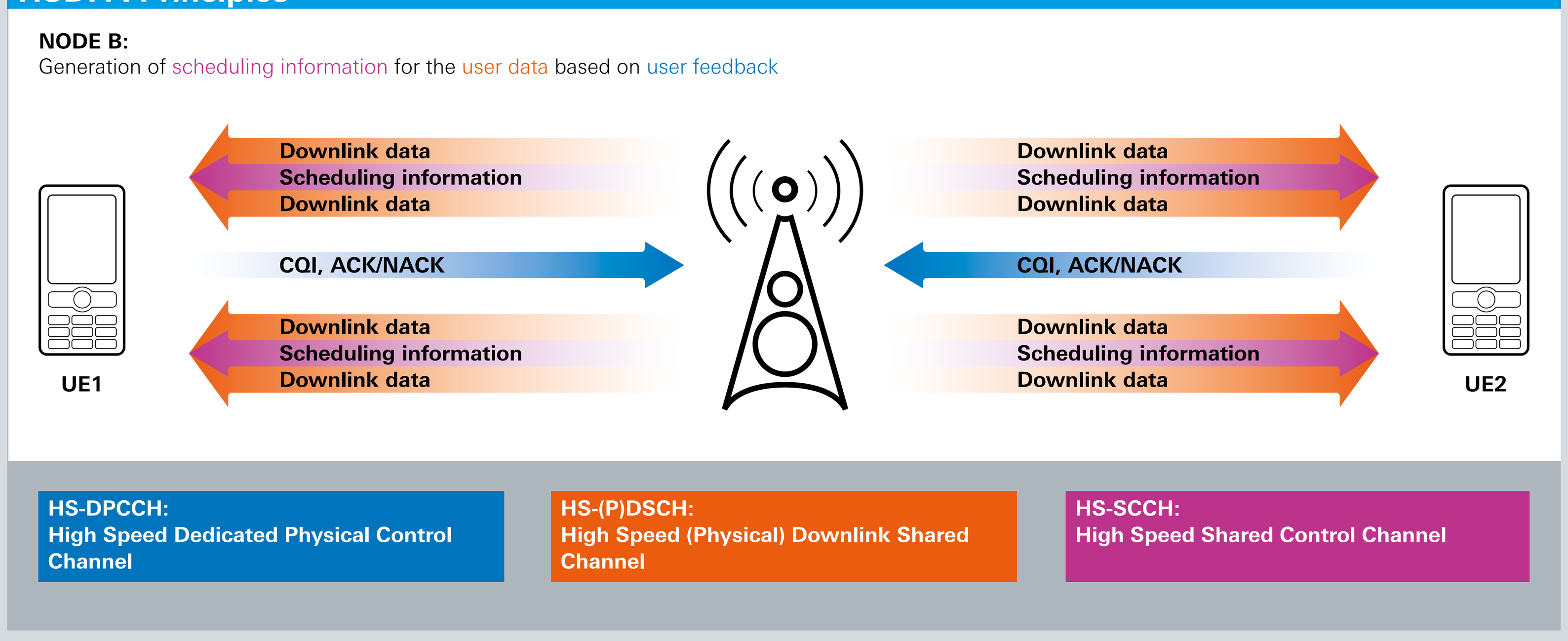
UMTS (Universal Mobile Telecommunication System) networks based on wideband code division multiple access (WCDMA) have been deployed worldwide as 3rd generation mobile communications systems. UMTS provides a clear evolution path to high speed packet access (HSPA). HSPA refers to the combination of high speed downlink packet access (HSDPA) and high speed uplink packet access (HSUPA). HSDPA allows data rates of up to 14 Mbit/s in the downlink. HSUPA makes uplink data rates of 5.76 Mbit/s possible. HSPA also boosts capacity in UMTS networks and provides significant latency reductions. 3G/WCDMA-HSPA is driving the global uptake of mobile broadband services.

Rohde & Schwarz offers a complete portfolio of WCDMA/HSPA test and measurement solutions addressing infrastructure equipment, wireless devices and their components such as power amplifiers. As a pioneer in the market, Rohde & Schwarz introduced the first one-box radiocommunications tester for HSDPA. Meanwhile, the portfolio has been completed to address all aspects of HSDPA and HSUPA from RF tests to full application layer support for E2E testing.

The overview below covers HSPA technology up to release 6.

HSDPA: High Speed Downlink Packet Access

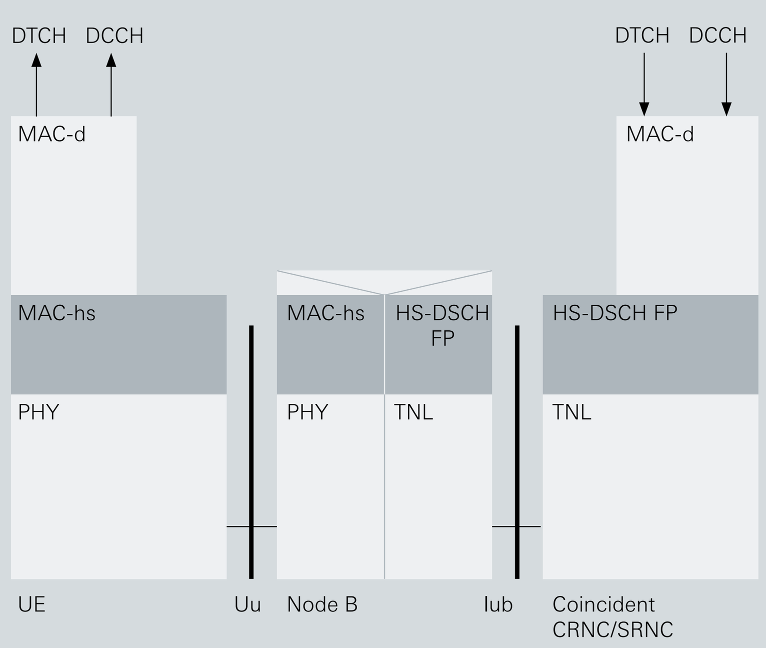
HSDPA Principles



HSDPA: UE Categories

HS-DSCH category	Maximum number of HS-DSCH codes received	Minimum inter-TTI interval	Maximum number of bits of an HS-DSCH transport block per TTI	Total number of soft channel bits	Data rate (in Mbit/s)
Category 1	5	3	7298	19200	1.22
Category 2	5	3	7298	28800	1.22
Category 3	5	2	7298	28800	1.82
Category 4	5	2	7298	38400	1.82
Category 5	5	1	7298	57600	3.65
Category 6	5	1	7298	67200	3.65
Category 7	10	1	14411	115200	7.21
Category 8	10	1	14411	134400	7.21
Category 9	15	1	20251	172800	10.13
Category 10	15	1	27952	172800	13.98
Category 11 (QPSK only)	5	2	3630	14400	0.91
Category 12 (QPSK only)	5	1	3630	28800	1.82

HSDPA Protocol Architecture



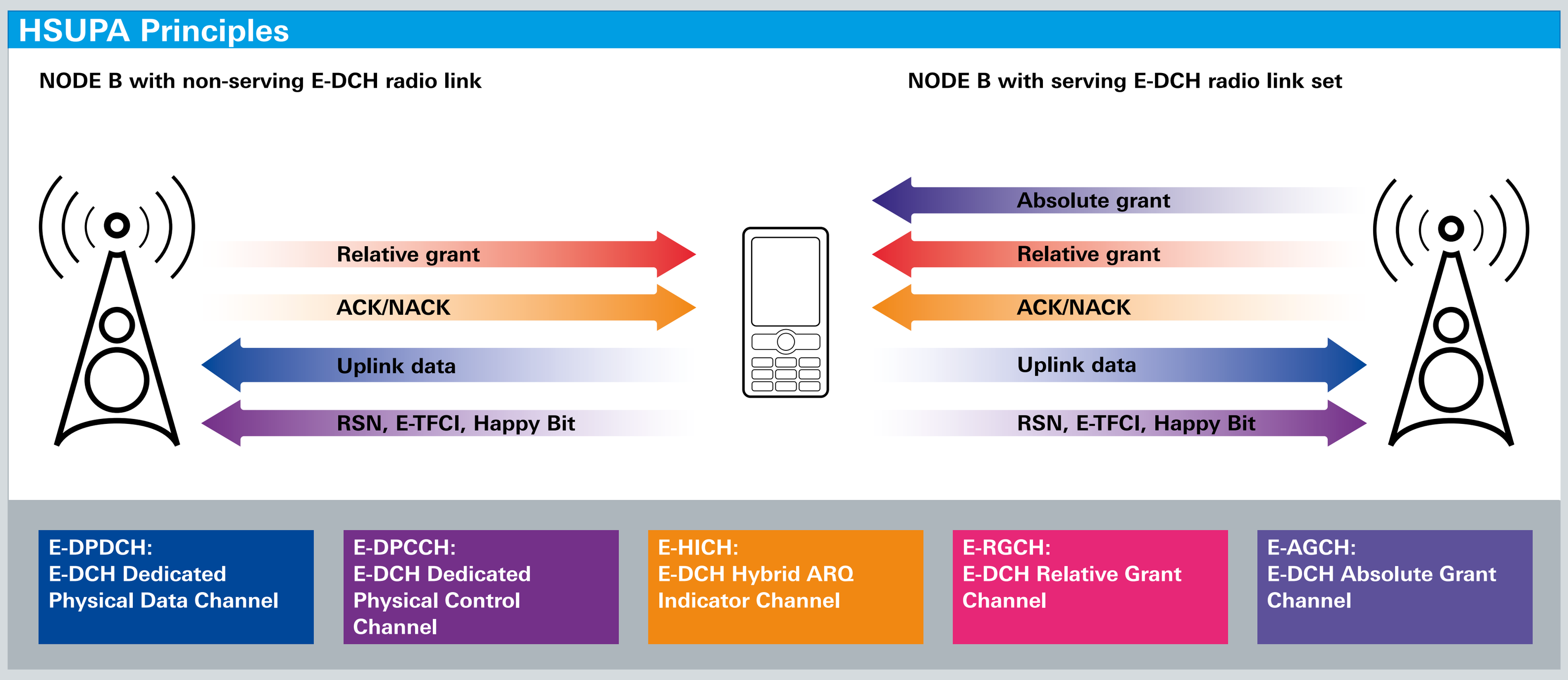
Physical Channels for HSDPA

Channel	Direction	Purpose	Physical parameters: Spreading factor	Modulation	Channel coding	Timing
HS-PDSCH	Downlink	Carries downlink user data	16	QPSK or 16QAM	Rate 1/3 turbo coding, use of HARQ	HS-PDSCH starts 5120 chips after the start of the associated HS-SCCH
HS-SCCH	Downlink	Carries control information for HS-PDSCH: ❙ Channelization code set ❙ Modulation scheme ❙ Transport block size ❙ Hybrid ARQ process ❙ Redundancy and constellation version ❙ New data indicator ❙ UE identity = H-RNTI	128	QPSK	Rate 1/3 convolutional coding	Time aligned with P-CCPCH
HS-DPCCH	Uplink	Carries control information: ❙ HARQ ACK/NACK ❙ CQI reports	256	BPSK	❙ Repetition coding for HARQ ACK/NACK ❙ Channel coding for CQI using a (20,5) code	Timing relative to uplink DPCH depends on downlink DPCH frame offset and timing of HS-PDSCH

Glossary: ACK = Acknowledgment in hybrid ARQ process; **BPSK** = Binary Phase Shift Keying; **CQI** = Channel Quality Indicator; **CRNC** = Controlling Radio Network Controller; **DCCH** = Dedicated Control Channel; **DPCH** = Dedicated Physical Channel; **DTCH** = Dedicated Traffic Channel; **E-DCH** = Enhanced Dedicated Channel; **E-TFCI** = E-DCH Transport Format Combination Identifier; **FP** = Frame Protocol; **H-RNTI** = HS-DSCH Radio Network Temporary Identifier; **HARQ** = Hybrid Automatic Repeat Request; **HS-DSCH** = High Speed Downlink Shared Channel; **MAC-d** = Medium Access Control entity handling dedicated transport channels; **MAC-e/es** = Medium Access Control protocol entities handling E-DCH; **MAC-hs** = Medium Access Control entity handling HS-DSCH; **NACK** = Negative Acknowledgment in hybrid ARQ process; **PHY** = Physical Layer; **QAM** = Quadrature Amplitude Modulation; **QPSK** = Quadrature Phase Shift Keying; **P-CCPCH** = Primary Common Control Physical Channel; **RLS** = Radio Link Set; **RSN** = Retransmission Sequence Number; **SRNC** = Serving Radio Network Controller; **TNL** = Transport Network Layer; **TTI** = Transmission Time Interval; **UE** = User Equipment

HSUPA: High Speed Uplink Packet Access

HSUPA Principles

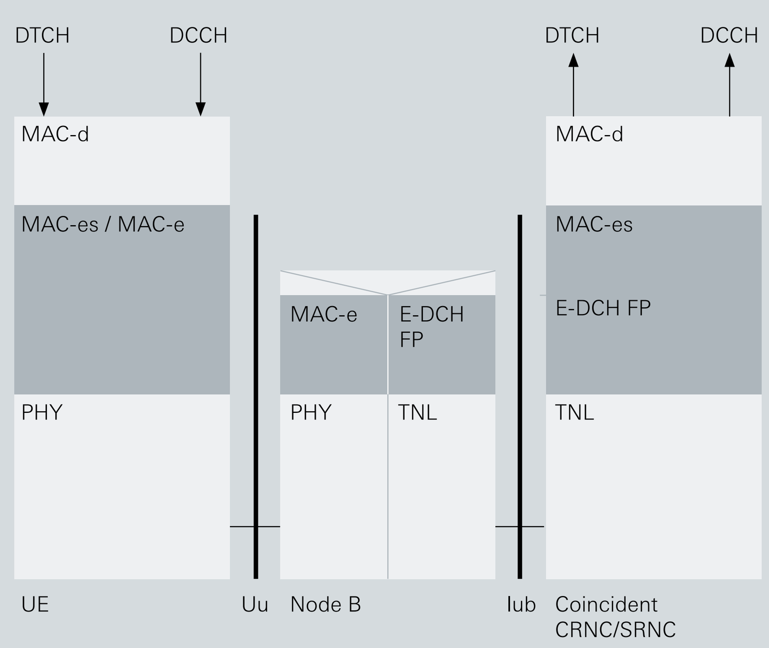


HSUPA: UE Categories

E-DCH category	Maximum number of E-DCH codes transmitted	Minimum spreading factor	TTI (in ms)	Maximum number of bits of an E-DCH transport block per TTI	Data rate (in Mbit/s)
Category 1	1	SF4	10	7110	0.71
Category 2	2	SF4	10	14484	1.45
Category 2	2	SF4	2	2798	1.4
Category 3	2	SF4	10	14484	1.45
Category 4	2	SF2	10	20000	2
Category 4	2	SF2	2	5772	2.89
Category 5	2	SF2	10	20000	2
Category 6	4	SF2	10	20000	2
Category 6	4	SF2	2	11484	5.74

Note: When four codes are transmitted in parallel, two codes will be transmitted with SF2 and two with SF4

HSUPA Protocol Architecture



Physical Channels for HSUPA

Channel	Direction	Purpose	Physical parameters: Spreading factor	Modulation	Channel coding	Timing
E-DPDCH	Uplink	Carries uplink user data	256, 128, 64, 32, 16, 8, 4, 2	BPSK	Rate 1/3 turbo coding, use of HARQ	Time aligned with uplink DPCCH
E-DPCCH	Uplink	Carries control information for E-DPDCH: ❙ RSN, 2 bits ❙ E-TFCI, 7 bits ❙ Happy Bit, 1 bit	256	BPSK	Channel coding using subcode of second-order Reed-Muller code	Time aligned with uplink DPCCH
E-AGCH	Downlink	Carries absolute grants for uplink E-DCH scheduling, 6 bits	256	QPSK	Rate 1/3 convolutional coding	5120 chips time offset relative to P-CCPCH
E-HICH	Downlink	Carries HARQ ACK/NACK indicator	128	QPSK	HARQ acknowledgment indicators transmitted with signature sequences	Time offset relative to P-CCPCH depending on E-DCH TTI and DPCH frame offset
E-RGCH	Downlink	Carries relative grants for uplink E-DCH scheduling	128	QPSK	Relative grants transmitted with signature sequences	❙ Cell in E-DCH serving RLS: time offset relative to P-CCPCH depending on E-DCH TTI and DPCH frame offset ❙ Cell not in E-DCH serving RLS: 5120 chips time offset relative to P-CCPCH

Selection of Rohde & Schwarz Test Solutions for WCDMA/HSPA

R&S®CMU200 radio communication tester
- All HSDPA/HSUPA categories supported
- Unrivaled flexibility for HSPA parameter settings
- Supports test mode as well as E2E application testing

R&S®FSV signal analyzer
- Class-leading analysis bandwidth: 40 MHz
- Up to five times faster than closest competitor
- Intuitive graphic operation with touch screen

R&S®SMU200A signal generator
- Outstanding signal quality
- Maximum flexibility and modular design
- Realtime fading and AWGN for diversity tests

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