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Federal Department of the Environment
Transport, Energy, and Communication DETEC

Federal Office of Communications OFCOM
Licences and Frequency Management Division

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Microwave Links Point-to-Point
Adaptive Coded Modulation, ACM

One of the new tools to combat rain fade is ACM. Adaptive modulation refers to the automatic modulation (and coding) adjustment that a wireless system can make to prevent weather-related fading from causing communication links to be disrupted. When heavy weather conditions affect the transmission and receipt of data and voice over the wireless network, the radio system automatically changes modulation so that non-real data-based applications may be affected by signal degradation, but real-time applications will continue to run uninterrupted.

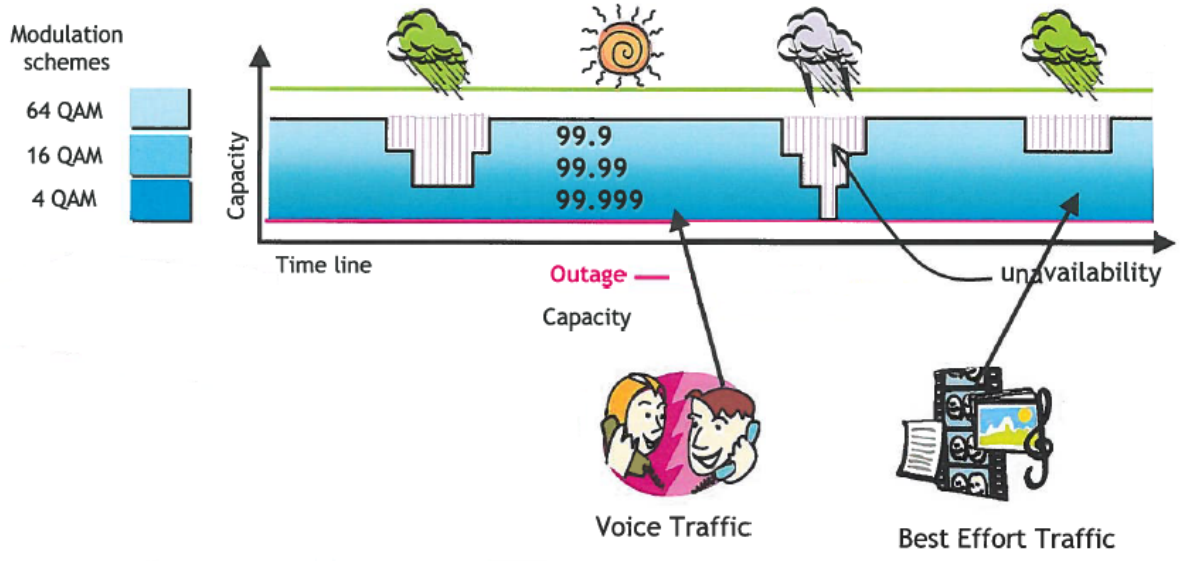

Figure 1
Operation of ACM (reference: Alcatel-Lucent 2006 21157)

Guidelines for using ACM

A) Binding requirements:

A.1) Reference Mode defines
- TX mask and modulation format at a certain availability,
- permissible max. TX power level,
- conditions for interference calculations (frequency assignment and coordination),

A.2) TX power level and TX mask used for Reference Mode remains the same also in case of lower- or higher-level-modulation,

A.3) Reference Modes are predefined for each frequency band by BAKOM,

A.4) ATPC (Automatic Transmitter Power Control) is active during highest-level-modulation applied,

A.5) The frequency bands 13 GHz to 42 GHz are made available for ACM use,

A.6) The frequency bands 6.2 GHz to 11 GHz are under study for ACM use.

B) Following rules / recommendations for FS frequency assignment are already standard in Switzerland and have to be considered also in case of ACM systems:

B.1) RX levels are constant, e.g. -50 dBm,

B.2) link length policy,

B.3) use of ATPC (e.g. min. 10 dB, max. 20 dB),

B.4) technical specifications for real equipment (radio, antenna),

B.5) rain climatic zone
- K (Northern part of Switzerland, ANS, 42 mm/h) and
- L (Southern part of Switzerland, ASS, 60 mm/h),

B.6) Reference is made to Radio Interface Regulation RIR0302-nn.

C) Remarks:

C.1) Modulation format QPSK is not used as a Reference Mode,

C.2) Number of transition stages will be defined by the operator, no subject of regulation.

C.3) Effects during transition are defined by the manufacturer, no subject of regulation.

C.4) Control of the transmission rate is only caused by propagation effects (rain attenuation).

C.5) Channel bandwidth remains always the same, not depending on transition stage,

C.6) Relevant for license fees is the assigned channel bandwidth (not the transmission rate).

D) **ACM** and **R**adio **I**nterface **R**egulations

D.1) Application of ACM:
only in frequency bands with significant rain attenuation (13 to 42 GHz).

D.2) RIR0302, item 5, defines per frequency band
- static modes and
- Reference Modes.

D.3) The predefined Reference Mode is for link planning and coordination but most of the time a higher mode may be available,

D.4) Frequency assignment is made for the Reference Mode (selected according to RIR0302-nn).

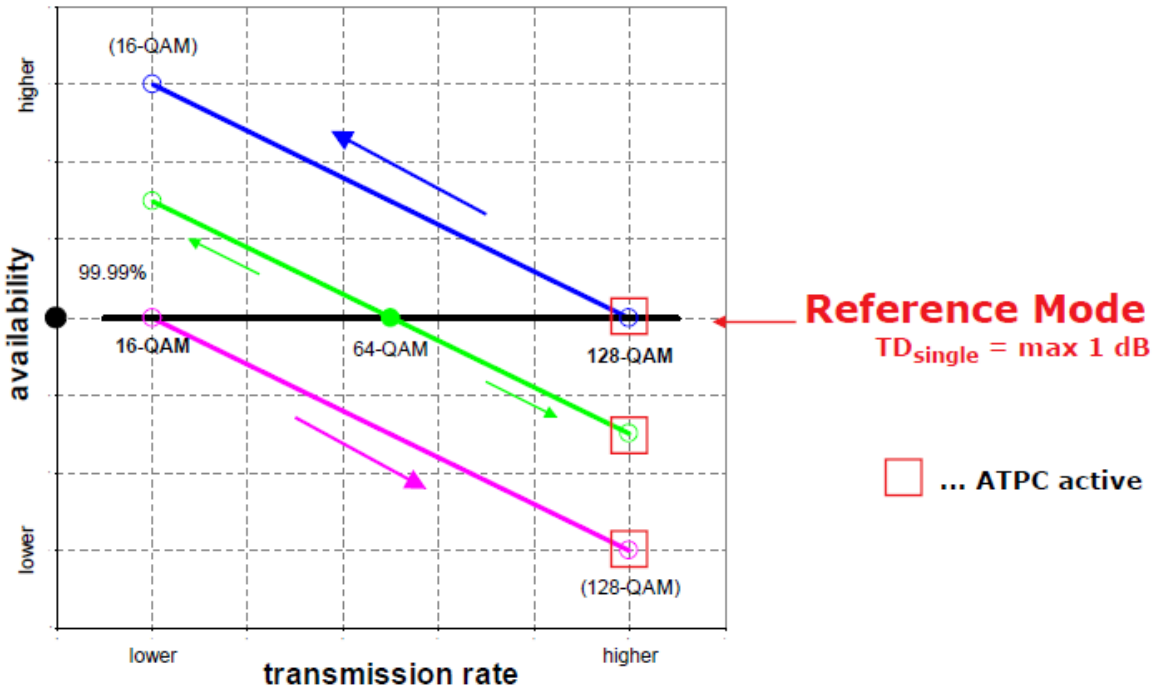

Figure 2
Reference Mode and ATPC