
DOCSIS 3.1 roll out joins 5G

first indications for a successful Fixed Mobile Convergence

Dipl. Ing. Carsten Engelke
ANGA, Director Technology

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Helicopter view on DOCSIS

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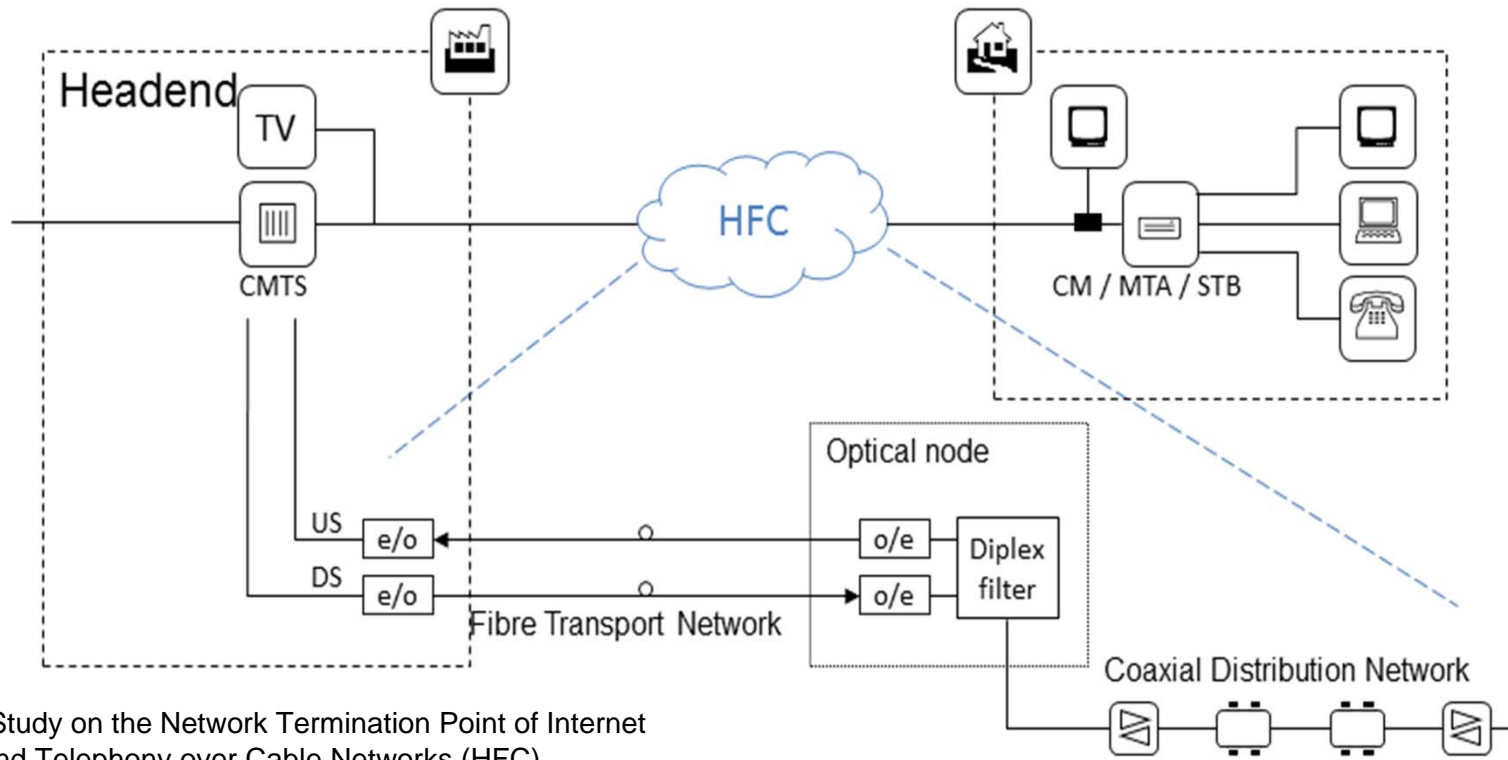
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carsten.engelke@anga.de

www.anga.de

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Slide 2

Overview DOCSIS



Source: Study on the Network Termination Point of Internet access and Telephony over Cable Networks (HFC) (ANGA 2015)

- DOCSIS is a perfect bridge between the new and existing world
- Operators can use the existing billing and maintenance platform to address growing demand for bandwidth
- DOCSIS fits with the existing in-house network requirements
- DOCSIS measurement equipment and well skilled field-engineers are available

Existing Cable Products



Product	Online-Vorteil	Monthly Price	Additional Info
2play START 20	20 €	19,99 € mtl.	Ab dem 10. Monat 24,99 € mtl.
2play COMFORT 120	80 €	24,99 € mtl.	Ab dem 10. Monat 34,99 € mtl.
2play PREMIUM 200	100 €	39,99 € mtl.	Ab dem 10. Monat 49,99 € mtl.
2play MAX 400	200 €	59,99 € mtl.	Ab dem 10. Monat 69,99 € mtl.

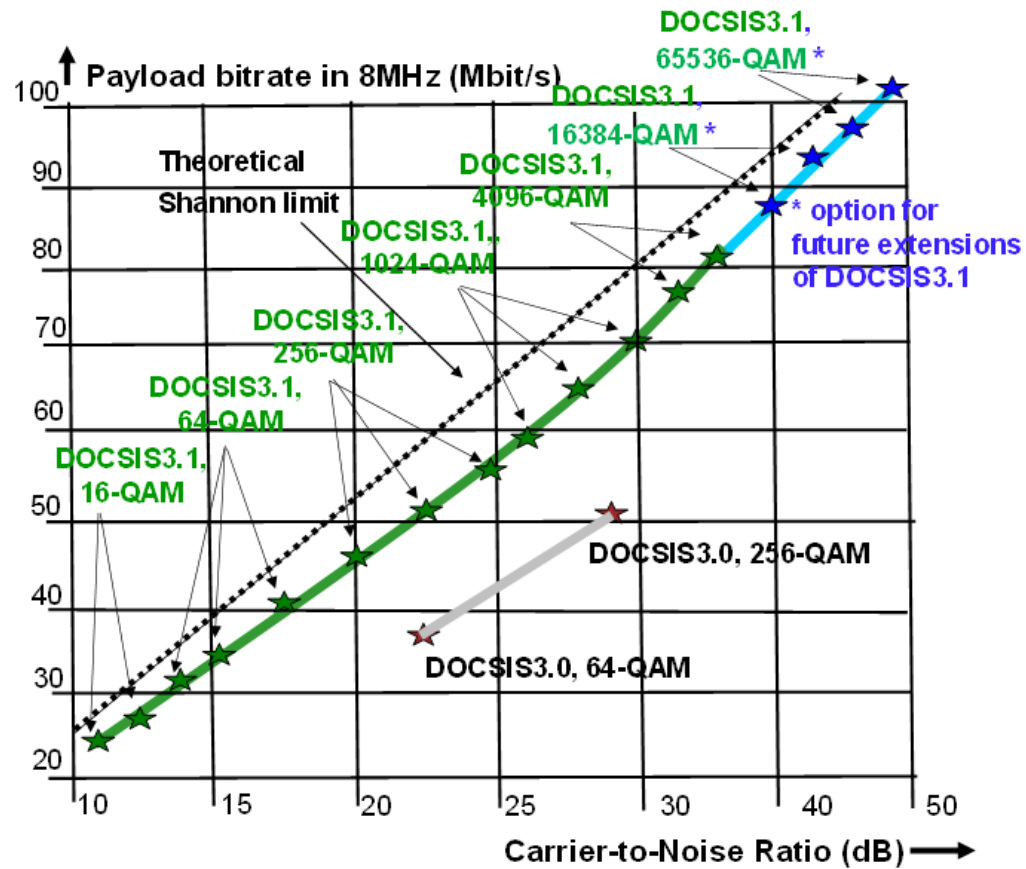
Internet-Flachrate	Internet-Geschwindigkeit
20 Mbit/s	Bis zu 20 Mbit/s Download und 1 Mbit/s Upload
120 Mbit/s	Bis zu 120 Mbit/s Download und 6 Mbit/s Upload
200 Mbit/s	Bis zu 200 Mbit/s Download und 10 Mbit/s Upload
400 Mbit/s	Bis zu 400 Mbit/s Download und 20 Mbit/s Upload

Up to 400 Mbit/s download
Up to 20 Mbit/s upload

Source: www.Unitymedia.de

- Today MSOs deliver products up to 400 Mbit/s to their customers (based on DOCSIS 3.0 DS @ 256 QAM)
- The next stage is the introduction of DOCSIS 3.1
- DOCSIS 3.1 allows operator to significantly increase the bandwidth of their products
- There are many steps in the evolution of DOCSIS 3.1
- Requested products can be offered to the customers

Highly Modulated Signals in HFC Networks



OFDM subcarriers

- One bit increase in Bit loading requires a around 3dB higher CNR
- E.g. 1024 QAM (2^{10}) requires 34 dB CNR, 2048 QAM (2^{11}) requires 37 dB CNR
- The given requirements on the CNR have a direct impact to the network planning
- For every 6 dB improvement in CNR an additional 1,5 Gbit/s speed (@862 MHz network) is gained
- With each of these improvements the network operators install fibre optics solutions closer to the CPE

DOCSIS 3.1 Downstream Capacity

- DATA subcarriers transport user data
- OFDM subcarriers are QAM modulated
- Requirement on the constellation diagram coming from QAM modulation
- 8192 QAM and 16384 QAM is optional for CMTS
- Mixed constellations are possible

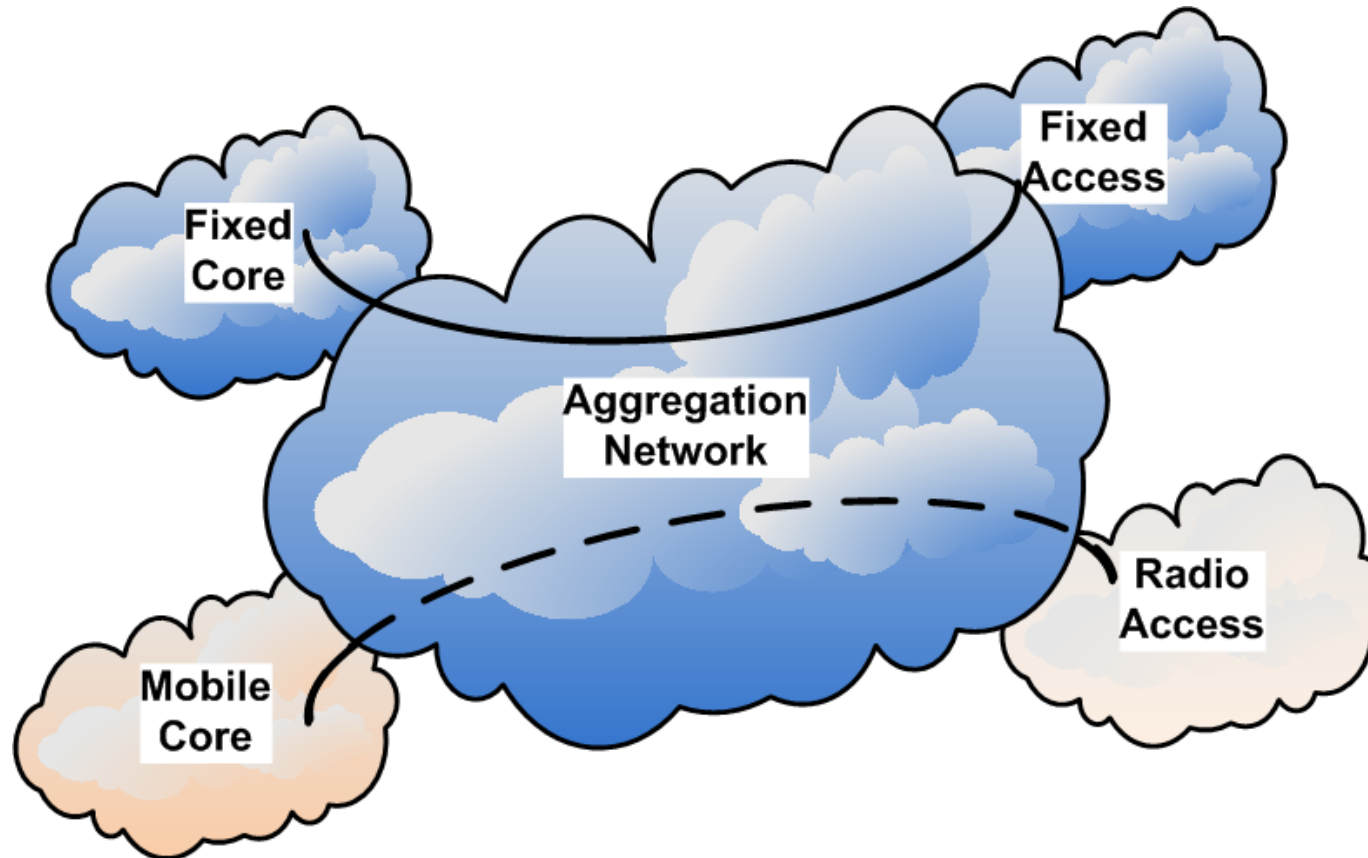
QAM	Bits per Symbol
16 QAM	4
64 QAM	6
128 QAM	7
256 QAM	8
512 QAM	9
1024 QAM	10
2048 QAM	11
4096 QAM	12
8192 QAM	13
16384 QAM	14

Source: Cable Labs Standard

New developments in telecommunications



Current situation regarding fixed and mobile



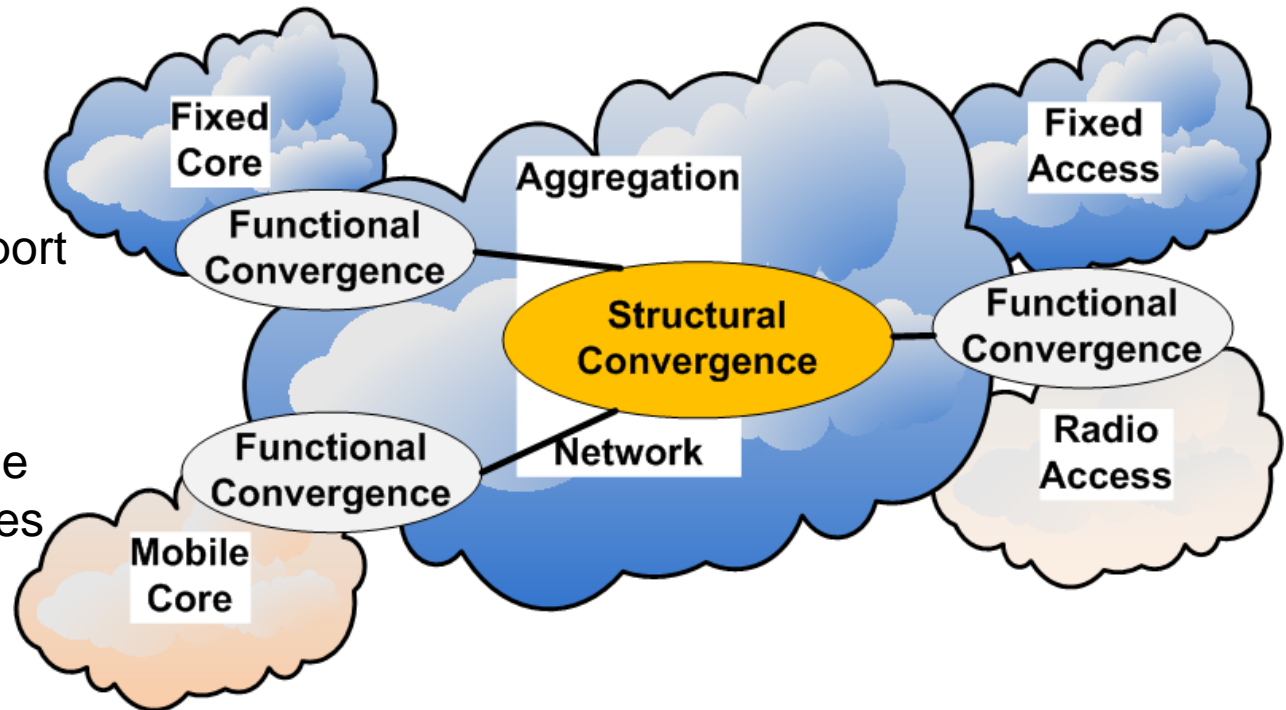


- In the past, there were different developments in fixed and mobile network technologies
- Increasing number of users and connected devices in all networks
- Access any content any time anywhere from any device
- Strong demand for video streaming – for fixed and mobile customers
- Increasing Wi-Fi traffic, IoT traffic, Smart Home traffic
- Price pressure on telcos: Reduce CAPEX/OPEX, generate new revenue, improve user experience

- The trend towards software-defined networks and virtual CPE shows the need for a common development
- Cable networks will start remote PHY and CCAP solutions in their networks
- The software-defined approach becomes more important
- The development of IoT and big data applications will drive this development
- Virtualized CPE on the customer level will generate new business opportunities

Structural convergence:
Shared use of infrastructure, technology, interfaces, transport mechanisms

Functional convergence:
Unification of fixed and mobile network functions and services



- The question: „The Evolution of Cable - Does DOCSIS 3.x make sense? Or is it better to do the final step towards FTTB/H?” is not the correct question.
- DOCSIS 3.x supports the roll out of fibre
- It is more important to focus the work on the fixed mobile convergence and not on the physical layers
- SDN solutions will help the telco industry to build the best networks for their customers
- The residential market becomes more important for the telcos and the driver is video and streaming

It goes on beyond the horizon

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- We will have an evolution rather than a revolution
- Fibre is an important piece in this environment but there are more pieces around the physical access
- A key point will be the “**Universal Access Gateway**”. It will combine the fixed- /mobile-access nodes with an **universal authentication** and a **universal data path management**. It handles the control interface, network interface and subscriber interface

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**Thank you for your attention and I am
happy to answer your questions**

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**7th to 9th June 2016
in Cologne, Germany
ISBE / ANGA International Breakfast at 8th June 2016
at 09.00 hour @ Speakers Corner**