WEBINAR VDSL-VECTORIZING

Stephan Eger
Bruno Jacobfeuerborn
Wolfgang Kopf
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HOST

Stephan Eger
Senior Vice President Investor Relations

EXPERTS

Bruno Jacobfeuerborn
Director Technology Telekom Deutschland and CTO DT Group

Wolfgang Kopf
Senior Vice President Public & Regulatory Affairs DT Group
INTEGRATED NETWORK STRATEGY (INS)  
SMART APPROACH ON OUR WAY TO FTTH

1. LTE rollout
2. Fiber rollout
3. Vectoring
4. Hybrid access

Best broadband
**INS: CAPEX EFFICIENT AND RAPID ROLLOUT OF BEST-IN-CLASS LTE NETWORK**

### LTE rollout plan – Outdoor pop coverage

- **Q3/2012**: 3G (HSPA) 88%, LTE 38%
- **2016**: 3G (HSPA) ≈ 85%, LTE ≈ 100%
- **Long term**: 3G (HSPA) ≈ 70%, LTE ≈ 100%

### Peak performance

- **3G (HSPA) 2x5 MHz**: 42 Mbit/s
- **LTE800 (10 MHz)**: 75 Mbit/s
- **LTE1800 (20 MHz)**: 150 Mbit/s

- Increase by ≈ +260% from LTE800 to LTE1800

### Higher capex efficiency

- **3G (HSPA) 2x5 MHz**: ≈ -70% capex per Mbit/s compared to LTE1800

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*Life is for sharing.*
INS: FIBER UPGRADE OF FIXED NETWORK IS A SMART “NO REGRET MOVE” TO FTTH

Fiber rollout plan – Coverage

<table>
<thead>
<tr>
<th>Q3/2012</th>
<th>2016</th>
<th>&gt;80</th>
</tr>
</thead>
</table>

 Vectoring performance upgrade¹

- **Download:**
  - VDSL: 50 Mbit/s
  - VDSL-Vectoring: 100 Mbit/s, +100%

- **Upload:**
  - VDSL: 10 Mbit/s
  - VDSL-Vectoring: 40 Mbit/s, +300%

Higher coverage with lower capex

- Capex per connected home:
  - FTTH: ∼70%
  - Vectoring: ∼65%

¹) with short distribution cable length

LIFE IS FOR SHARING.
**INS:** HYBRID REVOLUTION THROUGH COMBINATION OF FIXED AND MOBILE FOR SUPERIOR SPEED EXPERIENCE

Superior offering for customers...

<table>
<thead>
<tr>
<th>Network Type</th>
<th>Max. Download</th>
<th>Max. Upload</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDSL</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>Hybrid (Fiber + LTE²)</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Cable</td>
<td>150+</td>
<td>6+</td>
</tr>
<tr>
<td>ADSL</td>
<td>16</td>
<td>1</td>
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1) broadband speed communication for consumer  2) LTE 1800Mhz  3) Vodafone LTE Zuhause

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LIFE IS FOR SHARING.
VDSL-VECTORING BANDWIDTH INCREASES SIGNIFICANTLY COMPARED TO VDSL...

1) Real life performance depending on copper cable length
VECTORING AND HYBRID PROLONGATE THE COPPER LIFECYCLE UP TO 10 YEARS

INS fully covers customer use cases for the next decade

% of households satisfied by DT’s bandwidth plans

INS Effect: Empowering the network to fulfill customer needs for a long time
MUTUAL INTERFERENCE BETWEEN ADJACENT COPPER PAIRS IN A CABLE IS THE MAJOR LIMITATION OF VDSL

What is the matter with crosstalk?

- Crosstalk: Electric signal on each copper pair creates “noise”
- Noise disturbs signal transmission of neighboring pairs
- The wider the band of frequencies used the more crosstalk: VDSL with factor 8x over ADSL2+
- Result: Bandwidth on each pair is reduced by crosstalk effects of others

1) Real life performance depending on copper cable length
VDSL-VECTORING EQUIPMENT OPTIMIZES SIGNALS BY INTERACTING WITH CONNECTED MODEMS

Noise cancellation for you and me...

Noise cancellation for copper lines...

1. Vector MSAN
   - Test signal per line

2. Receiver test

3. Info to MSAN

4. Difference to test signal

5. Vector DSLAM
   - Precoded work signal

6. Modem
BASED ON FTTC, VDSL-VECTORING IS AN IMPORTANT STEP TO BRING FIBER TOWARDS THE CUSTOMER...

Gradual fiber rollout

Fiber to the Central Office – ADSL2+ “Classic”

Fiber to the Cabinet – VDSL/VDSL-Vectoring (Rollout focus of INS)

Fiber near or to the home

1) “Distribution Point” currently not part of the Telekom access network
ADVANTAGES OF THE FTTC/VECTORING ROLLOUT FOR DEUTSCHE TELEKOM

Time to market: Rapid expansion of broadband coverage...

(Household coverage in %)

<table>
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<tr>
<th>Year</th>
<th>Cable footprint</th>
<th>Q3/2012</th>
<th>2016</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>36</td>
<td>65</td>
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<tr>
<td></td>
<td>further option</td>
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...at affordable costs

(Capex per homes passed)

- ADSL 2+
- FTTC (VDSL-Vectoring)
- FTTB (e.g. G.fast)
- FTTH

≈70%
LEVERAGING POTENTIAL SYNERGIES WITH OTHER ACCESS NETWORK ROLLOUT PROJECTS

Access network today

- ADSL provisioning from CO site via copper (copper in main & distribution cable)
- Limited FTTC footprint with VDSL2 technology

Target structure after VDSL-Vectoring rollout

- VDSL-Vectoring provisioning from cabinet site (Fiber in main, copper in distribution cable)
- Synergistic fiber connection of bypassing commercial & new building areas, apartment blocks, LTE sites etc
- Opportunistic FTTH rollout & TV Grundversorgung rollout
CURRENT REGULATORY ACCESS REGIME

Competitor’s xDSL access points today

1. VDSL
   Physical Access to the sub-loop (sub-loop-unbundling)

2. ADSL
   Physical Access to the local loop (local-loop-unbundling)

3. Layer 3 BSA access at PoP sites

Household/APL Cabinet Central Office Regional Hub (900 site) Central Hub (73 site)

Copper Fiber

LIFE IS FOR SHARING.
BNETZA PROPOSAL FOR VECTORING: OVERVIEW

Competitor’s access options in VDSL Vectoring areas

Household/APL

- Physical Access to the sub-loop for VDSL (sub-loop-unbundling)

Cabinet

- Layer 2 BSA at cabinet site in case of termination by Telekom

Central Office

- Physical Access to the local loop (local-loop-unbundling)
- Provisioning of Layer 2 BSA in case of preventing sub-loop

Regional Hub

- (900 site)

Central Hub

- (73 site)

Sub-Loop

VDSL Vectoring

ADSL

Z900

PoP

1. Physical Access to the sub-loop for VDSL (sub-loop-unbundling)

1a Layer 2 BSA at cabinet site in case of termination by Telekom

2. Physical Access to the local loop (local-loop-unbundling)

2a Provisioning of Layer 2 BSA in case of preventing sub-loop

3. Layer 3 BSA access at PoP sites

LIFE IS FOR SHARING.
BNETZA PROPOSAL: AREAS WITH 2ND INFRASTRUCTURE

Access options for Vectoring

- Requires L2 BSA at/close to street cabinet
- Termination of already existing competitor street cabinets if carrier refuses to upgrade to Vectoring (not before 2017)
- Termination of newly established street cabinets with 12 months notice if:
  - ≥ 75% of buildings in street cabinet area are connected to parallel infrastructure (cable/fiber operator)
  - Telekom has rolled out more street cabinets than competitors
  - Availability of L2-BSA at street cabinet at the same price as sub-loop (= EUR 6.79)

Right of termination (only for Telekom)

Preventing sub-loop

- Prerequisite for preventing access to sup-loop: “Suitable” L2 BSA
- Pricing: No provisions (ex-post regulation) yet
- In discussion:
  - L2 BSA will be available in 2016
  - Will L3 BSA as an interim solution be accepted?
BNETZA PROPOSAL: AREAS WITHOUT 2ND INFRASTRUCTURE

Access options for Vectoring

- **Telekom is not able to terminate, but to prevent sub-loop**
- **First operator rolling out vectoring is privileged and investments are protected**
- **Prerequisite: All companies must offer L2 BSA as substitute**
- **“Cherry picking” in rural areas may lead to a Greyhound racing, but expected only in lucrative spots**
- **Full coverage of rural areas is unlikely**

- No regional monopolies are permitted, obligations are generally symmetrical
- For first time, regulator imposes reciprocal, open access
BNETZA FRAMEWORK ALLOWS USE OF VECTORING

- Access to sub-loops can be refused
- Priority for Telekom in specific areas
- No exclusivity for Vectoring, Open Access
- First step towards regionalization

Regulatory certainty and flexible framework for Vectoring roll-out
**TIMEFRAME VECTORING**

**December 19:**
DT amendment to the ULL access obligations

**April 08:** Draft consultation paper

**National consultation May 10**

**Notification to EU-Commission July**

**Final decision BNetzA August**

**Reference-offer procedure TAL at least 6 months**

**Reference-offer procedure BSA at least 6 months**

**Final decision: Q1/14 at the earliest**

**August:**
FTTC/Vectoring Rollout in non VDSL areas

**Launch of hybrid router**

**VDSL/Vectoring swap**

**Q4/12**

**Q1/13**

**Q2/13**

**Q3/13**

**Q4/13**

**Q1/14**

**Q2/14**

**Q3/14**

**Q4/14**

**...**

**2015/16**