

# **BANDWIDTH ON DEMAND IN FIXED ACCESS NETWORKS - APPLICATION SERVICE AWARE AND USER INITIATED INTERNET CONNECTIVITY**

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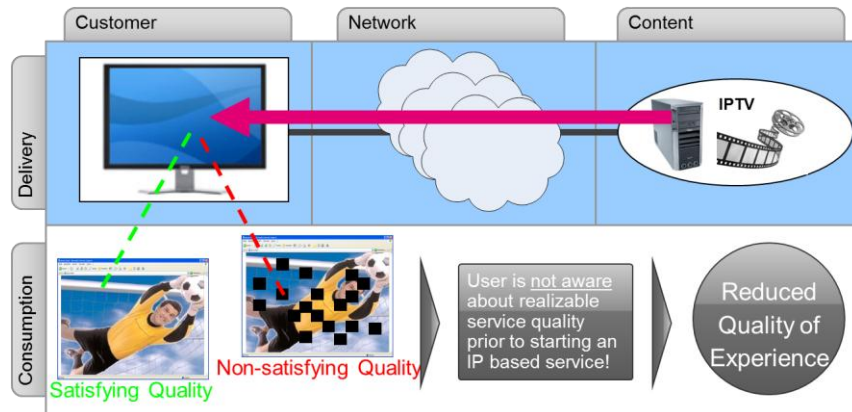
**CHALLENGE**

# NETWORK PERFORMANCE AFFECTS CONTENT DELIVERY

Decreased content quality influences users' quality of experience

## Today's situation of content provisioning

- Content is either provided in **user satisfying or non-satisfying service quality**.
- However, the **user is not aware** in which of both quality the service will be provided before the service starts.



## State of the art

Approaches to support content delivery:

- **Quality of service mechanisms** which provide, e.g. **traffic classification** in IP-based network can be used to transmit IP packets with a certain performance. However, this is not possible in the case of network congestion and is hardly possible in inter-network provider scenarios.
- Application specific solutions are able to **adapt content** before it is send to the user.
- User is able to **manage content quality settings** in, e.g. music and video player tools.

**MOTIVATION**

# BETTER QUALITY OF EXPERIENCE IN CONTENT DELIVERY

Enable win-win-win situation for all actors in content delivery chain

## **Actor - customer**

- Objective: Provide network access capabilities which fulfills application service requirements and satisfies customer's demand.
- Expected benefit: Enhanced quality of experience with network provider's network access product.

## **Actor - network provider (NP)**

- Objective: Selling network access resources in addition to already sold "base" Internet access product.
- Expected benefit: Additional income for the NP.

## **Actor - content provider (CP)**

- Objective: Content delivery in customer requested quality.
- Expected benefit: Enhanced quality of experience for users concerning the delivered content.

# **BANDWIDTH ON DEMAND (BOD) APPROACH**

# BANDWIDTH ON DEMAND (BOD)

## Annotation and edge condition

### General annotation:

- The BoD approach addresses customers who have a broadband Internet access product monthly book which is not the product with the best / maximal network performance capabilities.

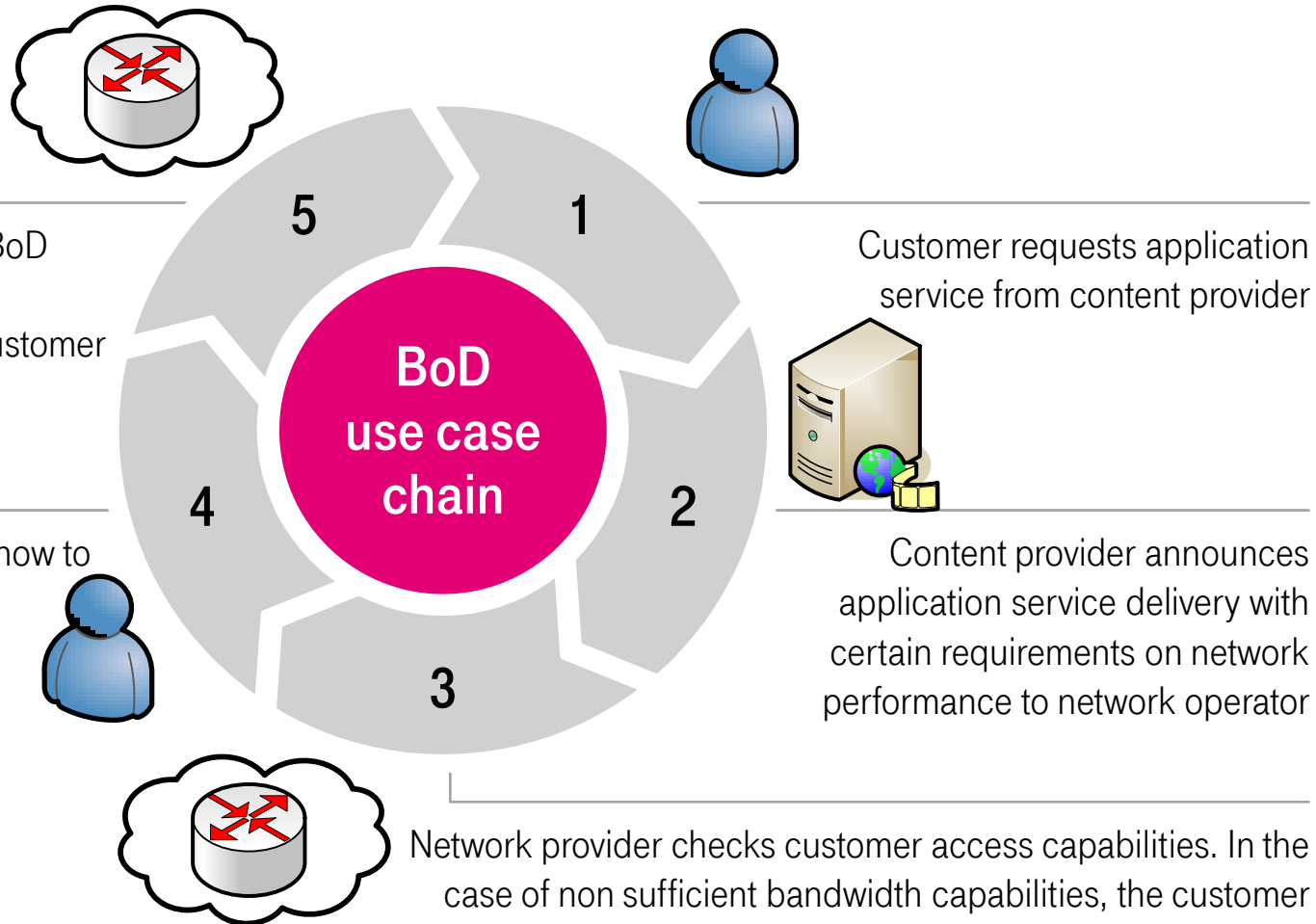
### Technical edge condition:

- It is assumed that the physical capabilities of the customer connecting network access line is able to provider higher network performance as used by the currently booked broadband Internet access product.



# BANDWIDTH ON DEMAND USE CASE

BoD chain: customer > CP > NP > customer > NP

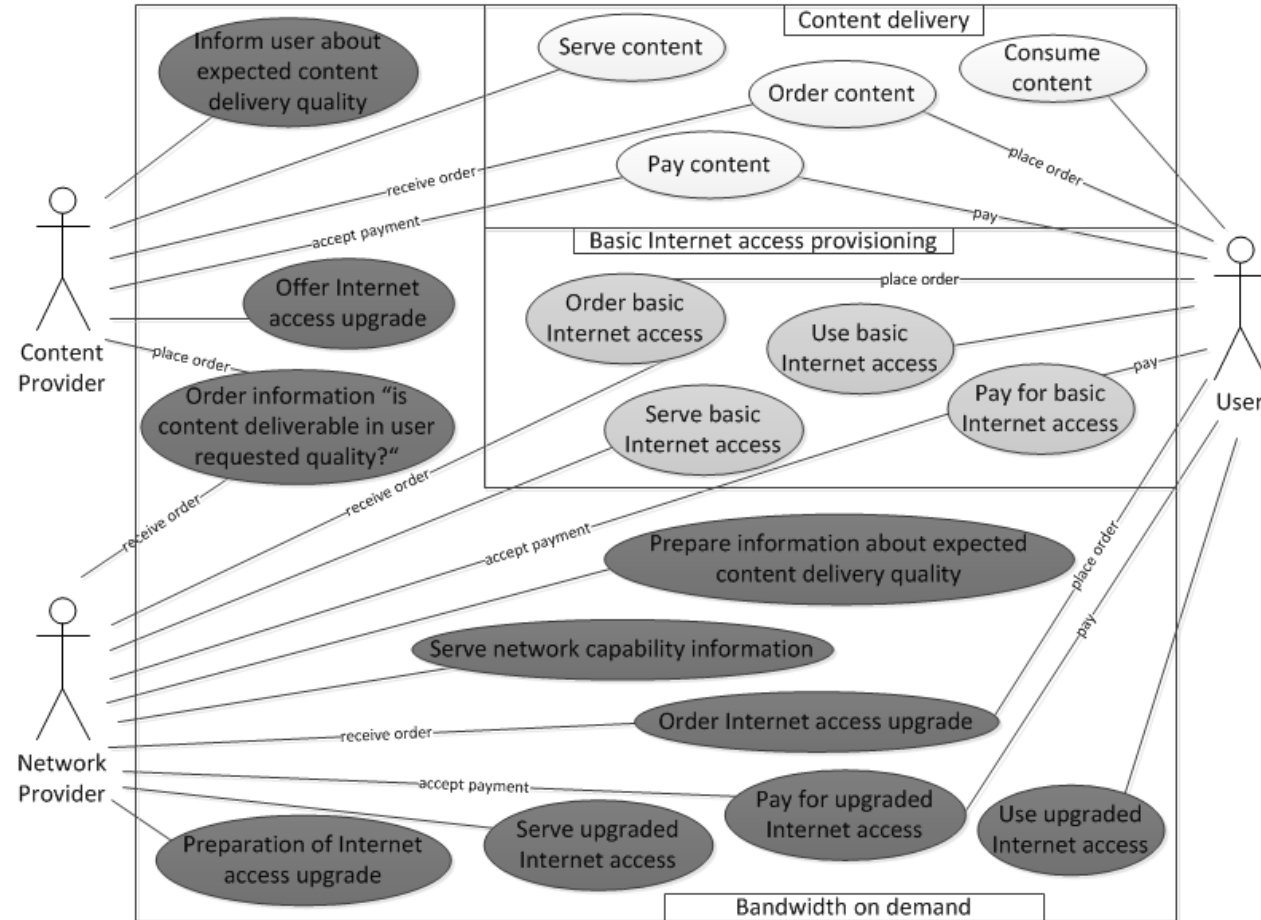


## Characteristic of BoD use case

- Customer gets informed about the network situation.
- Customer is involved in the decision process to invoke BoD or not.

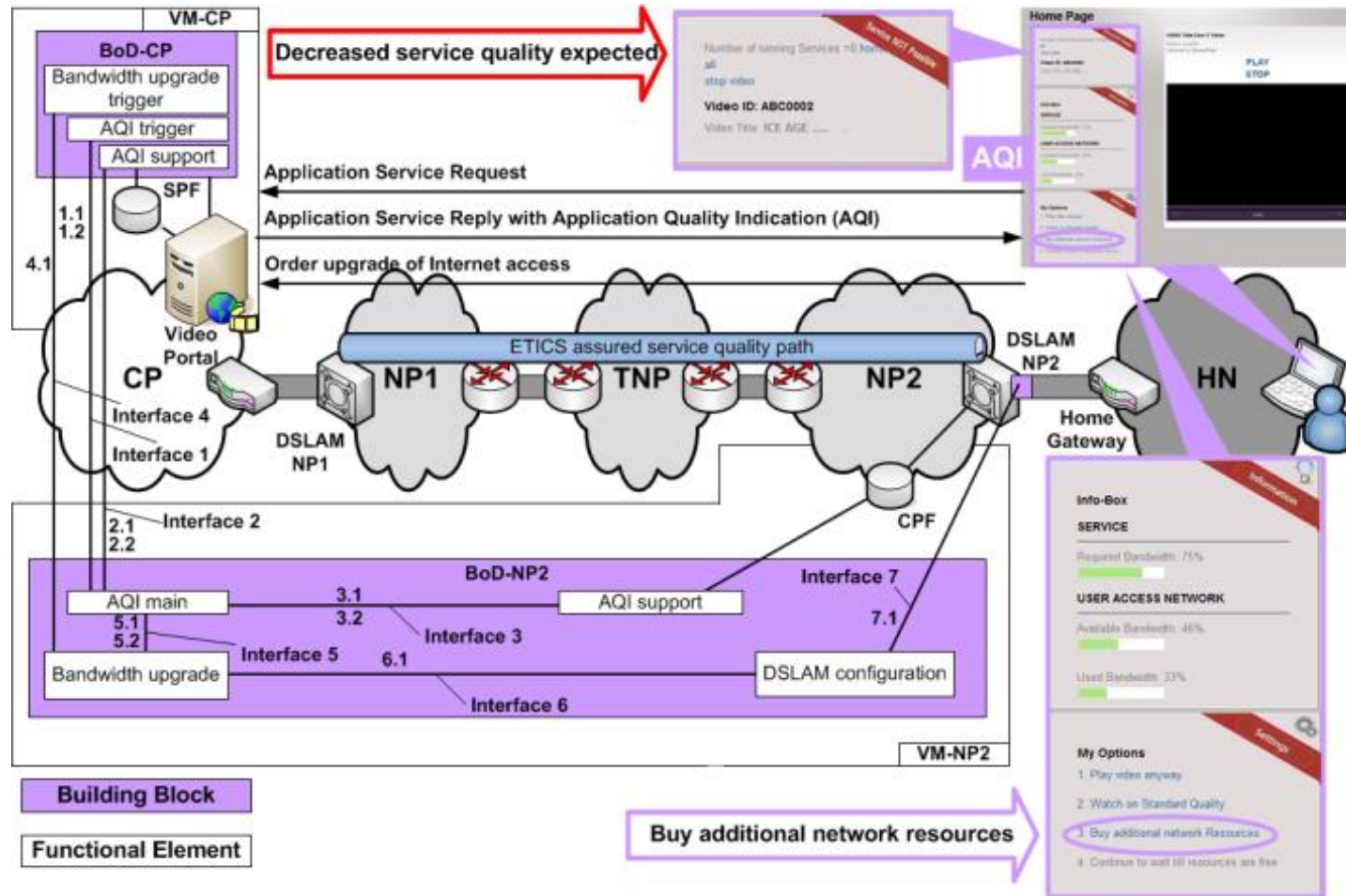
# BANDWIDTH ON DEMAND USE CASE

## Use case diagram



# BANDWIDTH ON DEMAND APPROACH

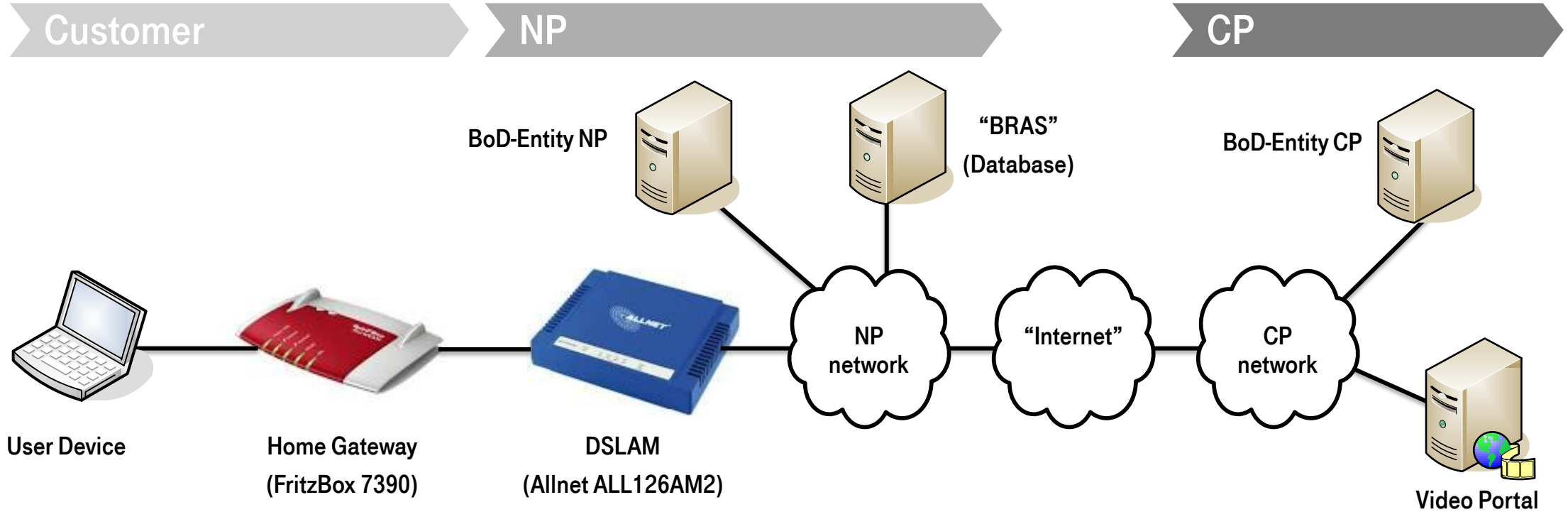
## Functional architecture



# **PROOF OF CONCEPT IMPLEMENTATION**

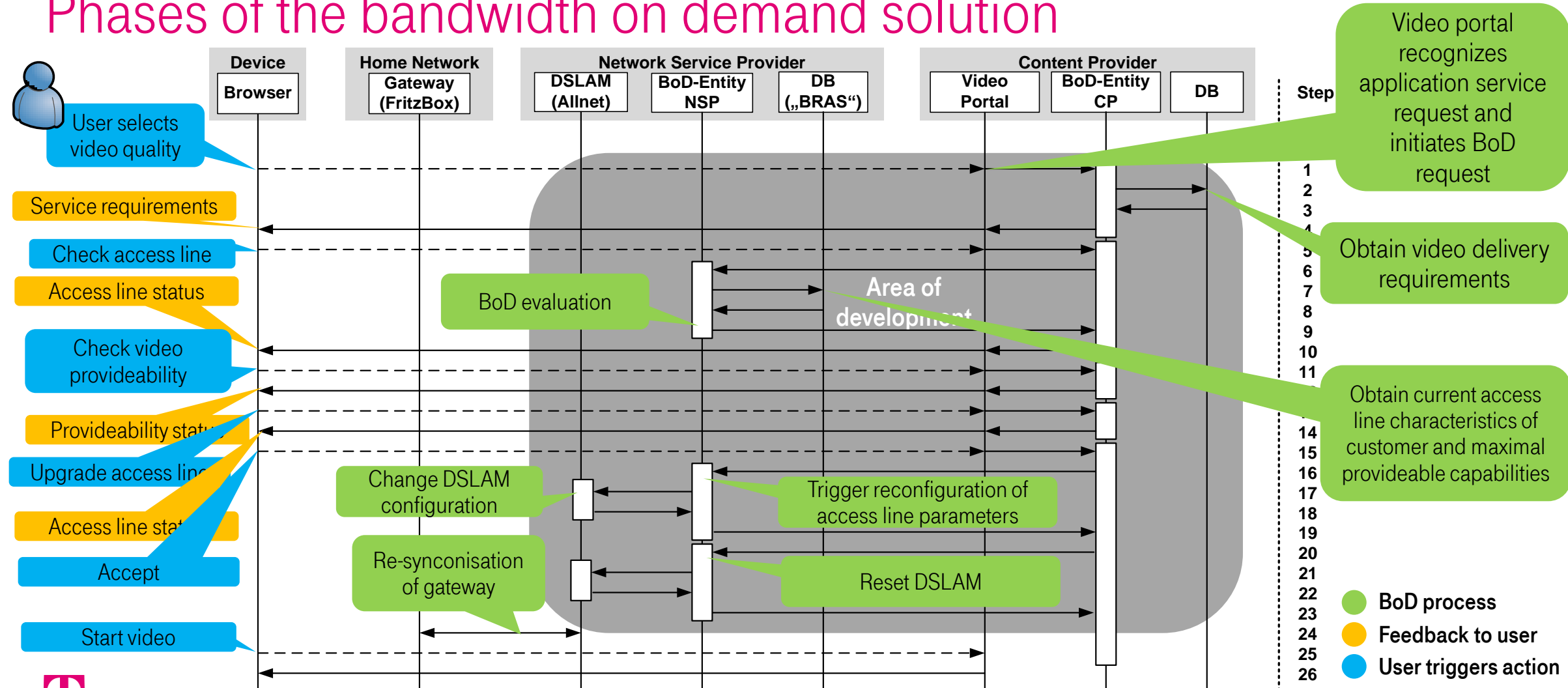
# TESTBED ENVIRONMENT

## Simplified network architecture



# SEQUENCE DIAGRAM OF BOD IMPLEMENTATION

## Phases of the bandwidth on demand solution



**VALIDATION**

# RESULTS FROM USER PERSPECTIVE

## Video portal example with BoD add-on

Bandwidth on Demand (BoD) supported Video Portal

Slapstick

**Big Buck Bunny - www.bigbuckbunny.org**

★★★★★

2,99 € mieten SD

3,99 € mieten HD

Full HD 11 Min.

Regisseur: Sacha Goedegebure  
Schauspieler:  
Originaltitel: Big Buck Bunny  
Genre: Slapstick  
Land: Niederlande  
Jahr: 2008  
Sprache: none  
Copyright: Creative Commons Attribution 3.0

**BoD Addon**

Please choose your desired video quality, High Quality (HD)

Name: BigBuckBunny\_high  
BWREQ [kbps]: 16000  
Duration [min]: 10

Check Access Line Status

Previous Bandwidth [kbps]: 2000  
Current Bandwidth [kbps]: 8000  
Max Bandwidth [kbps]: 25000  
Provideability: 0

Check Video Provideability

Your current Bandwidth is to low, please press Upgrade Access Line to set it higher.

Upgrade Access Line  
Accept  
Cancel

**BoD Addon**

Please choose your desired video quality, High Quality (HD)

Name: BigBuckBunny\_high  
BWREQ [kbps]: 16000  
Duration [min]: 10

Check Access Line Status

**BoD Addon**

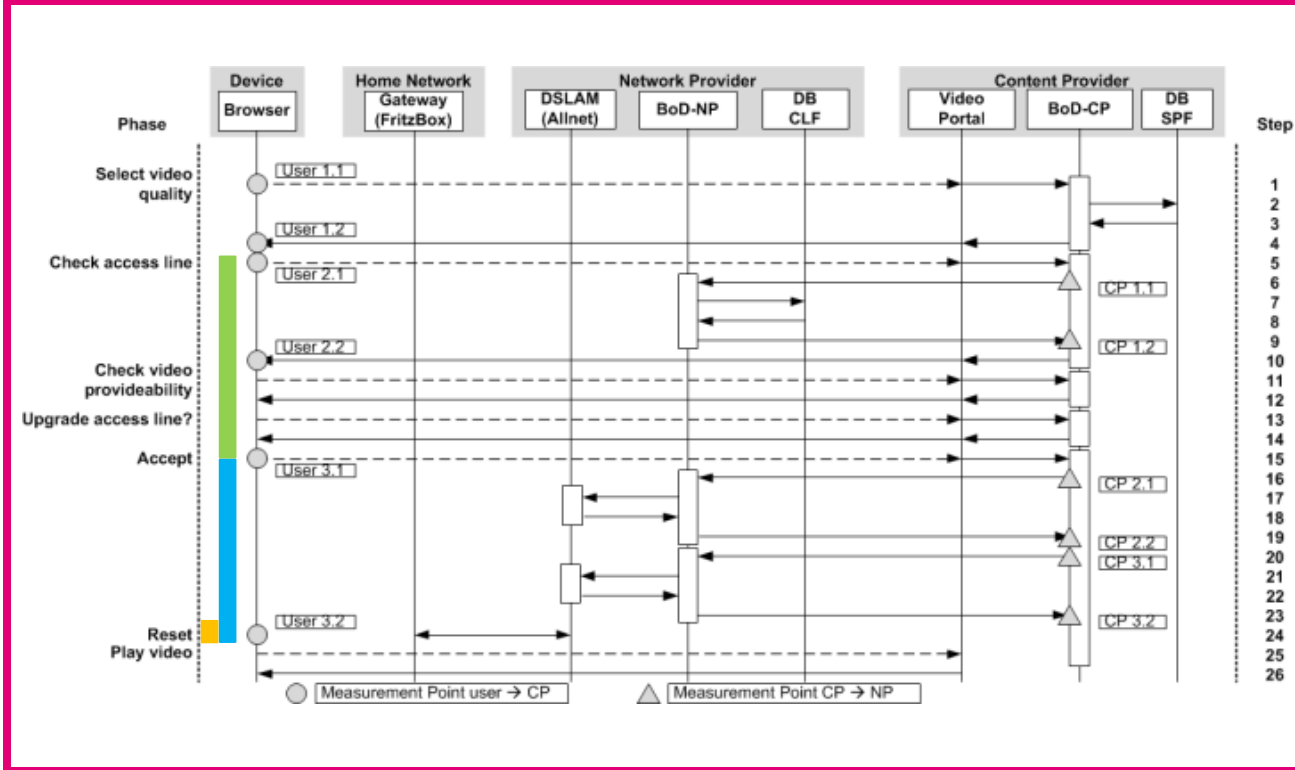
Please choose your desired video quality, High Quality (HD)



# RESULTS FROM PERFORMANCE PERSPECTIVE

## Selected measurements

### Measurement points



Measurement	Runtime [s]
MP 'User 2.1' to MP 'User 2.2'	45
MP 'User 3.1' to MP 'User 3.2'	102
Reset of DSLAM and sync of Fritzbox	52

# CONCLUSIONS & OUTLOOK

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## Conclusions

- Things to overcome:
  - Decreased content quality delivered to the user due to less available network resources.
  - Non-flexible broadband Internet access products.
- Things to be achieved by the bandwidth on demand solution:
  - Offer the opportunity to the customer to improve the performance of the broadband Internet access line in a user-friendly and flexible way in order to satisfy the application service requirements on network performance.
- Current achievements:
  - Description of the bandwidth on demand approach which informs the user about the application service provideability and enables the upgrade of bandwidth resources in the user's access line.
  - Proof of concept implementation.

## Outlook

- Improve bandwidth on demand implementation performance.
- Investigation of BoD approach in the context of network function virtualization and software defined networks.

# THANK YOU!



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