First stakeholder workshop for the study "Challenges and opportunities of broadcast-broadband convergence and its impact on spectrum and network use"

Date: **Thursday, 27 March 2014**

Time: **10:00 –14:00**

Venue: **Centre Albert Borschette – Room AB-0D, Rue Froissart 36, 1000 Brussels**

Agenda

09:30 to 10:00 Coffee and registration

10:00 to 10:05 Introduction – *European Commission services*

10:05 to 10:15 Study objectives, approach and timetable – *David Lewin*

10:15 to 10:30 Technology developments - TV broadcasting platforms – *Jean-Marc Racine*

10:30 to 10.40 The changing role of broadband in AV distribution – *David Lewin*

10:40 to 11:05 Discussion – *chaired by the Commission services*

11.05 to 11:20 AV market developments – *Chris Chatzicharalampous*

11:20 to 11:30 AV consumption patterns – *Tim Jacks*

11.30 to 11.35 AV scenarios for 2030 – *David Lewin*

11:35 to 12:00 Discussion – *chaired by the Commission services*

12:00 to 12:30 Lunch break with refreshments provided

12:30 to 12:45 A converged platform – the study team's initial findings – *William Webb*

12:45 to 13.00 A converged platform – a view from the broadcasting sector – *Darko Ratkaj of EBU*

13.00 to 13.15 A converged platform – a view from the mobile sector – *Ulrich Rehfuess of NSN*

13:15 to 13:40 Discussion – *chaired by the Commission services*

13:40 to 13:50 Next steps and questions for stakeholders – *David Lewin*

13:50 to 14:00 Concluding remarks – *European Commission services*

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Challenges and opportunities of broadcast-broadband convergence

Introduction

David Lewin

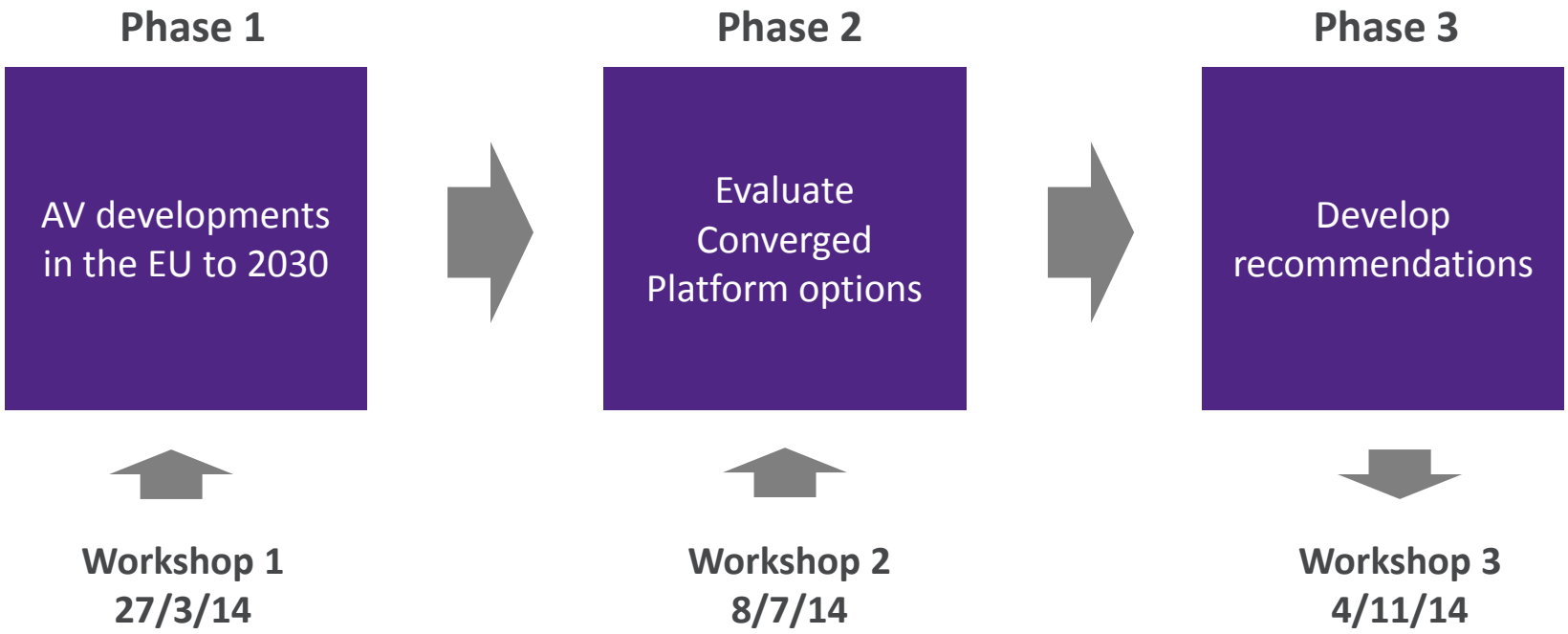
First stakeholder workshop

27 March 2014

Study objectives

- To explore future developments in the delivery of audio-visual and Internet services over the next 15 years
- To explore how these developments will impact on evolution of terrestrial wireless access networks and especially:
  - DTT networks
  - Mobile (broadband) networks
- To assess the social and economic merit in moving to a converged platform (CP) which uses UHF spectrum for both terrestrial broadcast and mobile services
  - Convergence at the ***platform*** level
  - Wide variety of options to consider
  - Broad evaluation required which takes account of other users e.g.
    - Programme making and special events (PMSE)
    - Public Protection and Disaster Relief (PPDR)
    - White space devices (WSD)

The study process and the stakeholder workshops



- Stakeholder feedback on Workshops 1 and 2:
  - On the day
  - In writing within one week

The agenda for today

Technology	*shape*	AV markets	*to assess*	CPs – options and challenges
1. AV standards developments 2. Role of broadband		3. AV market trends 4. AV consumption 5. Scenarios for 2030	**Break**	6. The team's initial findings 7. Mobile sector view 8. Broadcast sector view
Discussion		**Discussion**		**Discussion**
50 mins		55 mins		70 mins

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Challenges and opportunities of broadcast-broadband convergence

Audio-Visual Standards Developments

Jean-Marc Racine / Lionel Tranchard

First stakeholder workshop

27 March 2014

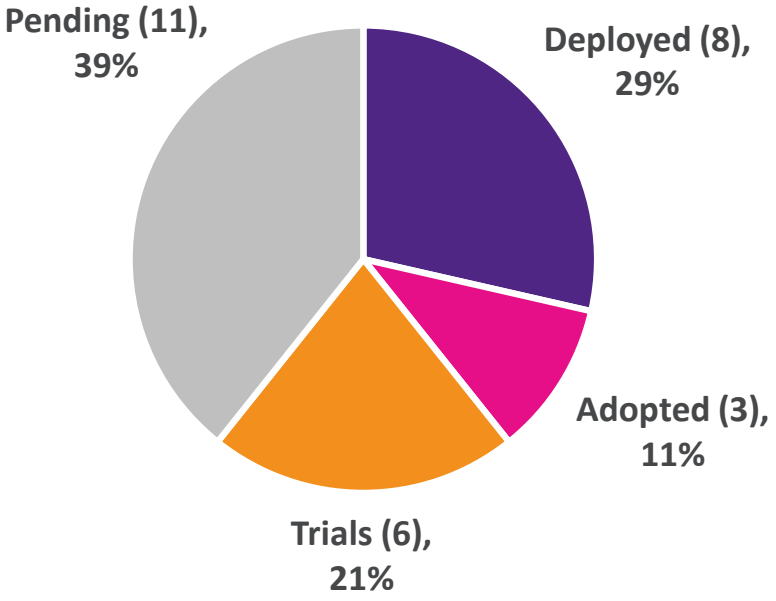
DVB Standards

- The transition from DVB-T to DVB-T2 broadcast standards improves spectral efficiencies by 50-60%
- DVB-T2 generation standards are approaching the theoretical limits of bits/s/MHz.
- Although capacity improvements might be possible in the future using a number of enhancements techniques, these would require costly investments on both the network and device sides
- DVB-T2 include variants better suited for mobile reception, longer battery-life and smaller chipsets
- Unclear if/when a 3rd generation will be standardised and implemented
- Similar to Terrestrial, Cable and Satellite transmission standards are evolving in parallel with DVB-C2 and DVB-S2 improving bitrates by 30%
- Recent announcements of DVB-S2X boosting performance by a further of 20-50%, depending on application.

DVB-T/C/S2 – Deployment status

- T2 is deployed in nearly 1/3 of EU Member States
- Limited number of DVB-C2 deployments and geographically restricted; a few trials in parallel with no official transition announcements
- A few examples of DVB-S2 deployments includes BSkyB in the UK and Ireland, Sky Deutschland in Germany, Sky Italia in Italy – mostly based on an extended HD service offering
- Further deployments of 2nd generation broadcast standards together with higher encoding schemes will be critical to enable more HD and over HD services

DVB-T2 status in the EU



Source: DVB (2013)

Encoding/ Compression

- Compression efficiencies continue to improve reducing bandwidth requirement for a “given” quality of content @10% every year
- A shift to higher resolution content (HD/>HD) is likely to offset some or all of these gains
- Transition to H.264 still in progress given recent investments and upgrades on networks and devices – may hinder adoption of HEVC
- HEVC’s take up will also depend on support from major technology players and availability of chipsets and devices

Video resolution

Format	Typical bitrate range (Mbp/s)	Resolution	Frame-rate	Typical encoding	Mainstream adoption
SD (576i/25)	2.5 – 5		25 fps	MPEG-2	**1995 – 2005**
Legacy HD (720p/50)	5 – 9	1280 x 720p	50 fps	AVC (H.264)	**2005 – 2020**
Legacy HD (1080i/25)	5 – 9	1920 x 1080i	25 fps	AVC (H.264)	
HD (1080p/50)	8 – 15	1920 x 1080p	50 fps	AVC (H.264)	**2015 – 2025 (?)**
Ultra HD-1	8 – 20	3840 x 2160p	50 fps	HEVC (H.265)	**2025 – 2035 (??)**
Ultra HD-2	*To be defined*	*7680 x 4320p*	*100 fps*	*To be defined*	*??*

- An all-HD future by 2030 is likely (if not earlier), but >HD would require another technology cycle across networks, devices and content productions

Adaptive Bit Rate

- A technique to mitigate bandwidth limitations and adapt the audio/video quality to the available network throughput
- Used over both fixed and mobile broadband networks
- Various implementations currently in the market supported by a number of device and technology players (Adobe, Apple, Microsoft)
- This creates a market fragmentation among devices, platforms and eventually audiences
- As a result, reaching these audiences becomes more and more costly as content needs to be prepared and managed for all different formats - MPEG-DASH is the industry's attempt to create a universal standard
- We expect that less fragmentation and wider adoption of ABR encoding will:
  - Increase the network reach of OTT platforms where access infrastructure won't be upgraded
  - Enable cost savings and/or the ability to stream higher quality video to lower bitrate connections.

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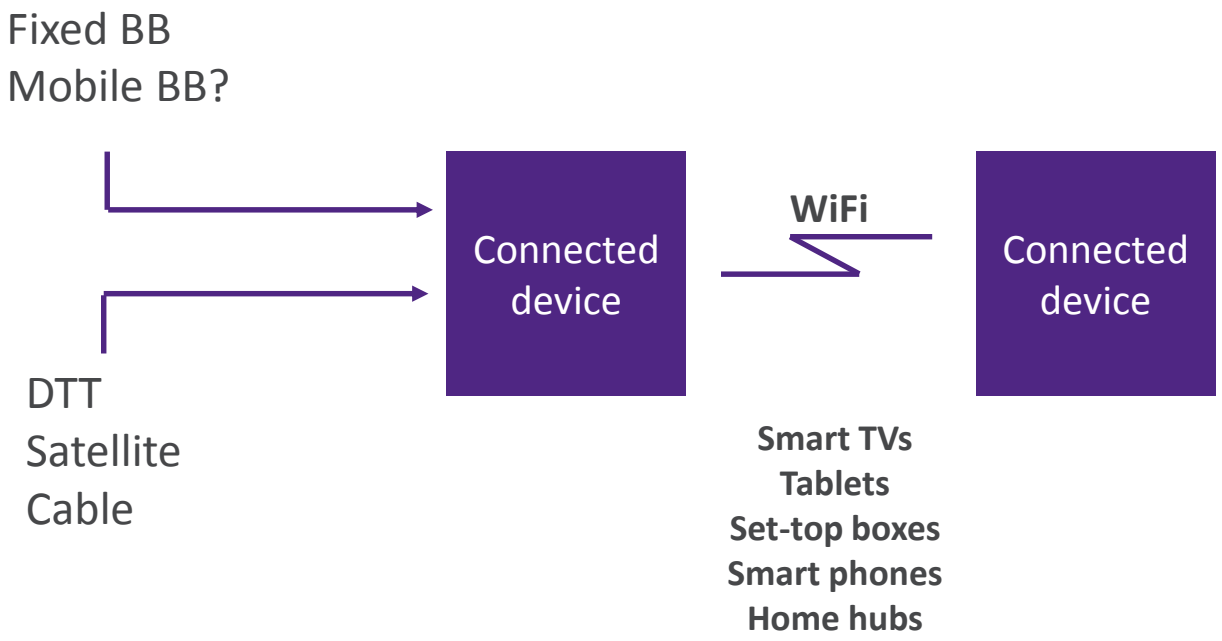
The role of broadband in AV distribution

David Lewin

First stakeholder workshop

27 March 2014

In the home broadband and traditional broadcast networks will combine through connected devices



- What role for wireline BB, FWA BB, mobile BB and Wi-Fi?
- What impact on traditional broadcast networks?

The role of wireline BB

- Download speeds already adequate for SD streaming for the majority of EU households
  - IPTV used by 10% of EU households in 2011 and take-up growing by 90% pa
  - 20GB per month per HH of OTT AV in 2013 (Cisco VNI)
- Increase in price performance of networks expected over the next 15 years:
  - 100x for wireline BB?
  - Much less for spectrum-based AV networks
- Likely role for wireline BB:
  - A strong complement to traditional broadcast networks in the short-term
  - Increasingly a substitute for DTT in the long-term (given trends in relative costs of supply)
  - But wireline BB unlikely to meet PSB requirements for near universal AV delivery

Limitations of wireline BB for AV distribution

- Limited viability in rural areas of many member states
- Uncertainty over take-up by some households eg low income, elderly
- Is network capacity sufficient for a World Cup final?
- Possible QoS issues

The role of FWA

- More cost-effective way to get NGA speeds to rural areas
- Could be especially important in central European member states
- Capacity of FWA to deliver AV content is uncertain and varies by member states
- Delivery costs per GB an order of magnitude greater than for wireline BB
- So households might use FWA:
  - To complement traditional broadcast platforms but…
  - …not as a substitute for traditional broadcast networks
- Contended nature of FWA means quality of service could be variable

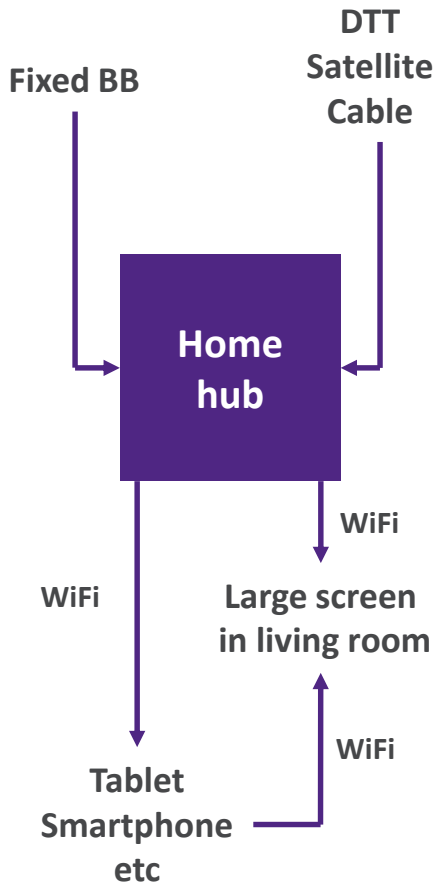
- Assumptions:
  - LTE technology
  - Households use high gain roof top aerials
  - Dedicated 2x20 MHz at 2 GHz+
  - UK rural population distribution
- Possible performance:
  - Cell throughput of 50 to 60 GB per month per household
  - Download speeds of 20 Mbps on average

The role of ***unicast*** mobile

- 4G technology gives download speeds which make SD streaming a possibility
- Additional spectrum (+50%) and greater spectral efficiency (+600%) will increase the capacity of the network substantially
- But a 32-fold increase in the number of cells would also be required for unicast mobile to have the capacity needed to (say) replace DTT
- In future unicast mobile will:
  - Deliver several hours per month of video at affordable prices to end users…
  - …but is far too costly to act as a substitute for traditional broadcast networks
- 5G initiatives:
  - Just starting - direction still under discussion
  - Early indications suggest the main capacity gains will come from integration with Wi-Fi rather than greater spectral efficiency

The role of Wi-Fi

- Wi-Fi capacity has increased several ’00 x since 2000:
  - More efficient technology (802.11b to 802.11ac)
  - More spectrum (at 5 GHz)
- Wi-Fi could change distribution of AV content in three main ways:
  - New distribution patterns in the home
  - Tablets replacing DTT second sets
  - Public Wi-Fi as cheap substitute for mobile BB (to meet the bulk of consumer requirements for AV consumption on the move)
- But major uncertainties:
  - Interference issues at 5 GHz still unresolved
  - Home hub concept conflicts with existing business models of consumer electronics suppliers and pay-TV providers
  - Use of tablets for TV viewing in its infancy
  - Limited public Wi-Fi use so far



Over the next 15 years…

- Will Shannon's Law limit improvements in the performance of spectrum-constrained AV networks?
- Will wireline broadband become more cost competitive as a way of distributing TV content to mass audiences?
- Will UHD become the normal AV viewing format on big screens or remain a niche proposition?
- Will the consolidation of Hybrid standards improve DTT's attractiveness?
- Will demand for DTT decline further given:
  - The cost competitiveness of wireline broadband?
  - The possible replacement of DTT second TV sets by tablets?
  - The spectrum challenges of carrying UHD on DTT?
- Will public WiFi or mobile BB meet the bulk of demand for AV viewing in public places?

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Audio-Visual Market Developments

Chris Chatzicharalampous

First stakeholder workshop

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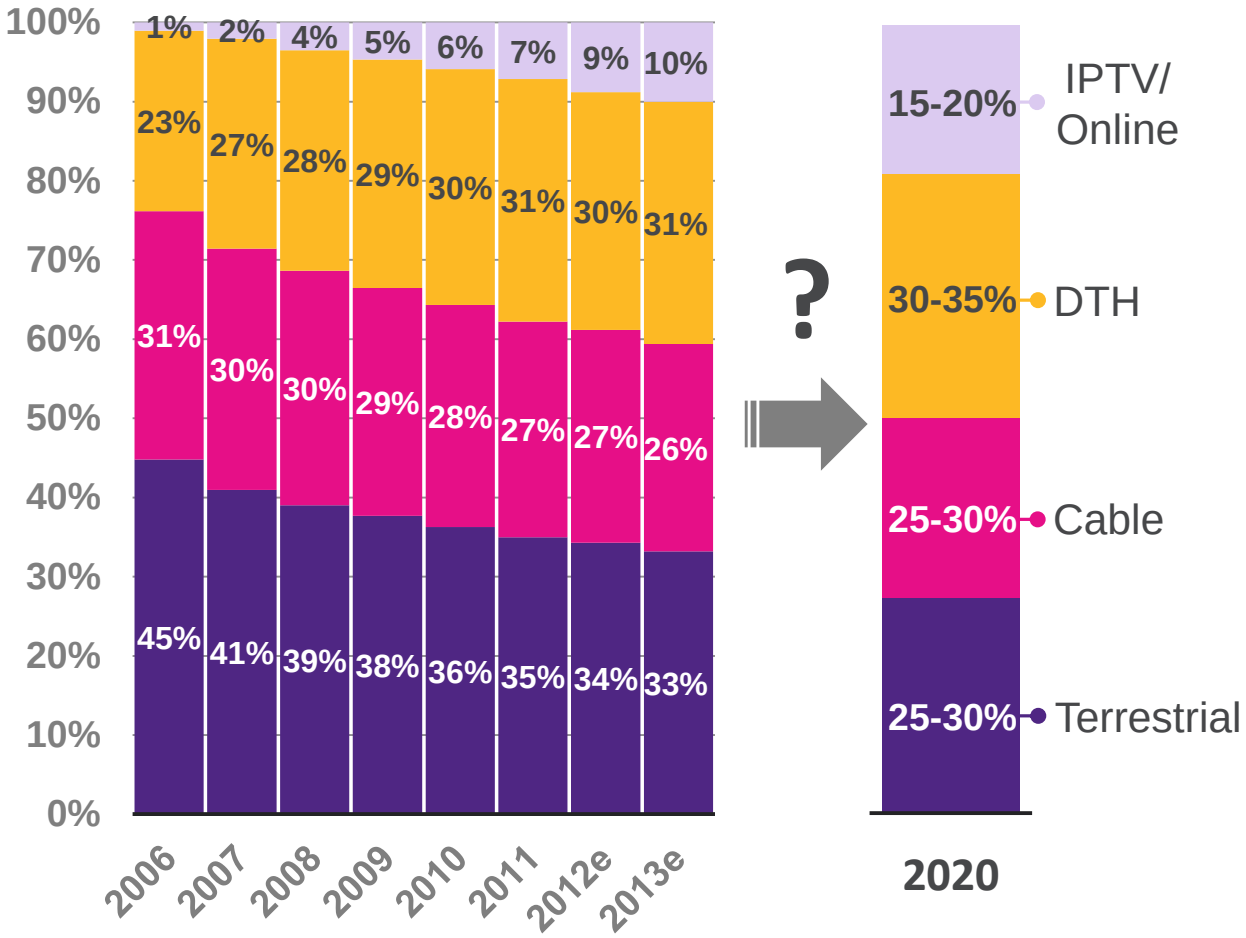
TV platform trends (EU-28)

Primary TV platform market share (% TV HHs)

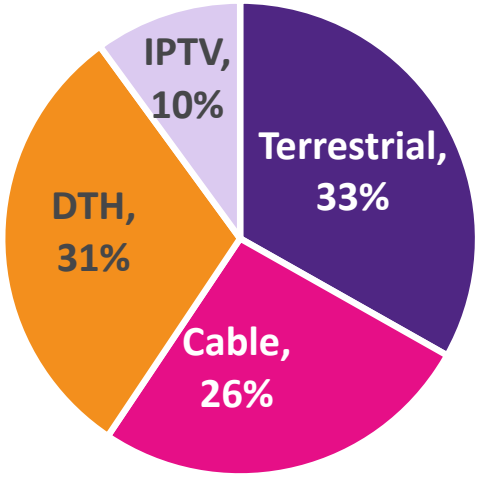


- Digital Switchover and the digitisation across platforms have changed the landscape of TV platforms
- Early indications of "shake-up" lessening

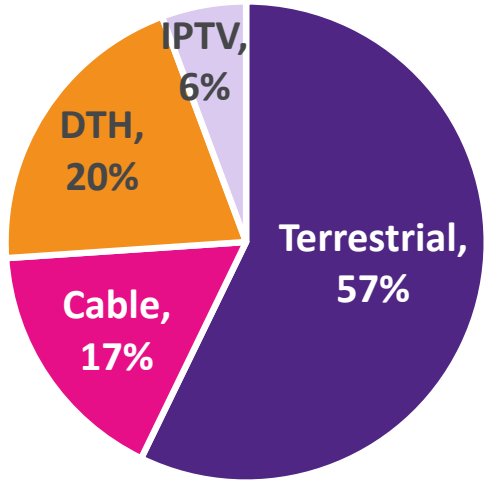
Source: EAVO (2011, 2012), e-Communications Household Survey (2013), Farncombe analysis & research (market shares refer to main TV-set)

Secondary TV-sets

% of TV Households, 2013e (main TV-set)



% of TV Households*, 2013e (incl. secondary TV-sets)

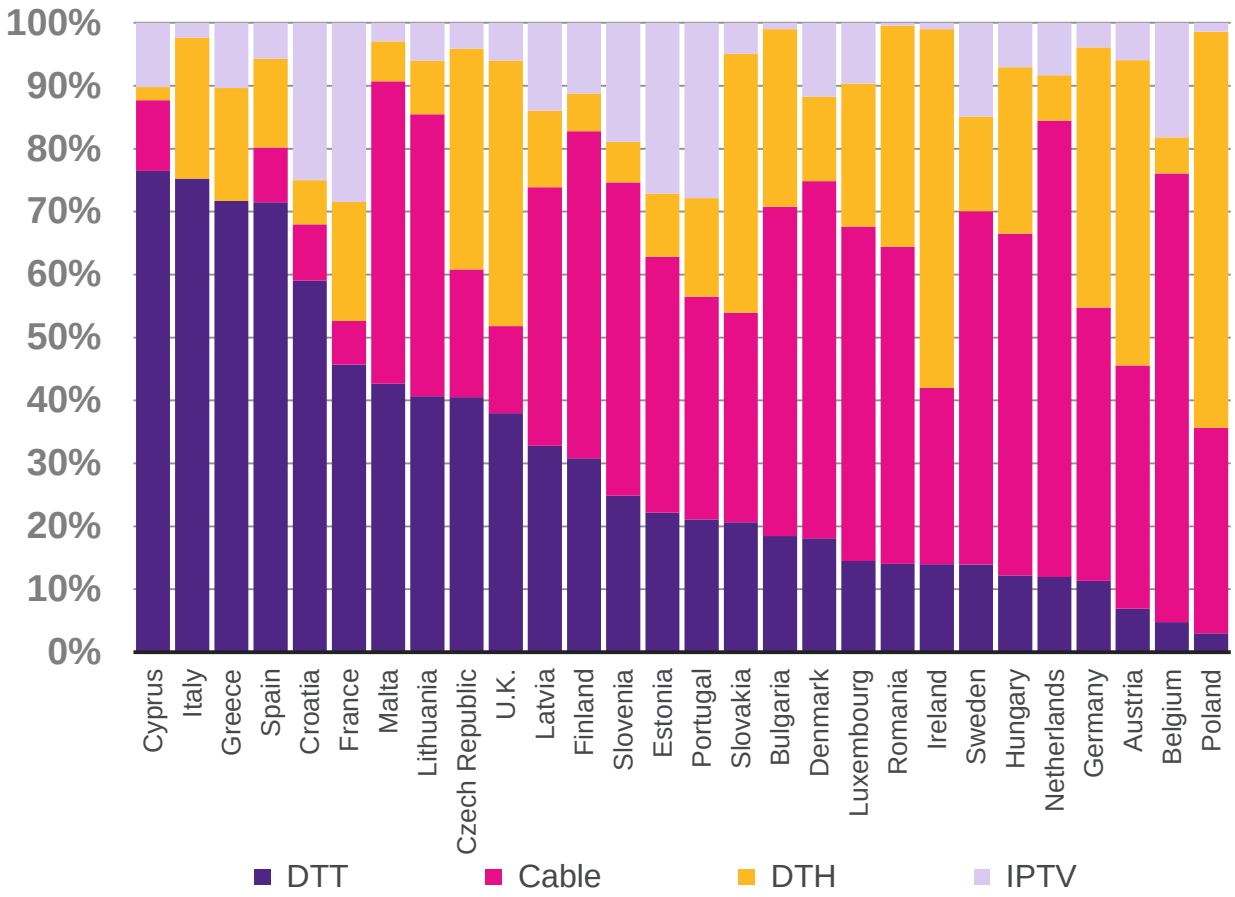


Source: EAVO (2012), e-Communications Household Survey (2013), Farncombe analysis & research

- Terrestrial platform remains dominant way to reach secondary TV-sets in the home
- Increasing penetration of tablets might substitute or supplement some of the secondary viewing in the future

Significant variations across Member States …

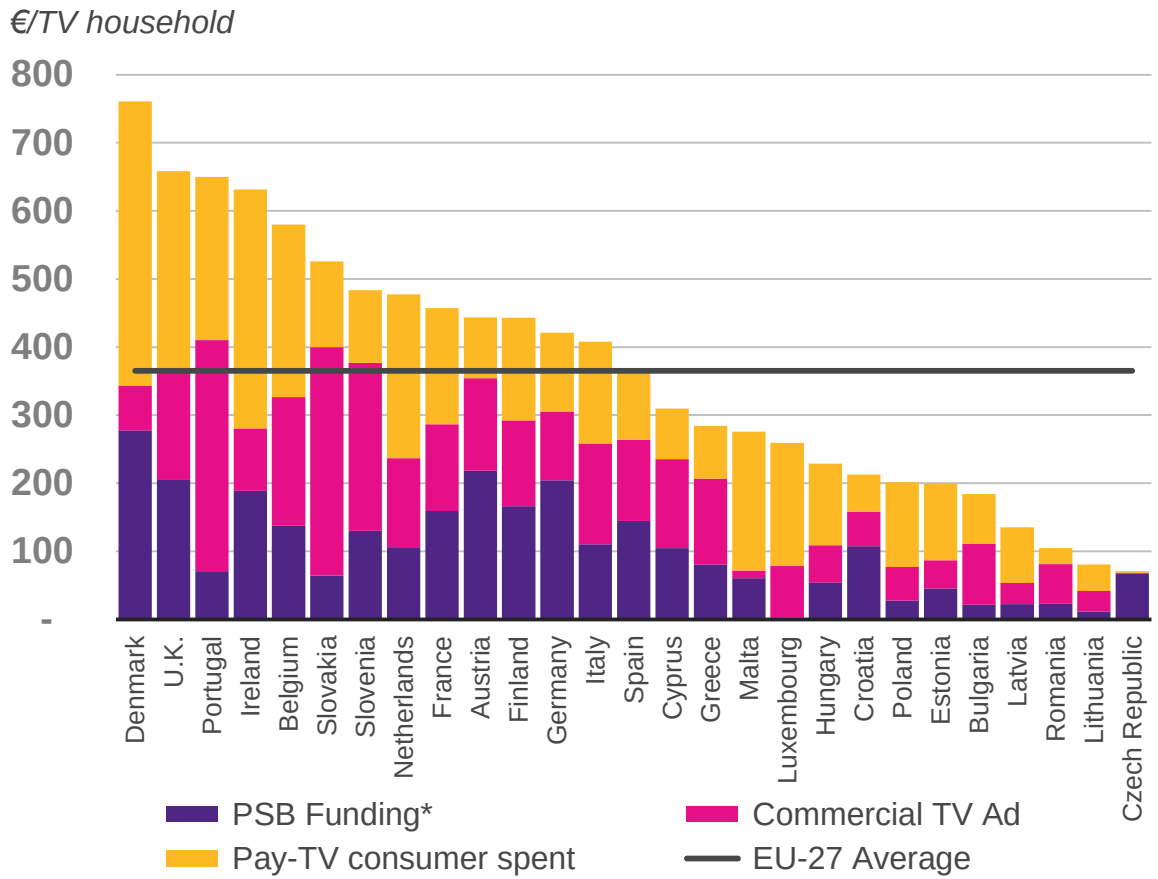
Primary TV platform market share (% TV HHs, 2013)



- Most EU markets dominated by Cable & DTH combination and are Pay-TV favourable
- 5 countries are DTT dominant (accounting for ~25% of EU TV households)
- But DTT evolution stage differs; nearly half of Member States introduced/ planning for T2 transition; the rest have not yet committed to T2

Source: EAVO (2012), e-Communications Household Survey (2013), Farncombe analysis & research (market shares refer to main TV-set)

… and varying levels and sources of finance



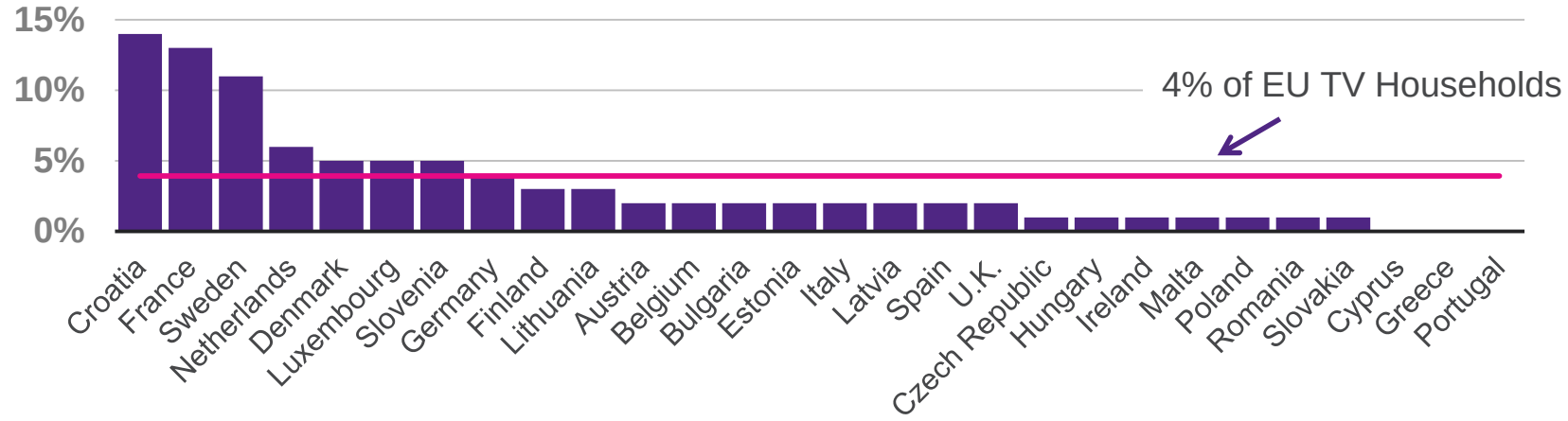
Note: Case of Sweden, as an outlier, is filtered out (value for Sweden is €1,963/TV HH

Source: EAVO (2012), Farncombe analysis

- PSB funding in some Member States is as high as 88%, with an EU average of 25%
- Recently declining ad revenues and increasing Pay-TV take-up are shifting the platforms overall financing balance to consumer spent revenues
- *Key issue: Migration costs and funding of a potential "converged" platform*

Awareness of online platforms is increasing across the EU

% of households claiming that receive TV services via Connected-TV/Wi-Fi, PC, other device)



Source: e-Communications Household Survey (2013)

Online platforms – Key drivers

- Broadband availability and take-up
- Broadband quality (speed)
- Access to free-to-air content
- Availability of connected/viewing devices, enhanced user interfaces
- New audience reach by network

Online platforms – Key inhibitors

- Broadband access service cost
- Higher resolution content requiring next generation access networks or might limit the addressable market/audience reach
- Quality/consistency of user experience
- Content rights for Online
- Competition from platforms with similar (bi-directional) features
- Uncertain regulatory framework (at present)

Over the next 15 years …

- Will DTT remain a primary distribution platform for rooftop aerials and TV-sets, enabling an all HD/>HD, linear and non-linear hybrid user experience? → Hybrid DTT
- Will DTT be confined to a conventional or complementary role fulfilling public service requirements? → Basic DTT
- Will DTT further expand and be at the core of enabling better mobile reception and reaching personal devices (e.g. mobile devices, tablets) and vehicles? → DTT for all
- Will DTT play an intermediary role to facilitate a transitional process until is replaced by either an alternative technology or platforms? → DTT superseded

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Audio-Visual Consumption Trends

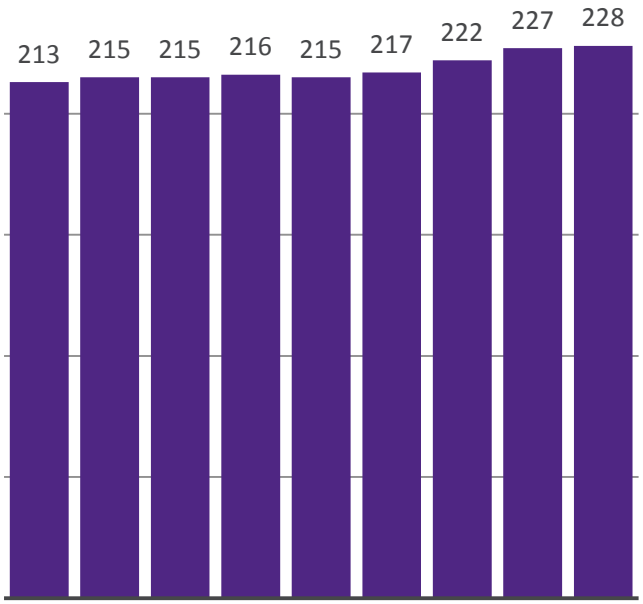
Tim Jacks

First stakeholder workshop

27 March 2014

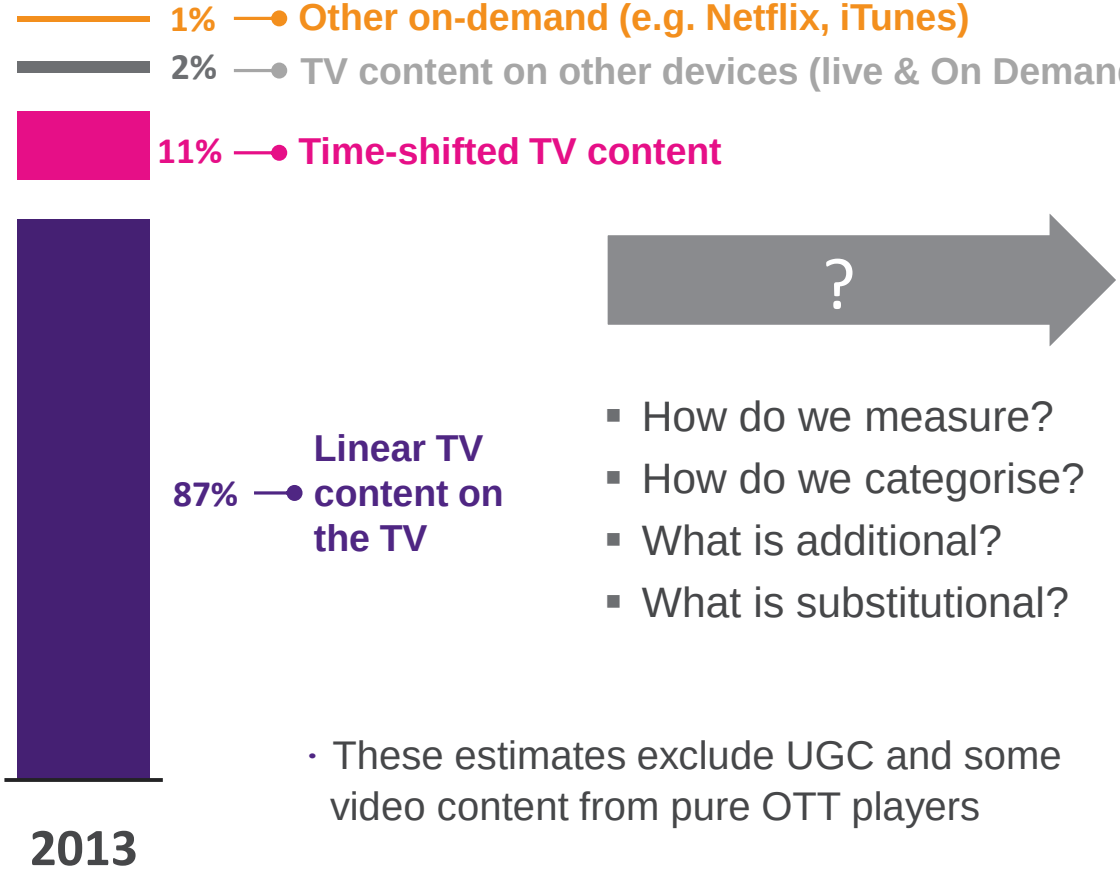
What does current consumption look like?

Average daily minutes of TV viewed, Europe



Source: Eurodata

% of in-home TV viewing minutes in the UK



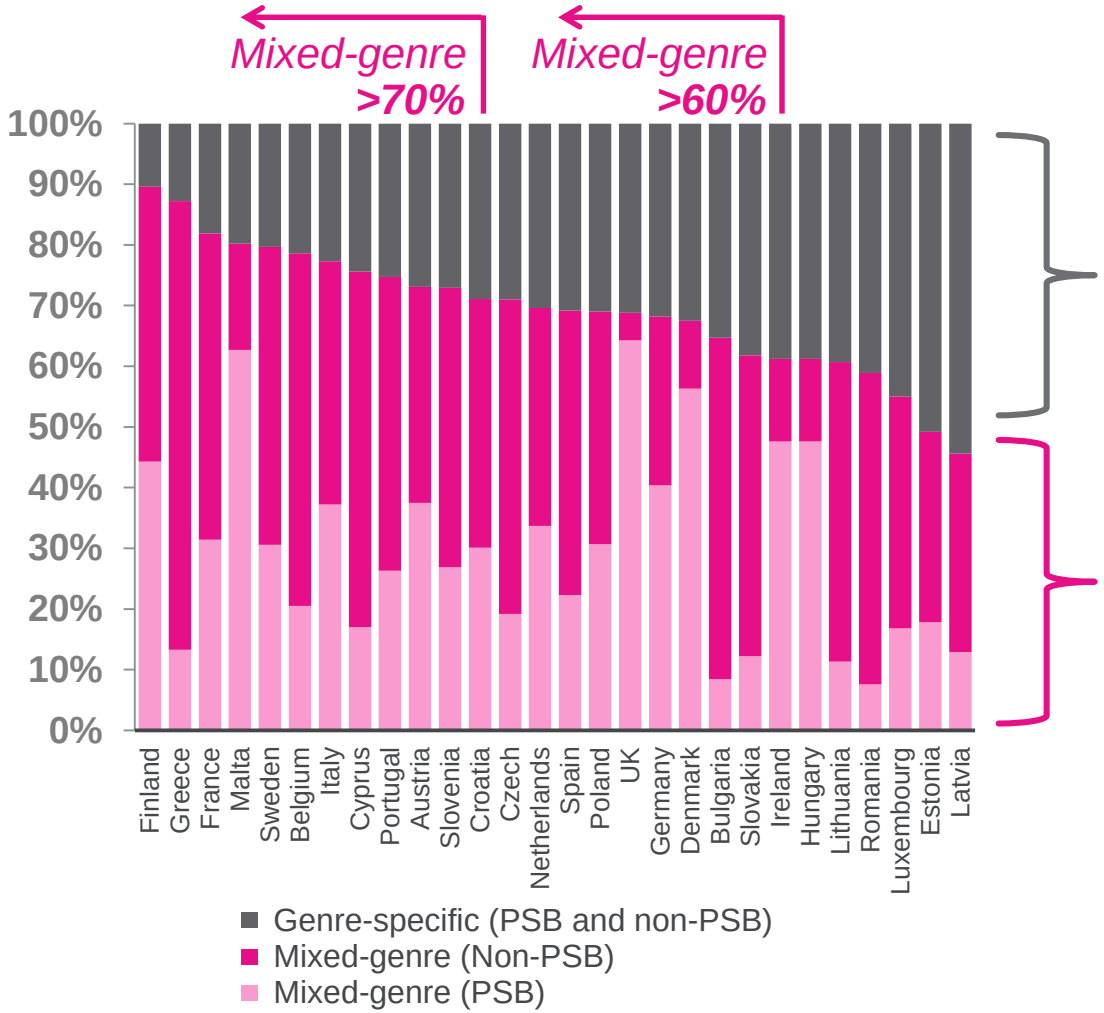
- How do we measure?
- How do we categorise?
- What is additional?
- What is substitutional?

- These estimates exclude UGC and some video content from pure OTT players

Source: BARB, Thinkbox, Farncombe's analysis and assumptions

Not all linear is equal

Percentage of Mixed-Genre and Genre-Specific content watched in EU-28 countries

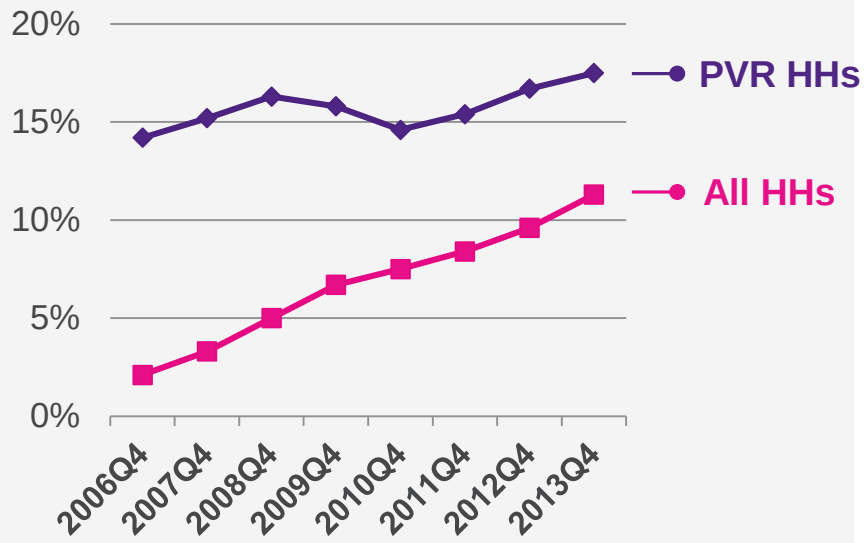


Source: EAVO, Farncombe analysis

- Genre-specific channels have:
  - Mostly repeats
  - Little variety in schedule
  - Lower position on EPG
- Mixed-genre channels have:
  - Large proportion of first-run original programming (high programming spend!)
  - Varied schedule: breakfast, daytime, early evening, primetime, late night
  - Prime position on the EPG

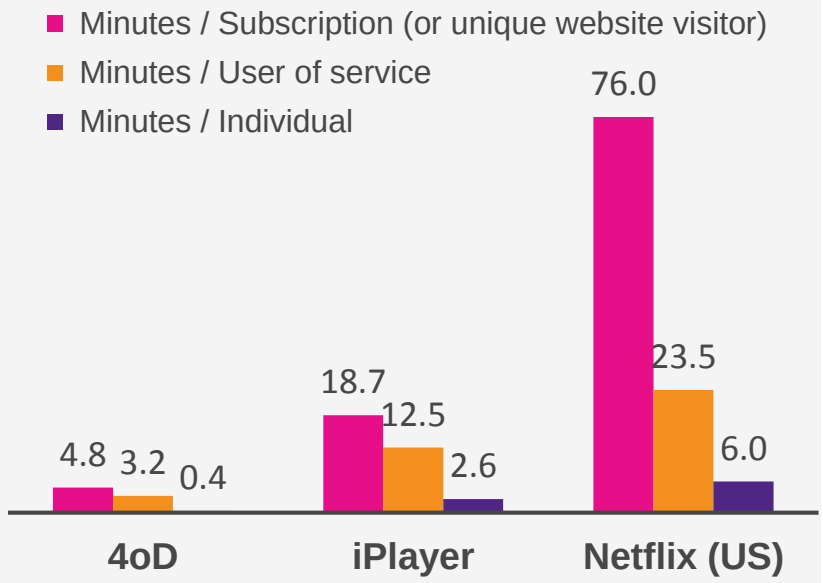
Time shifted and on-demand viewing

% of TV viewing that is time-shifted, UK



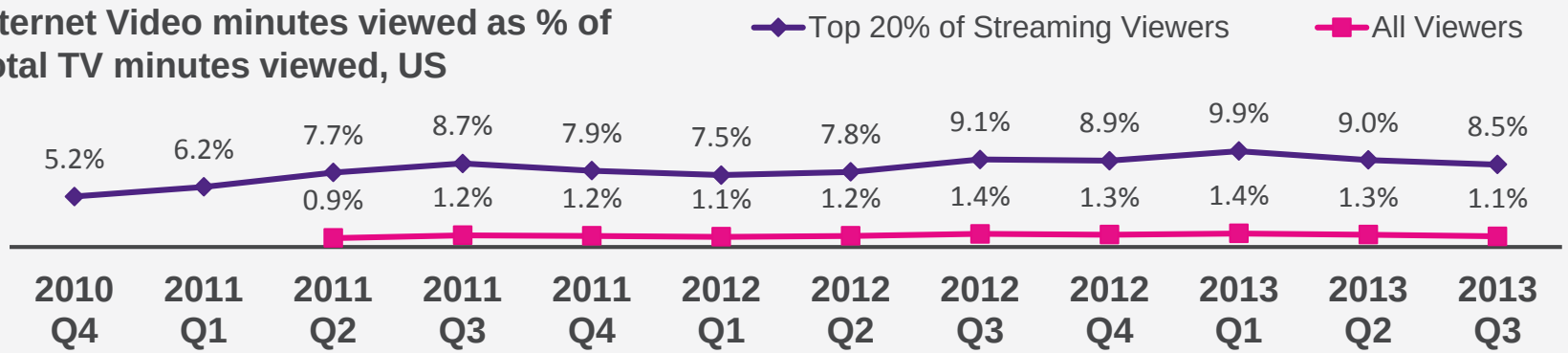
Source: Sky, BARB

4oD, iPlayer, Netflix average daily viewing minutes



Source: Comscore, 4oD, BBC iStats, Netflix, Farncombe analysis

Internet Video minutes viewed as % of Total TV minutes viewed, US

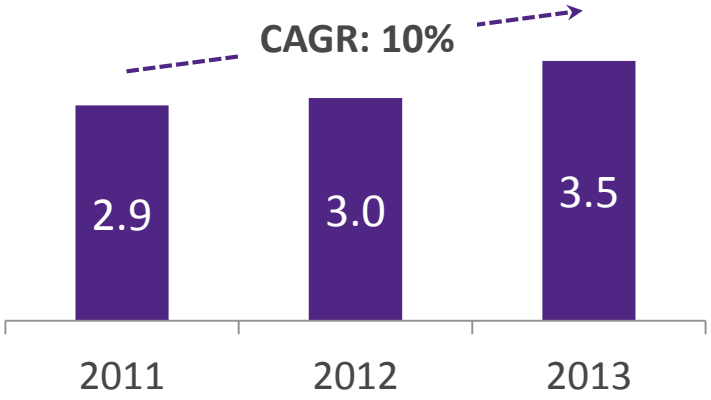


Source: Nielsen, Farncombe analysis

How much is viewed on portable devices?

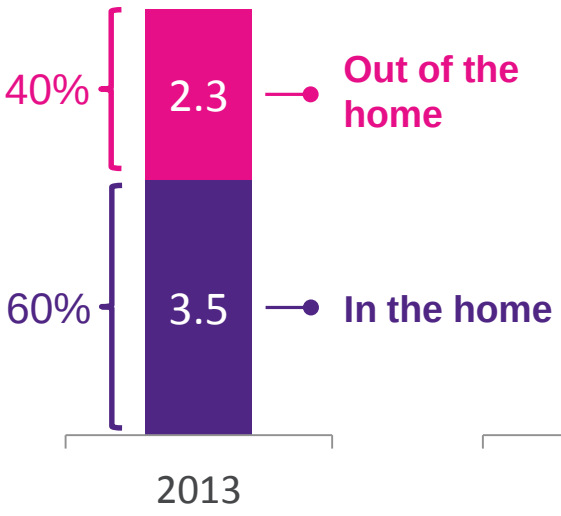
In the home…

Average daily minutes of TV viewing on portable devices in the home in the UK

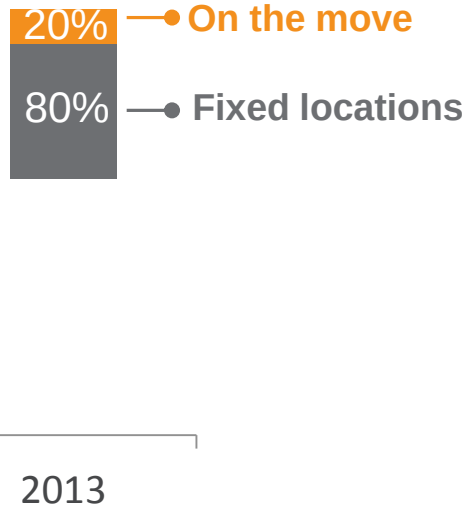


Source: Thinkbox, Barb, Farncombe analysis

…and out of the home?



Source: Ericsson, Farncombe analysis



Source: Quickplay media, Farncombe analysis & assumptions

- These estimates exclude UGC and video content from pure OTT players

What will change in future?

Cheap OTT devices

ROKU

$49.99

chromecast

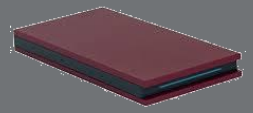
$35.00

NOW TV
Powered by sky

£9.99

On demand "as linear" / OTT as broadcast

Qplay



$49.00

YouView OTT "channels"

OTT content spend

UK Programming spend

iPlayer exclusive content

Pure OTT platforms

Magine

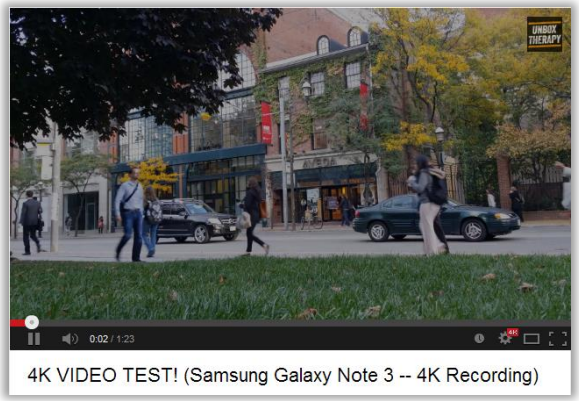
wilmaa

TVPlayer

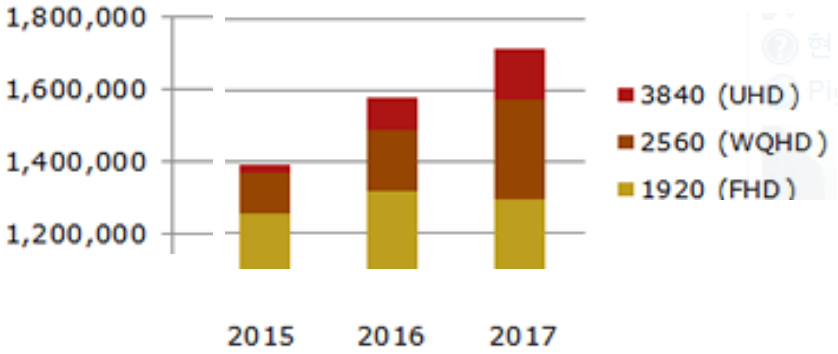
SD / HD / >HD

>HD could be driven by non-TV devices…

4k recording from Samsung Galaxy Note 3



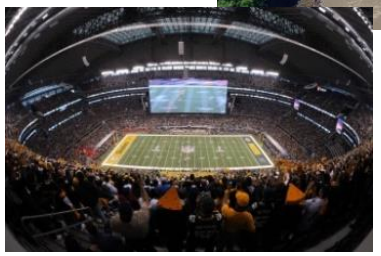
Global sales of smartphones by resolution type (000s)

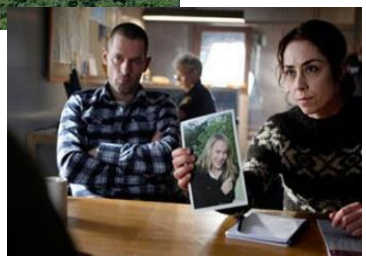


Source: NPD Display Search

…but may not be applicable everywhere

Increasing impact of higher resolutions





Immersive content

Cinematic content

Source: Farncombe

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Challenges and opportunities of broadcast-broadband convergence

Scenarios for AV consumption in 2030

David Lewin

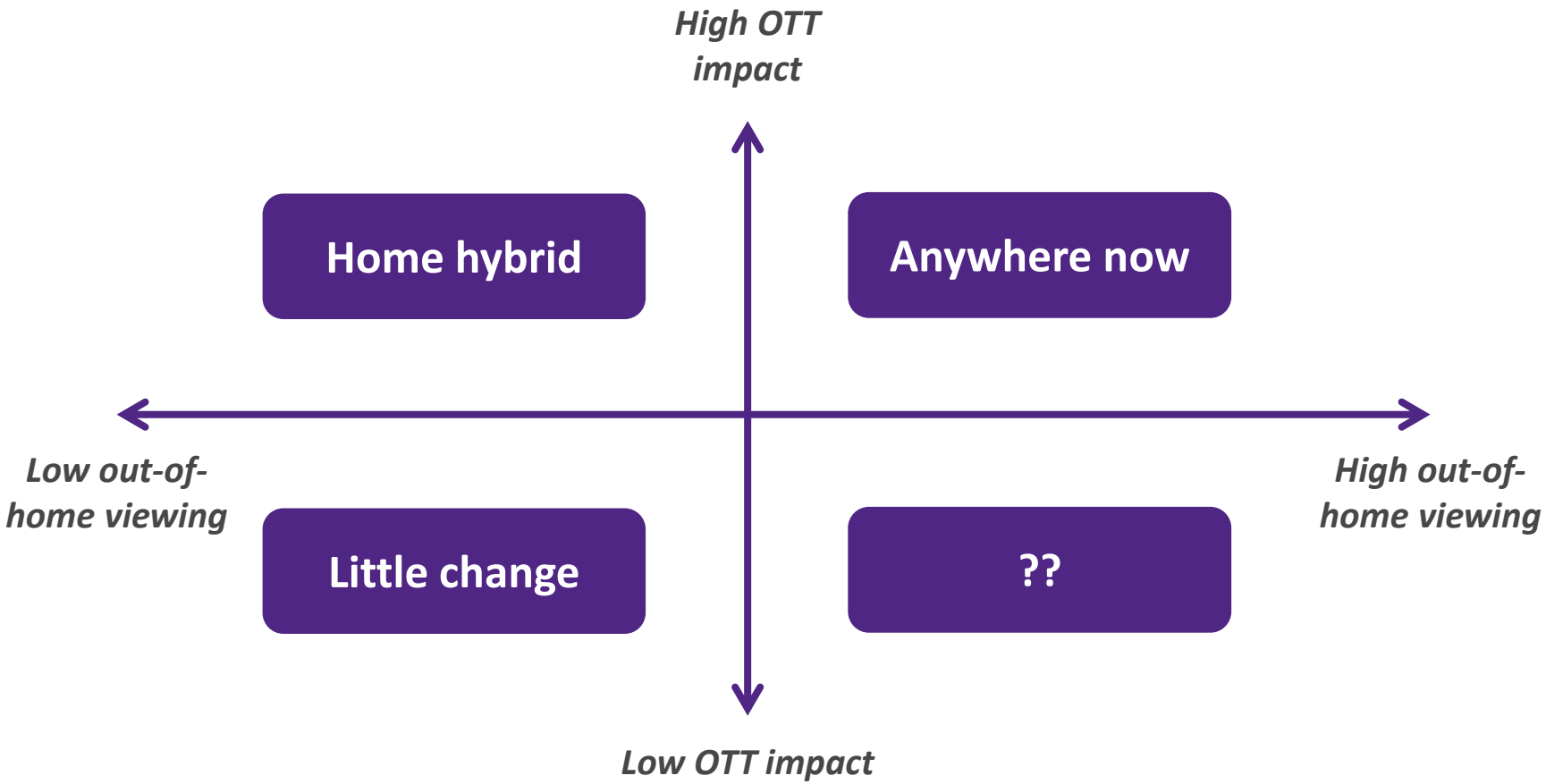
First stakeholder workshop

27 March 2014

The need for scenarios

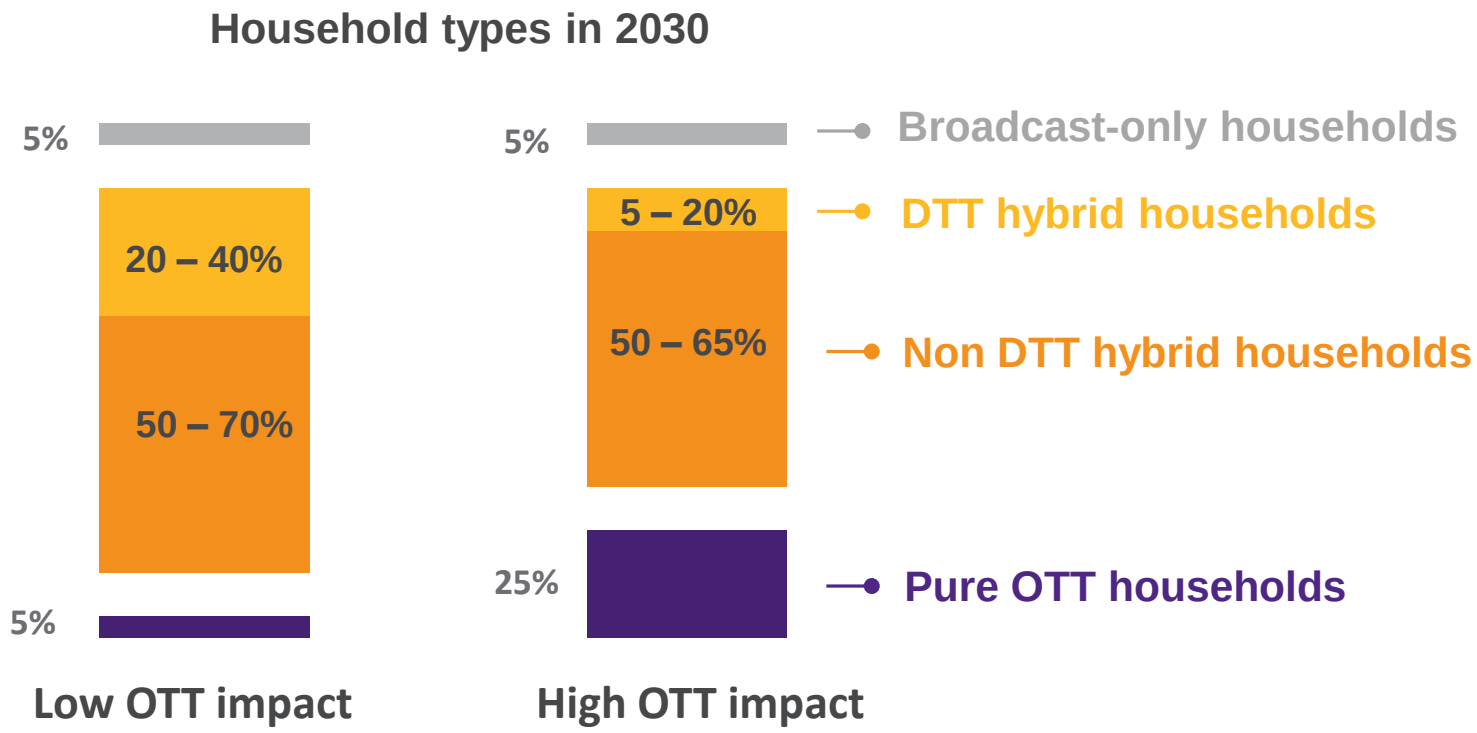
- Big uncertainties over AV distribution and consumption by 2030
- So need for scenarios in Phase 2 when evaluating options for a converged platform
- Each scenario should be:
  - A description of what might happen which is…
  - …reasonably likely
  - ...consistent with the evidence
  - …internally coherent
- Scenarios need to inform the extent to which:
  - DTT is used in 2030
  - Mobile BB is used in 2030

Four possible scenarios for 2030



- Are there other scenarios we should consider?

OTT impact on networks used in the home in 2030



- What assumptions should we make about DTT use in 2030?

Out of home viewing in 2030?

- No good measures of current position – never mind 2030

Measure	Outcome 1	Outcome 2
Average out-of-home viewing per day per person	10 to 15 minutes	20 to 30 minutes
% of viewing pre-loaded	10%	20%
% of viewing at a fixed location	80% (as now)	60%
% of viewing on the move	20%	40%
% of viewing using mobile broadband on the move	10%	20%

- Where is the evidence on future AV viewing out of home?

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Initial findings – a converged platform

William Webb

First stakeholder workshop

27 March 2014

Defining convergence and scenarios

- We are considering whether the same platform could be used for both broadcast and mobile broadband services using UHF spectrum
  - By platform we mean transmitter sites, backhaul, etc
  - This generally implies one device can receive both types of content

	DTT (eg DVB-T2)	LTE (eg eMBMS)
HPHT	Status quo	Proposal by Reimers et al
LPLT	Move DTT onto LTE towers	Integrate broadcast onto eMBMS

- Hybrid approaches are possible including some mix of both or in-fill with alternative technologies such as satellite in rural areas
- HPHT-LTE and hybrid options for further study in Phase 2

The LPLT – LTE option

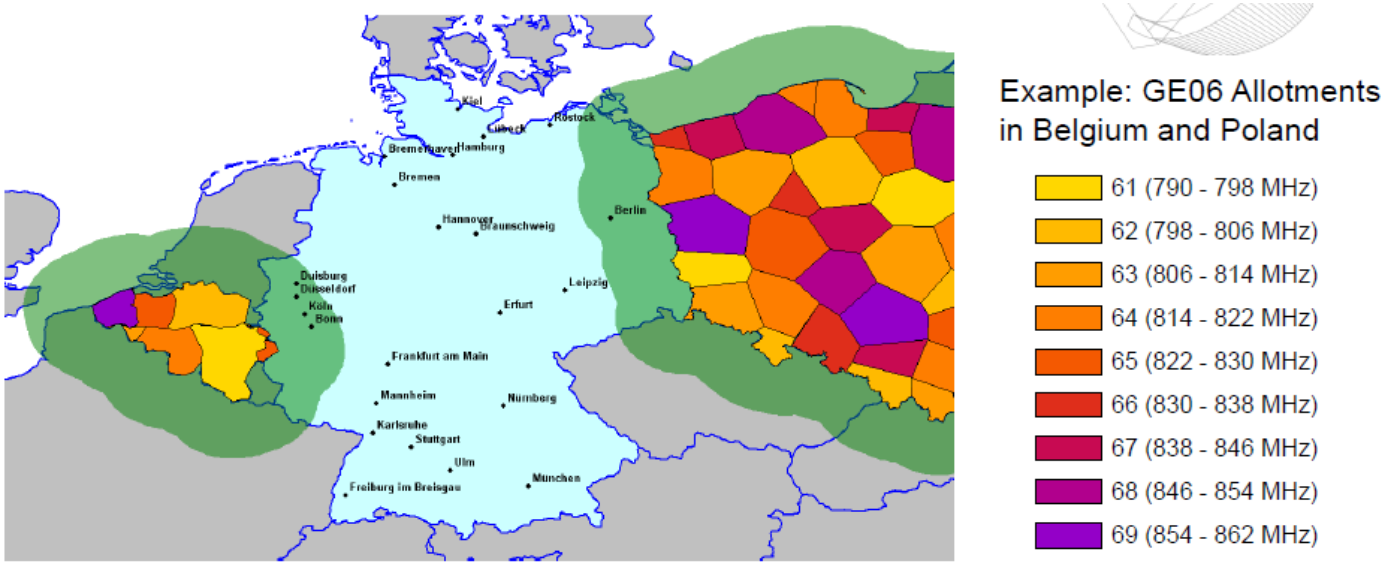
- Moving to LPLT makes Single Frequency Networks (SFNs) more viable
- As a result the spectrum requirement could reduce to ~80MHz in the best case
  - Spectrum released could materially improve mobile broadband coverage in rural areas and indoors
  - Potentially much better mobile TV services than DVB enabled mobile device
- Cost savings (power, backhaul, site costs) appear minimal
- If LTE adopted
  - Opportunities for converged services exist but nothing compelling identified yet
  - eMBMS is not well-suited at present but changes could be made to the 3GPP specification if there were widespread support
- If DTT adopted
  - Fewer convergence opportunities
  - No need to change eMBMS and transition may be simpler

LPLT would facilitate mobile reception but there are device issues

- Making handsets that can work across the entire UHF band (plus all the other 2G/3G/4G bands) is currently not possible
- Some problems such as antenna size are extremely difficult to solve
- Other problems like filters and amplifiers can be solved at the expense of increased device cost and power consumption
- The situation is much simpler if the UHF band below 700MHz is designated downlink only - this may not be too restrictive as most mobile traffic is in downlink (DL)
- Handset manufacturers will not be keen to divert resources to looking at these issues unless there is a clear demand and large market

Cross-border issues with spectrum release

- HPHT is planned on a pan-European basis
- Interference can extend 50km+ over a border into another country
- Studies in Sweden have shown that if neighbours do not change their usage then moving to LPLT does not release any spectrum
- A pan-European approach would enable benefits to be realised soon after transition and reduce uncertainty but is not essential technically



Rural areas may limit spectrum release

- Beyond an inter-site distance (ISD) of 5km there is little spectrum release
- SFNs require that all cells use the same modulation and coding scheme (MCS) meaning urban areas may be dragged down to rural efficiencies
- ISDs in rural areas are unclear, typically 5-10km
- Providing only rooftop coverage in rural areas helps but reduces flexibility
- Suggests that alternative approaches in rural areas (eg satellite) needed

ISD [km]	Spectral efficiency [bit/s/Hz] Fixed reception		Spectral efficiency [bit/s/Hz] Mobile / Light indoor reception	
	Conservative	optimistic	conservative	optimistic
2	3.0	3.0	3.0	3.0
5	2.0	2.7	1.0	2.0
10	0.5	1.0	Not possible	0.5

DTT = 4 to 5 bits/s/Hz

Transitional issues with LPLT-LTE

- Ensure that the eMBMS standard provides all the facilities needed
- Set aside some spectrum for simulcasting of LTE in the UHF band
- Roll out eMBMS to all macro-cell sites in the selected network (regional roll-outs might also be possible)
- Encourage consumers to move from DVB to LTE-based receivers.
- Test the need for antenna realignment at homes and provide advice/support
- Progressively switch off DTT transmission
- Finally, move eMBMS transmission to its final home if needed

Summary

- Gains of moving to LTLP are:
  - Potential spectrum release of up to 150MHz
  - Some long term cost savings
  - Convergence benefits, but these are more philosophical than actual at present
- Difficulties of LPLT are:
  - Pan-European approach required to get benefits in reasonable timescales
  - Changes to the 3GPP specifications and to equipment required
  - Changes to contractual arrangements and legal obligations required
  - Major transitional challenges
  - Users of interleaved bands and white spaces may have reduced access
- Need to:
  - Study other options including whether hybrid options could be a viable alternative
  - Quantify the most promising options

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The first stakeholder workshop for the study:
'Challenges and opportunities of broadcast-broadband convergence and its impact on spectrum and network use'

Brussels, 27 March 2014

A View from the Broadcasting Sector

Darko Ratkaj
ratkaj@ebu.ch

CONTENT

CONSUMER DEMAND FOR TV

Television is the medium used most by Europeans:
87% say they watch it every day or almost every day and
97% at least once a week.

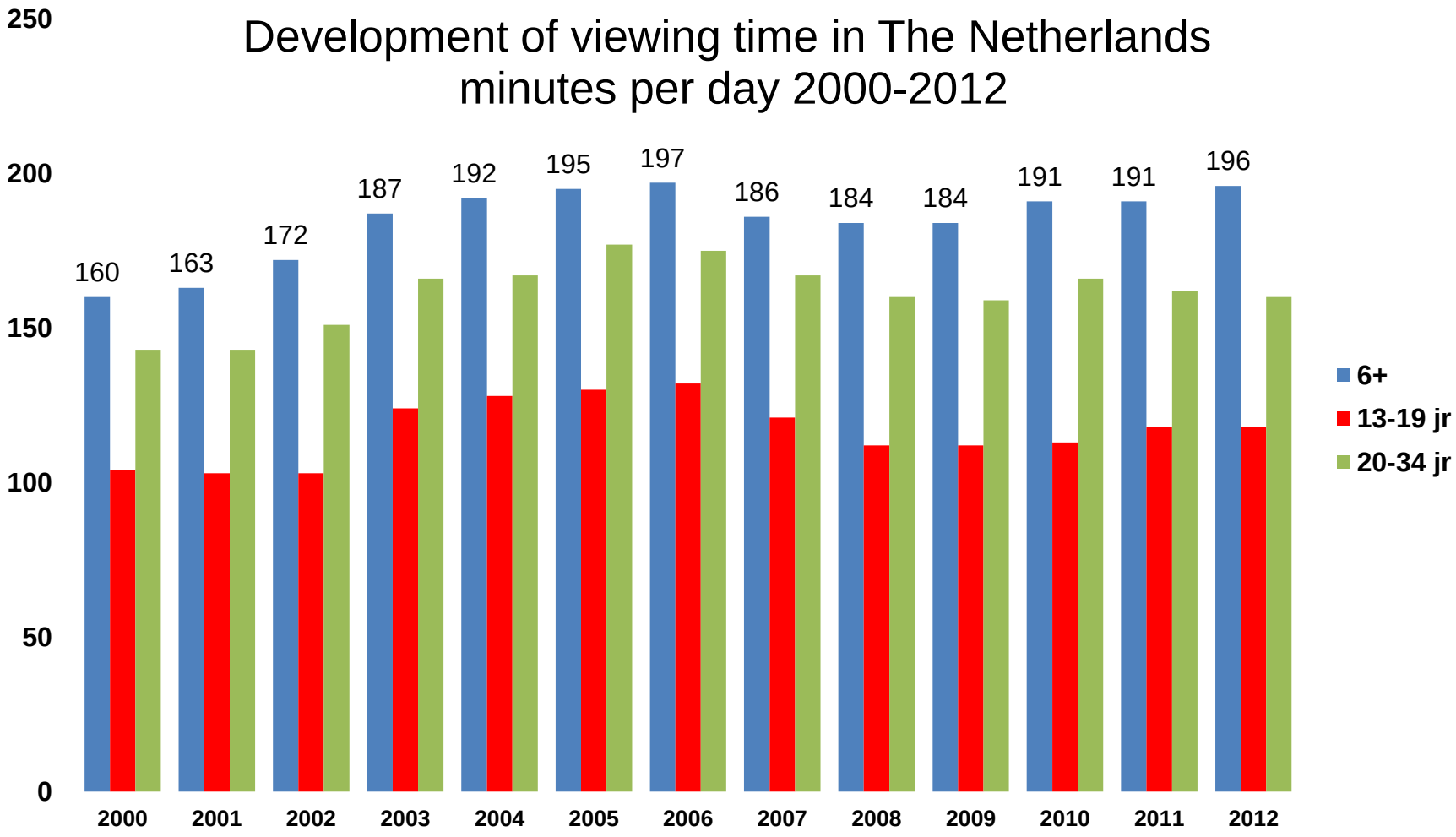
Standard Eurobarometer 80, November 2013

In 2013 the average UK viewer watched a total of
3 hours and 55 minutes of TV a day.

- 98.5% via TV set (3h 52min)
- 1.5% on mobile devices (3min 30sec)

Thinkbox, January 2014

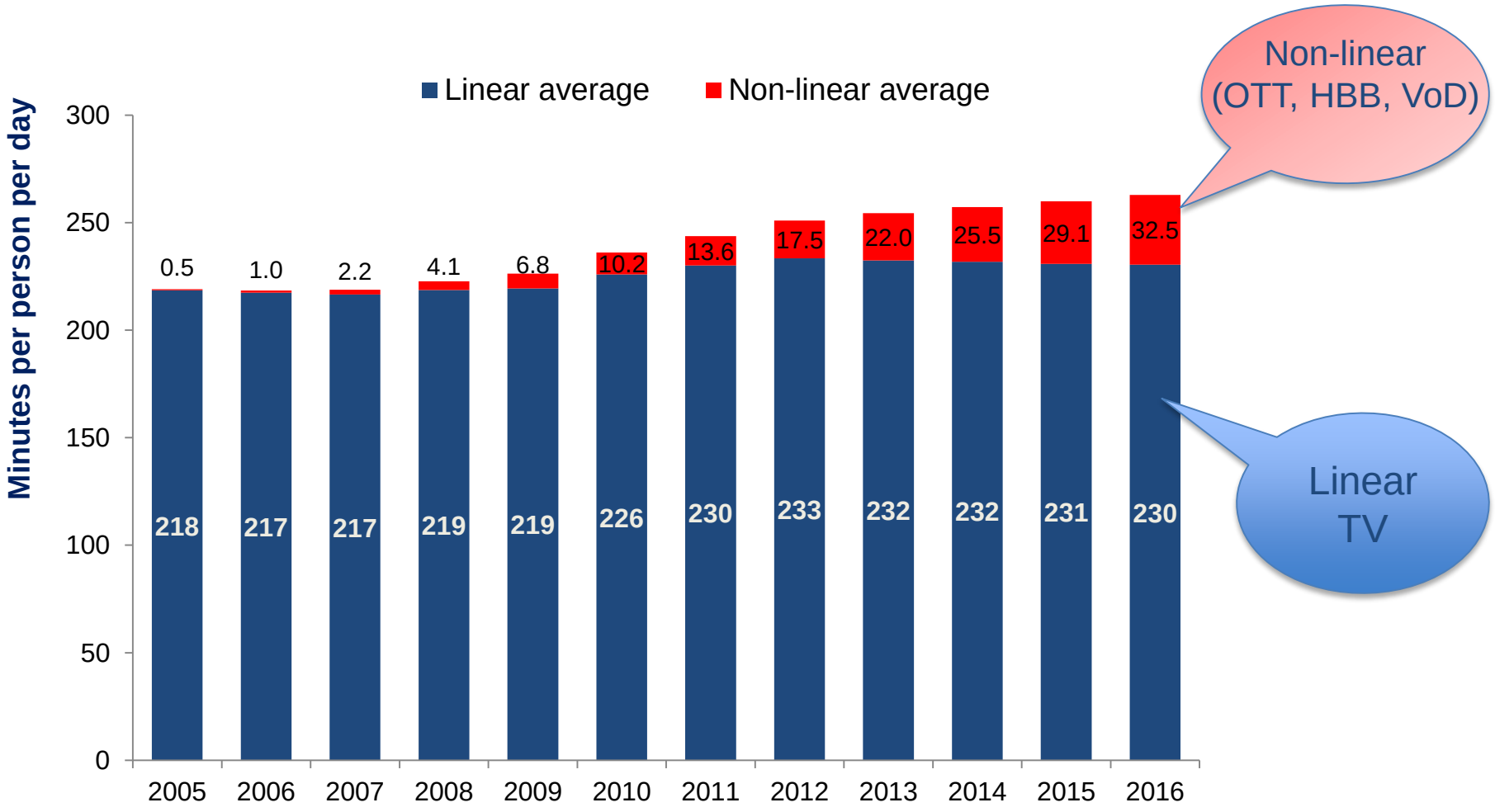
CONSUMER DEMAND FOR TV (2)



Source: KijkOnderzoek (SKO) | CKO (NPO KLO)

Evolution of linear and non-linear TV viewing

Average in the EU 'Big 5'



Source: IHS – ScreenDigest: Cross-platform Television Viewing Time FY 2012

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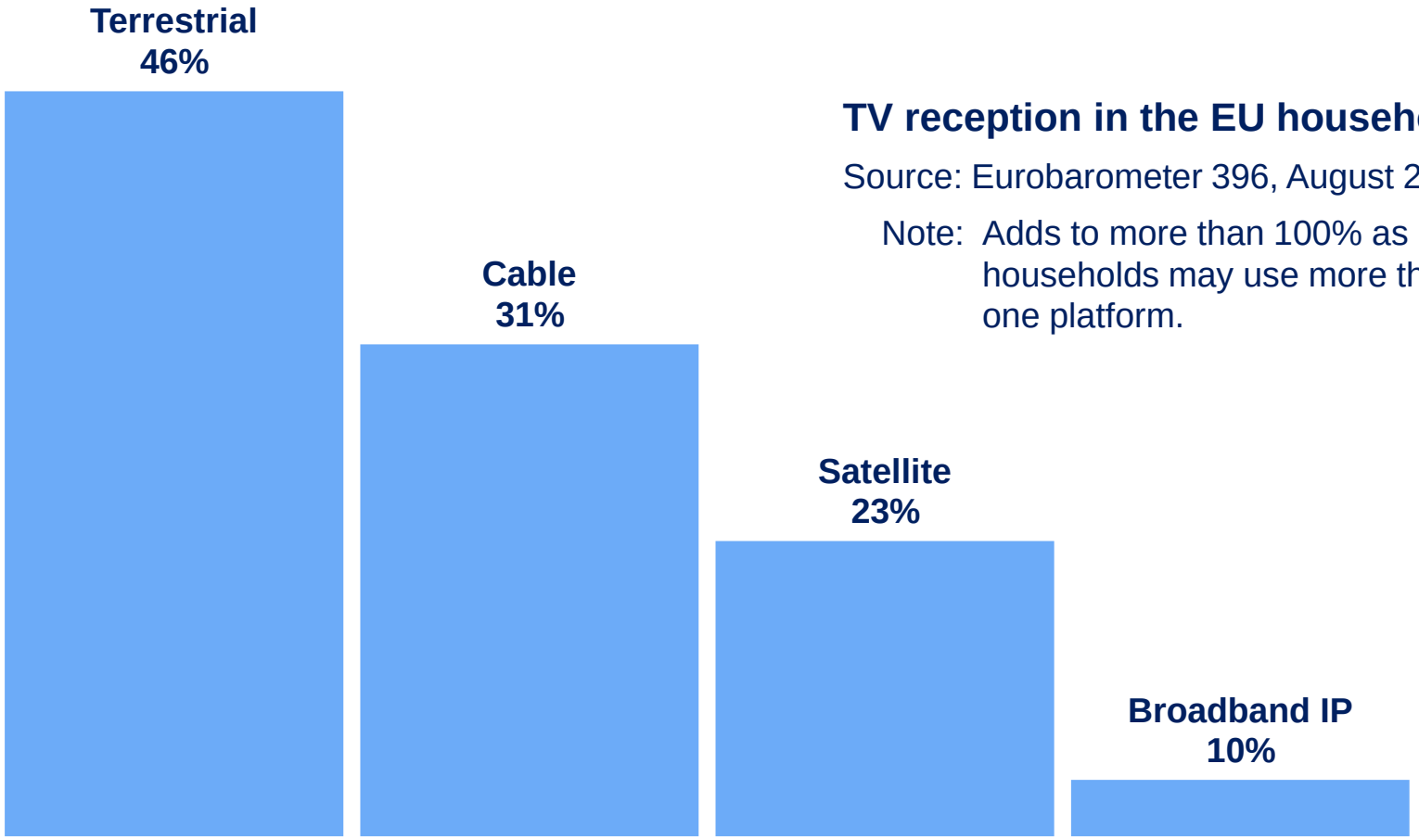
HOW IS CONSUMER DEMAND FOR TV SATISFIED?



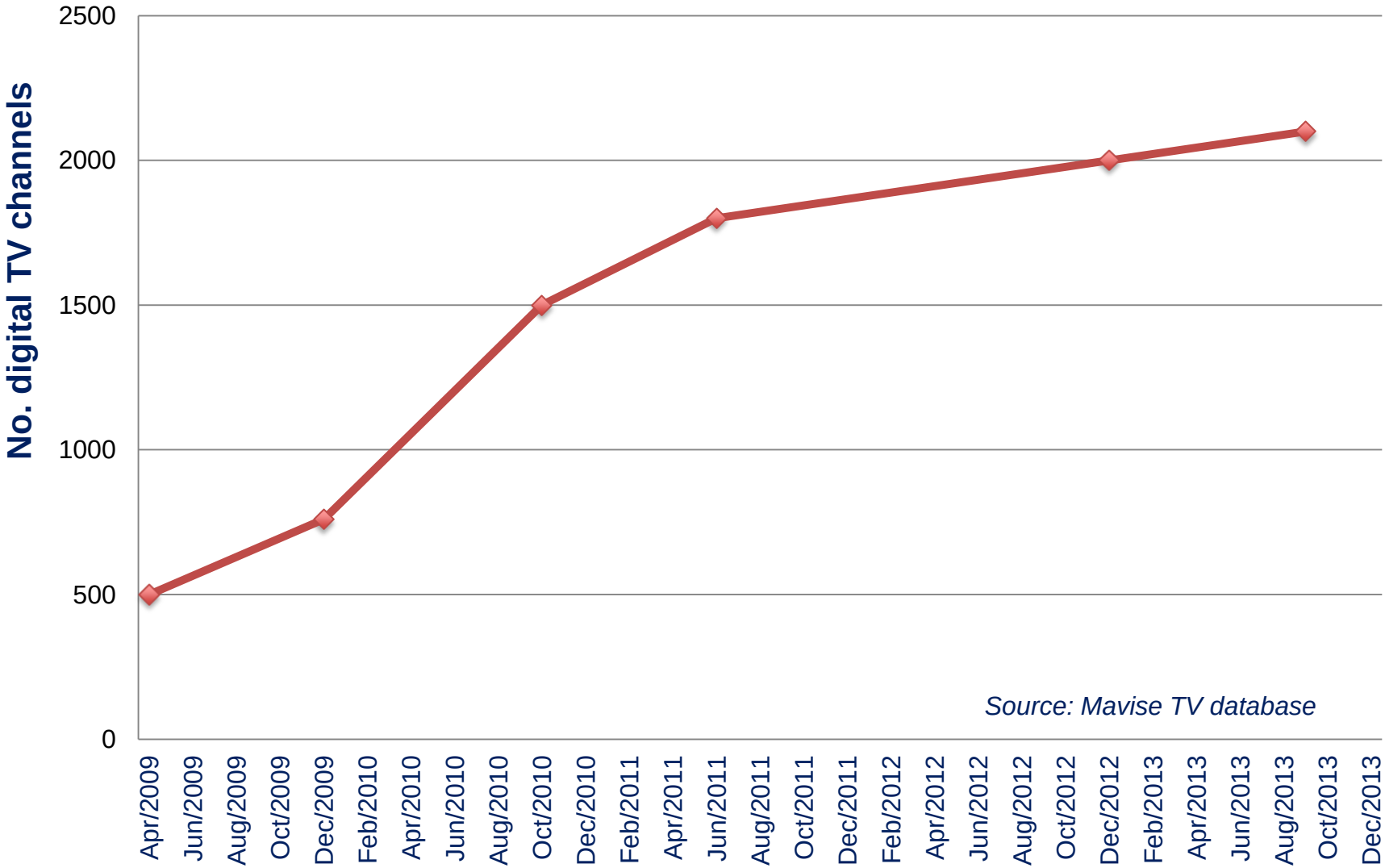
TV reception in the EU households

Source: Eurobarometer 396, August 2013

Note: Adds to more than 100% as households may use more than one platform.

The mix of TV platforms is different in different countries.

TV CHANNELS ON DTT* IN THE EU



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*DTT = Digital Terrestrial TV platform

OUR UNDERSTANDING OF WHAT IS MEANT BY A 'CONVERGED PLATFORM'

- A single platform capable of delivering both broadcast and broadband services.
- User devices will be able to receive the full range of linear and on-demand media services.

- Hypothesis: *A converged platform would replace DTT until 2030.*

THE CURRENT ROLE OF DTT

- Free-to-air, live viewing, large audiences
- Near-universal coverage (in many countries >98% of the population)
- Primary TV platform for 230 million viewers in the EU (46% population)
  - much more if secondary sets are included
- More than 2000 TV channels in the EU
  - including national, regional and local
- Affordable for large audiences
- Guaranteed quality of service
- Key platform for Public Service Media
- Coexistence of Public Service and commercial TV (both FTA and pay-TV)
- Synergies with other platforms (HbbTV, catch-up TV, second screen)
- Ensures market competition and consumer choice
- Resilient, essential infrastructure in emergency situations

Will a converged platform be able to replicate these benefits?

THE OPTIONS FOR EVALUATION

- What added value will a converged platform bring to consumers?
- What are the drivers towards a converged platform?
  - Type of technology?
  - Business case for investments in converged networks?
  - Business case for the content providers?
- What are the migration issues and how to address them?
  - Feasibility, time frame, costs, social and cultural impact
- Why consider only the UHF spectrum and not all suitable frequency bands and technologies?
- How can innovation in broadcast platforms, including DTT, facilitate a converged media environment of the future?

The benchmark for evaluation of a converged platform should not be the *status quo* but an evolved DTT platform within the considered time frame (until 2030), assuming a favourable regulatory environment and a sufficient amount of spectrum.

THANK YOU

FOR YOUR ATTENTION !

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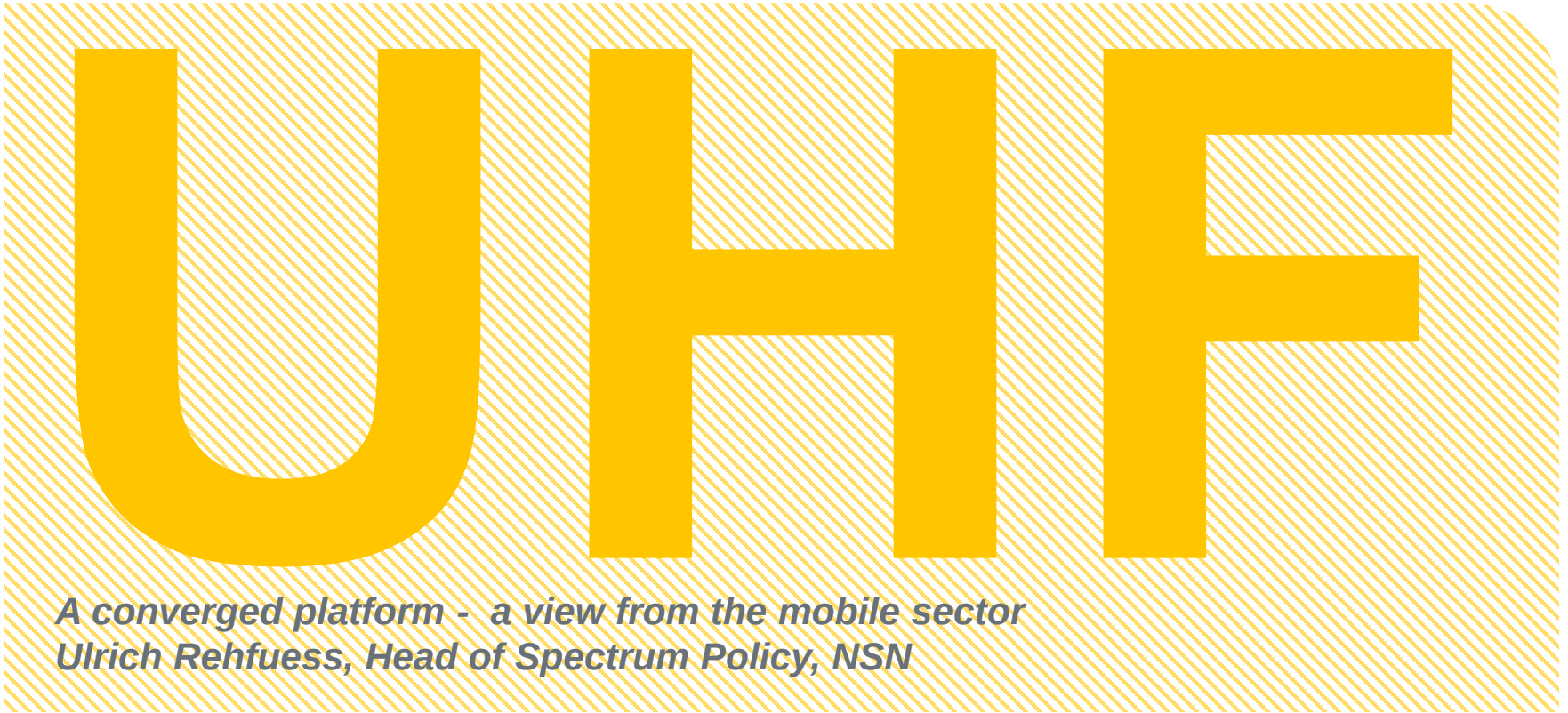
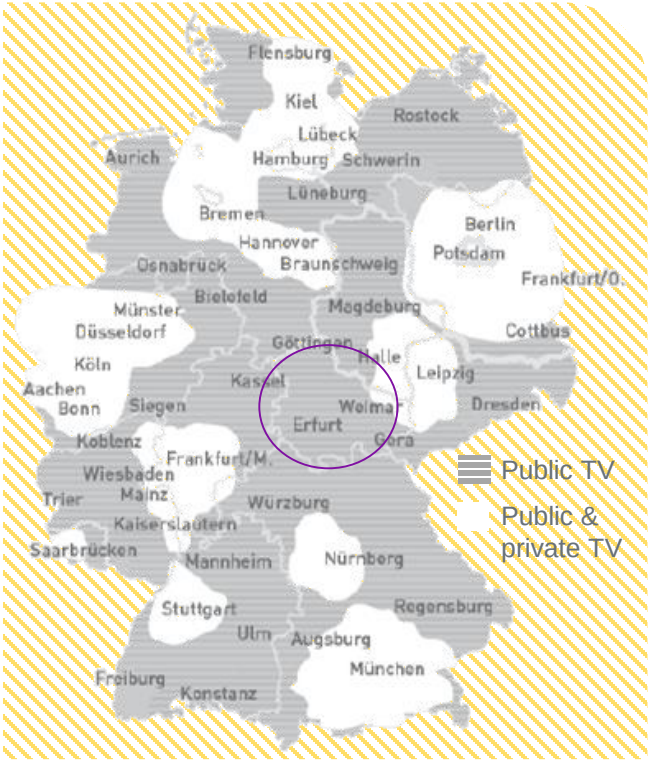
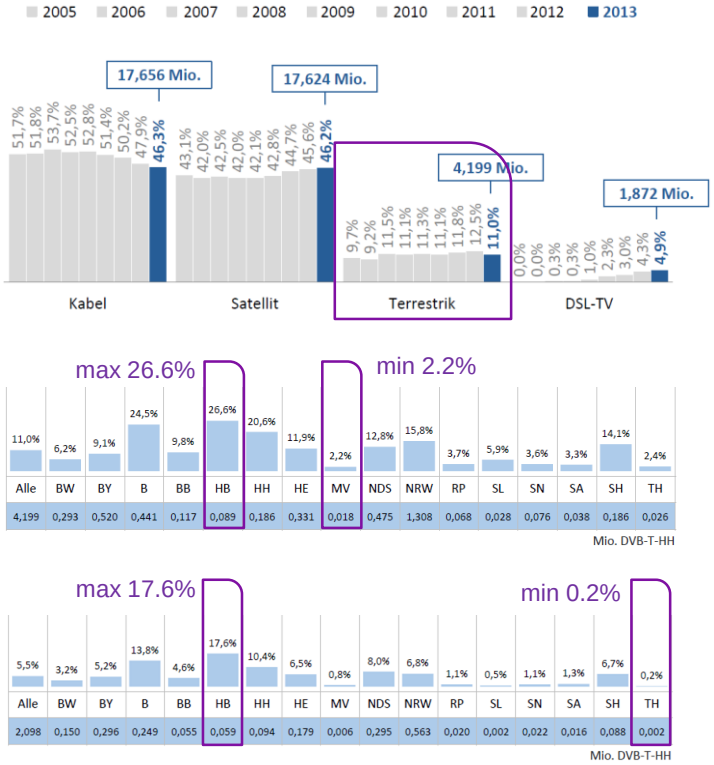


A converged platform - a view from the mobile sector

Ulrich Rehfuess, Head of Spectrum Policy, NSN

DTT use varies strongly, >50% households in several member states, but can be as low as 2000 households with DTT as primary source in Thuringia





In Germany, an average of 11% households uses DVB-T as a source for TV, 5.5% depend on DVB-T

DVB-T use ranges between 2% and 27% subject to private TV offer

Between 0.2% and 18% of the households rely on DVB-T exclusively

Source: http://www.die-medienanstalten.de/fileadmin/Download/Publikationen/Digitalisierungsbericht/2013/Bericht_Digitalisierungsbericht_2013.pdf

Any convergent platform technology needs to provide flexibility

Flexibility in terms of deployment options

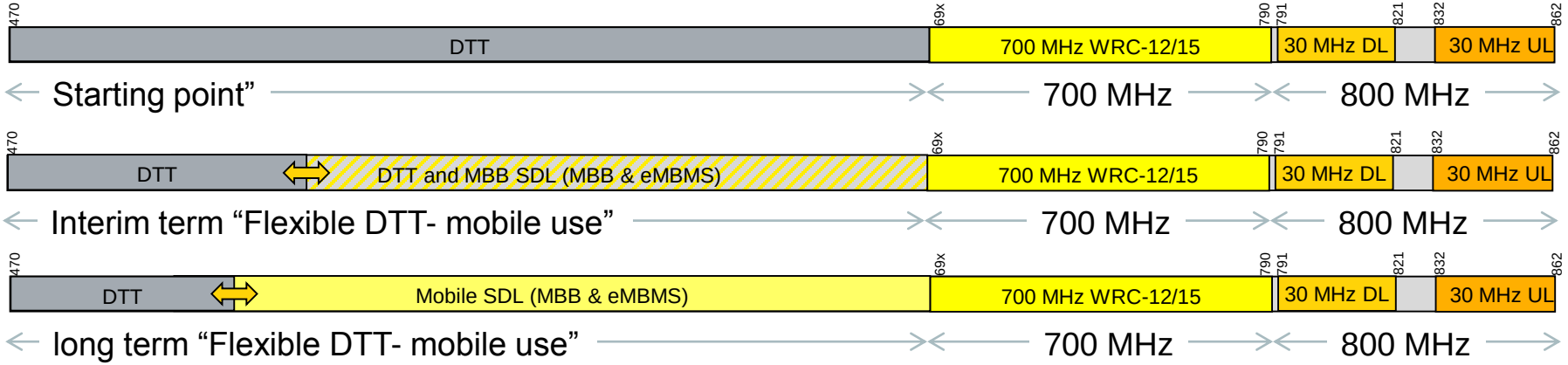
- co-existence with remaining DTT along country boarders and between regions within a country
- different pace and degree of adoption of convergence

Flexibility in terms of usage patterns

- Adaptation to e.g. increase in share of non-linear use of broadcast offer, e.g. year by year
- Adaptation to actual use of channels, e.g. channels in the long tail of the distribution can be served in unicast where more efficient
- Adaptation to extra demand for linear services e.g. during sports events (Olympic Games, Champions League), e.g. day by day or hour by hour

Supplemental Downlink (SDL)

A flexible way to introduce Mobile Broadband in the UHF band



SDL is downlink only and thus well compatible with DTT, even within Geneva-06 agreements

SDL allows for harmonised wide band RX devices to address scattered spectrum in 470-694 MHz

SDL adds DL capacity to Mobile Broadband networks via LTE-A carrier aggregation

Within SDL, eMBMS can be used to efficiently carry linear traffic, based on market demand

Vision >2020: mobile allocation in 470-698 MHz for ubiquitous video and TV across the full device range

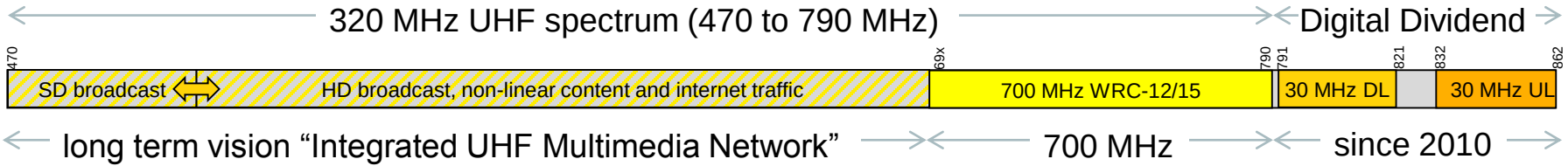
- Wide choice of linear live TV programs and individual non-linear offering consistently across multiple device types
- Full Mobility: at home not only in the living room, at the station, on the train, even underground, in the car …
- Fully interactive capabilities e.g. active participation in shows

Convergence potential of terrestrial TV and Mobile Broadband

An Integrated UHF Multimedia Network based on LTE-Advanced and eMBMS SFN *), may resolve the competition for UHF spectrum between broadcast and MBB

Rewards and challenges:

- Massively improved UHF spectrum utilisation can free the bandwidth required for digital inclusion with massive video capacity for linear and non-linear broadcast content plus internet services
- Terrestrial broadcast reach extends to smart phones and tablets, to indoors and mobile
- HD capability for terrestrial broadcast based on a global standard and latest CODECs
- Interactive TV capability for broadcast including bandwidth required for control and non-linear content
- Flexibility regarding linear vs. non-linear and internet content
- Shared infrastructure investment into existing base station sites
- Innovation potential in technical, regulatory and business model domains



*) eMBMS SFN: enhanced Multimedia Broadcast Multicast System in Single Frequency Network, efficient technology to broadcast multimedia content in LTE and LTE-Advanced networks

NSN's position on the future of UHF in Europe: two steps

700 MHz is a near term opportunity opening immediately after WRC-15

- With a band plan compatible to APT-700 3GPP Band 28, the ecosystem will be ready
- Using 700 MHz for Mobile Broadband can significantly speed up broadband delivery everywhere and massively reduce cost for DAE target of 30 Mbps

470-694 MHz opens longer term options >2020

- Stepwise introduction of Supplemental Downlink (SDL) as DTT bandwidth demand allows to
- Macro cellular infrastructure can complement DTT for mobile delivery to tablets and smart phones e.g. on suburban commuter trains & urban underground lines via eMBMS

Both require flexibility in band plans and technology to support viable migration paths and different pace in different member states

Both open innovation potential within TV, telecoms and adjacent sectors

Both require mobile allocation to kick-start innovation

More under nsn.com/governmentrelations

Thank you!

A converged platform - a view from the mobile sector

Ulrich Rehfuess, Head of Spectrum Policy, NSN
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farncombe

plum

Challenges and opportunities of broadcast-broadband convergence

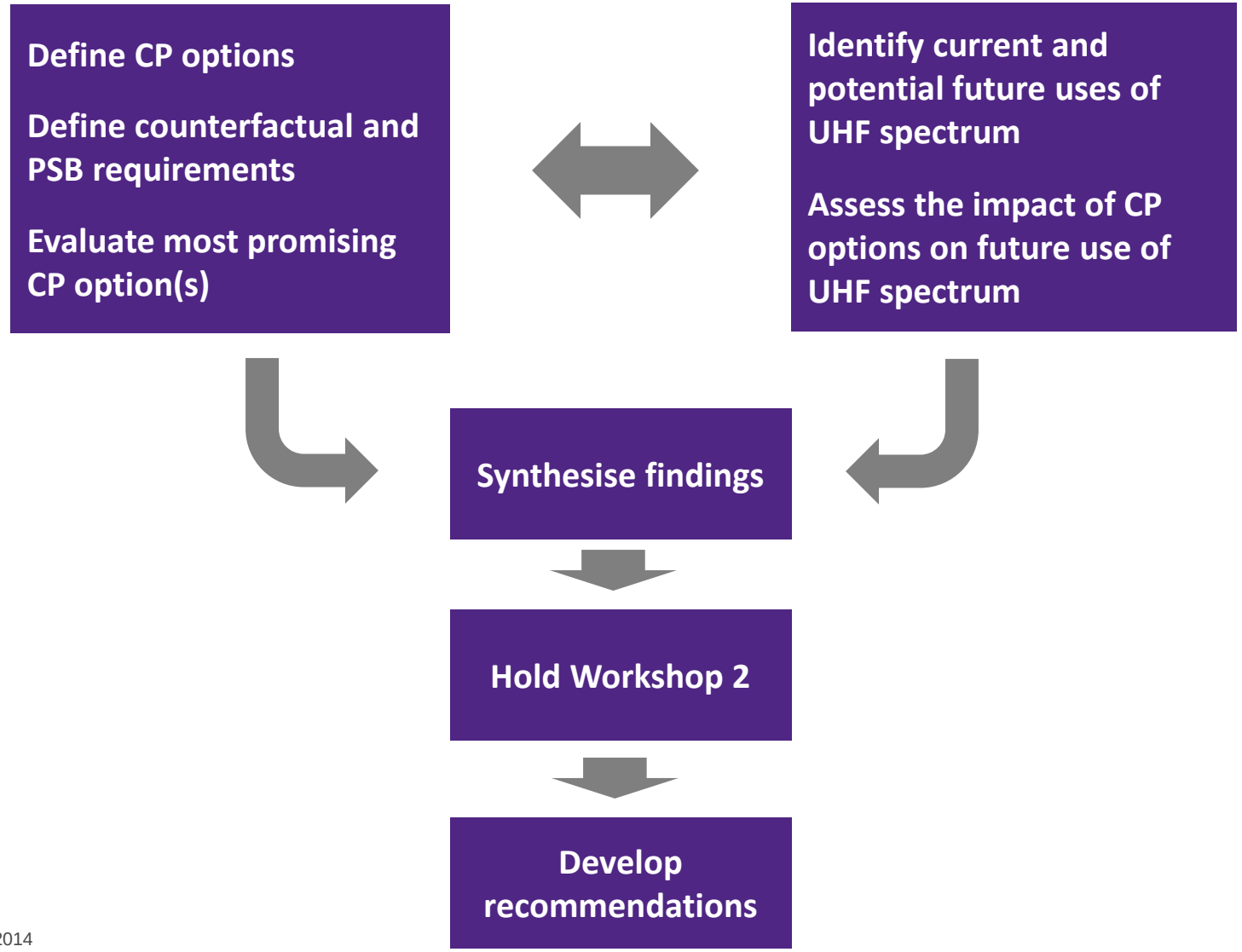
Next steps

David Lewin

First stakeholder workshop

27 March 2014

Evaluating options for a converged platform



Evaluating the proposed CP options

- What is the best transition path to the CP option?
- What is the best counterfactual in which:
  - UHF spectrum remains partitioned between broadcasting and mobile broadband
  - TV markets to 2030 develop on this basis
- What are the incremental costs and benefits of the CP option relative to the counterfactual?

The incremental costs and benefits of a CP

- Benefits of incremental revenues from:
  - Converged mobile – broadcast applications
  - Mobile TV
- Reduce cost of providing extra mobile broadband capacity with the release of more UHF spectrum

- Costs of transition to the CP:
  - For network operators
  - For end-users

??

- Ongoing savings or costs from changes in operating costs

- Other factors to consider
  - What is the impact on other incumbent users of UHF spectrum?
  - Will a move to a CP stimulate or inhibit innovation?
  - How easily can individual member states moved to a CP independently of their neighbours?
  - Will other world regions moved to a CP?
  - What are the environmental impacts?

Key questions for stakeholders

- Is the proposed evaluation process sound?
- What evaluation criteria, if any, are missing?
- Which CP options do you think are most promising?
- What evidence is there on the benefits of a CP?
- How would a move to a CP impact on existing business models
  - For mobile operators?
  - For broadcasters?
  - For other stakeholders?