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Challenges and opportunities of broadcast-broadband convergence

Workshop role and agenda

Phillipa Marks

Third stakeholder workshop

4 November 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 and 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 using a` common infrastructure
  - Broad evaluation required which takes account of other users e.g.
    - Programme making and special events (PMSE) and other incumbent users
    - Public Protection and Disaster Relief (PPDR)
    - White space devices (WSD)
- Our focus is one issue – a converged platform at UHF - but could inform the wider issue of the long term future of the UHF band

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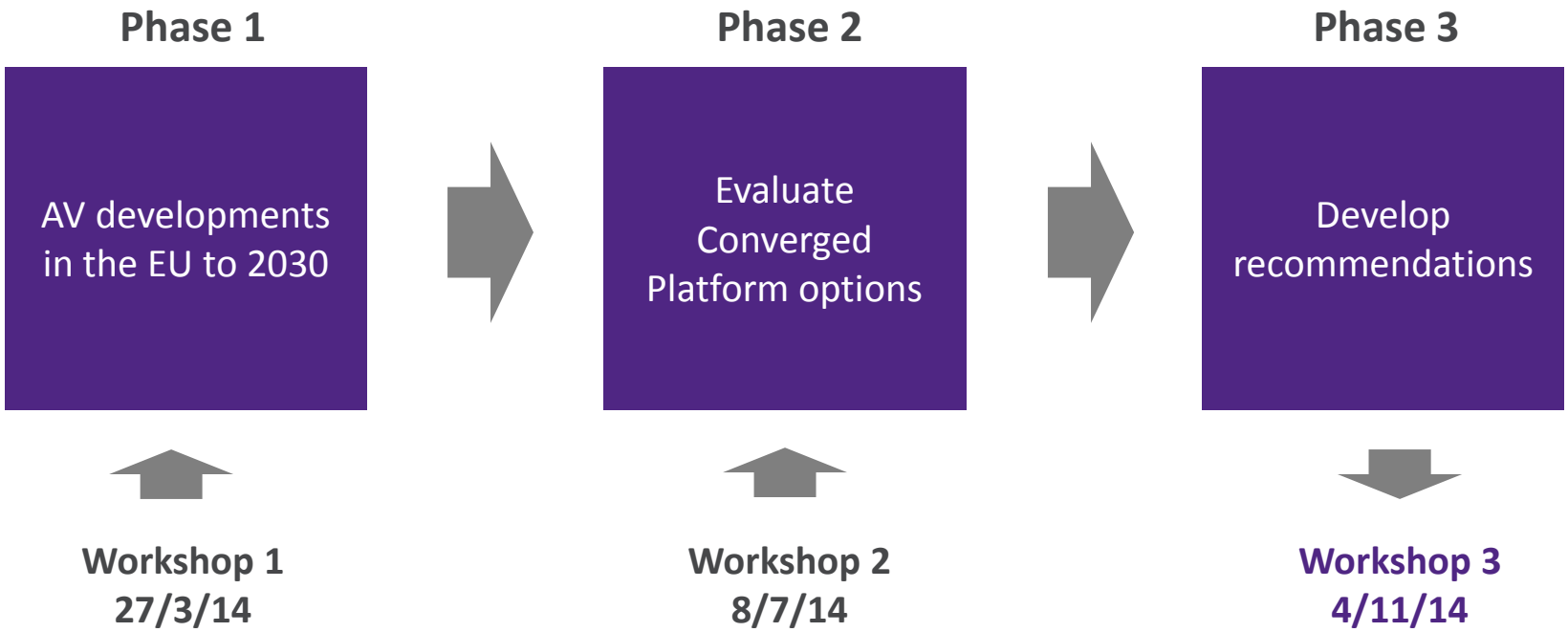
The study process and the stakeholder workshops



- Since Workshop 2: Written feedback (15 stakeholders); five additional discussions with stakeholders; refined analysis and developed recommendations
- Workshop 3: To present and discuss the overall study findings with a view to finalising our report and publishing by mid December

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The agenda for today

The building blocks

1. AV consumption to 2030
2. Converged services and a converged platform
3. Transition issues

Discussion

90 mins

Break

Findings and recommendations

4. Costs and benefits
5. Recommendations and possible next steps

Discussion

90 mins

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Challenges and opportunities of broadcast-broadband convergence

AV consumption – now and in 2030

Chris Chatzicharalampous

Third stakeholder workshop

4 November 2014

AV consumption – now

- Traditional linear TV viewing in the home dominates current AV consumption
- Current trends :
  - More supplementary viewing of non-linear OTT/broadcast content on TV
  - Growth in IPTV based households
  - Complementary OTT viewing on portable devices both in and out of home
- Big variation in how AV content is delivered and consumed by Member State
  - Platform mix, market structures and rates of change
  - State of the DTT platform eg:
    - % HH with DTT as primary platform varies from 4% to 80%
    - Variation in plans to move to DVB-T2
- Lack of coherent and consistent measurement across member states for non-traditional video consumption hinders ability to verify trends

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Technology trends

- Big improvements expected in price/performance of fixed broadband when compared with traditional TV broadcast networks
- Strong demand for personalised unicast video over mobile broadband but:
  - Cost of unicast mobile video likely to remain 1 to 2 orders of magnitude higher than for fixed broadband
  - This limits the role of unicast mobile video in enhancing and substituting for traditional broadcast platforms
- Wi-Fi will play a central role in changing AV consumption patterns:
  - New AV distribution patterns around the home
  - Cheap substitute for unicast mobile video both in and out of the home

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AV consumption – 2030

- Likely developments include:
  - Fixed broadband playing a central role for the delivery of AV content
  - Enhanced broadcast platforms through hybrid services
  - Substitution of broadcast by broadband platforms in many member states
- Big uncertainties over patterns of AV consumption in 2030
  - Consumers switching from linear to on-demand viewing?
  - DTT retaining its market share or being displaced by OTT/IPTV platforms?
  - Tablets replacing TV sets for secondary viewing in the home?
  - Balance between AV consumption on portable devices out of home and AV consumption in the home?

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The use of scenarios

- To deal with these uncertainties in later analysis we have:
  - Constructed four high-level scenarios for possible AV consumption by 2030
  - Considered the merits of a converged platform under each of these scenarios
- Each scenario describes the possible set of market outcomes by 2030 in an internally consistent way
- The scenarios:
  - Together span the range of outcomes which reasonably likely
  - Aim to capture the key drivers which would impact the merits of moving to a complete platform
  - Represent the position in a typical state
- Individual member states will develop at different rates and may move towards different scenarios

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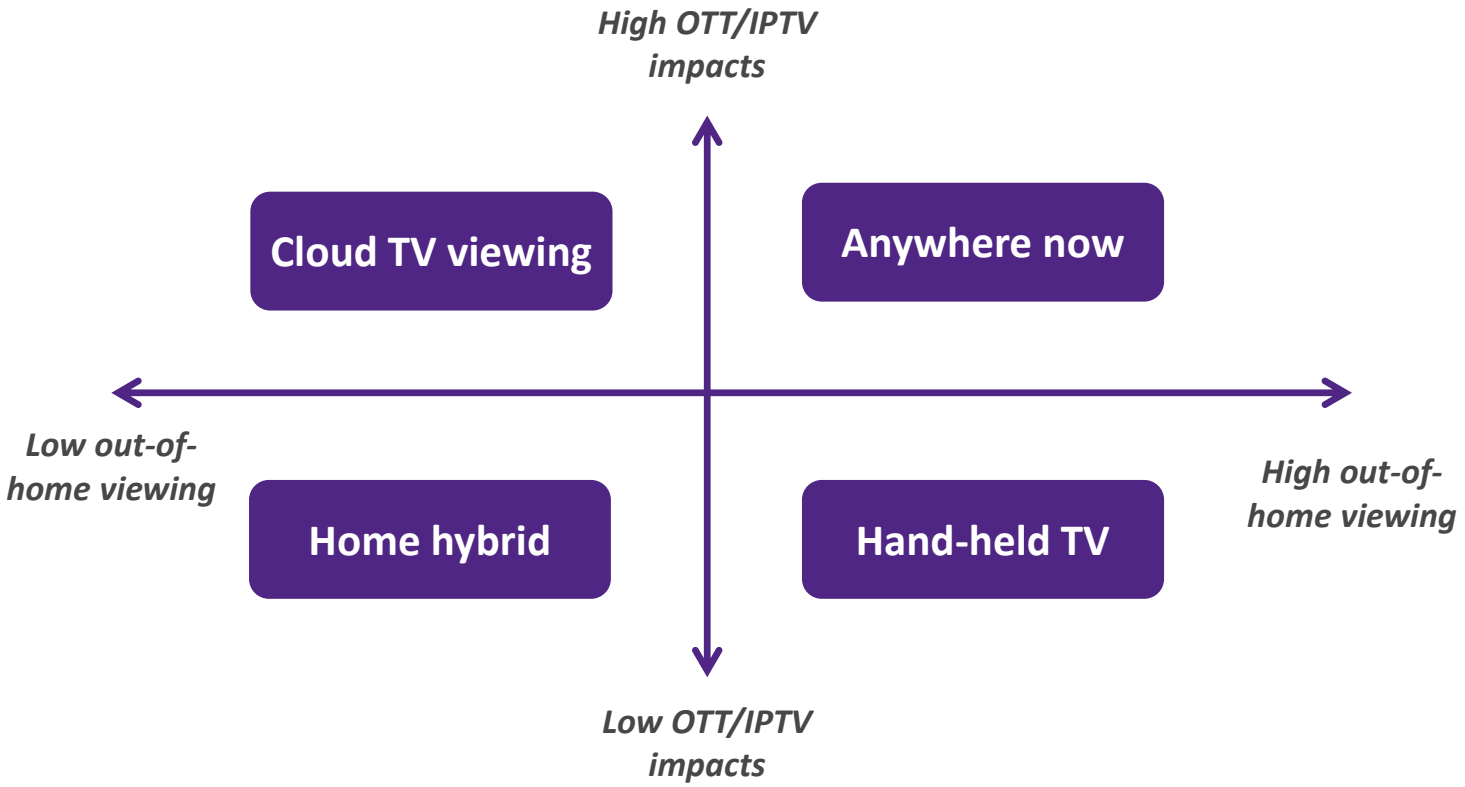
The four scenarios for 2030 - 1



- High OTT/IPTV impact – 70% reduction in DTT HH by 2030
- Low OTT/IPTV impact – 10% reduction in DTT HH by 2030
- High OOH viewing – 40 minutes/day/person OOH viewing on portable devices?
- Low OOH viewing – 20 minutes/day/person OOH viewing on portable devices?

The four scenarios for 2030 - 2

- Home hybrid:
  - Limited changes from current patterns – demand remains largely in the home
  - Fixed broadband based services supplement rather replace DTT
- Cloud TV viewing:
  - Demand remains largely in the home but
  - Strong substitution of DTT by fixed broadband based services
- Handheld TV:
  - Hybrid TV services very successful but
  - Move to portable devices for consumption both inside (Wi-Fi) and outside the home (preloaded, DVB receivers, unicast mobile)
- Anywhere now:
  - Most disruptive of the scenarios
  - Strong substitution of DTT by fixed broadband services and strong growth in viewing on portable devices on the move

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Challenges and opportunities of broadband-broadcast convergence

Converged services and a converged platform

David Lewin

Third Stakeholder workshop

4 November 2014

Levels of broadcast-broadband convergence - 1

- The growing role of broadband services in AV consumption will lead to:
  - Substitution effects (last presentation)
  - Convergence effects (complementary combinations of broadcast and broadband services)
- Four main types of broadcast-broadband convergence
  - **Content** convergence at the device level: allows users to view broadcast and broadband AV content on the same device
  - **Application** convergence at the device level: allows users to view broadcast and broadband AV content over the same user interface on the same device
  - **Service level** convergence: allows end users to access the same (linear and non linear) AV content seamlessly on multiple devices
  - **Infrastructure level** convergence: uses the same infrastructure to deliver broadcast and broadband services to end users

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Levels of broadcast-broadband convergence - 2

Convergence level	Examples	Market status
Content convergence	Connected TVs for fixed broadband and broadcast delivery of AV content	Extensive deployment already
Application convergence	EPG which integrates catch up and broadcast TV Search for both linear and non-linear content Interactive applications for more active viewer participation and targeted advertising	Focus on main TV sets so far – using fixed broadband and broadcast inputs
Service level convergence	Streaming video content between in-house devices	Full deployment so far limited by investment required and uncertainty over market demand
Infrastructure level convergence	IPTV and cable-based services	Extensive deployment over fixed (but not mobile) networks broadband

- Convergence currently focused on combining broadcast and **fixed** broadband
- Should infrastructure level convergence be expanded from fixed broadband to mobile broadband via a converged platform?

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Levels of broadcast-broadband convergence - 3

- Content, application and service level convergence will probably succeed or fail through normal market mechanisms
- Infrastructure level convergence likely to need public policy interventions given current regulatory constraints on the changes required.
- So need to assess economic merits of the converged platform before committing to any such interventions
- Assessment needs to take account of the fact that convergence at device and service level is possible without converged platform and….
- …. a significant proportion of the benefits of converged services can be captured without implementing a converged platform.

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Requirements which a converged platform should meet

- Use sub-700 MHz UHF spectrum:
  - Supra-700 MHz is moving to mobile
  - VHF spectrum not available or not viable (given lack of suitable household antennas) in many member states
- Provide TV broadcast services which offer:
  - Near universal free-to-air coverage (to preserve the European AV model)
  - An adequate number of TV channels (assume varies by member state from 60 to 180 Mbps payload)
- Provide two-way mobile broadband services
- Free-up substantial amounts of sub-700 MHz spectrum to create incremental benefits which might justify the cost of transition

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The five options considered

Topology	Broadcast DL	Unicast DL	Unicast UL	Evaluate?
LPLT	DVB <700	LTE <700	LTE >700	Yes
HPHT	LTE-B <700	LTE >700	LTE >700	No – limited opportunities for spectrum release
LPLT	eMBMS <700	LTE <700	LTE >700	No – eMBMS not suitable for rural TV broadcast
LPLT	LTE-B <700	LTE <700	LTE >700	Yes
LPLT	LTE-B <700 or more	LTE <700	LTE <700	No – coexistence problems with UL <700 MHz

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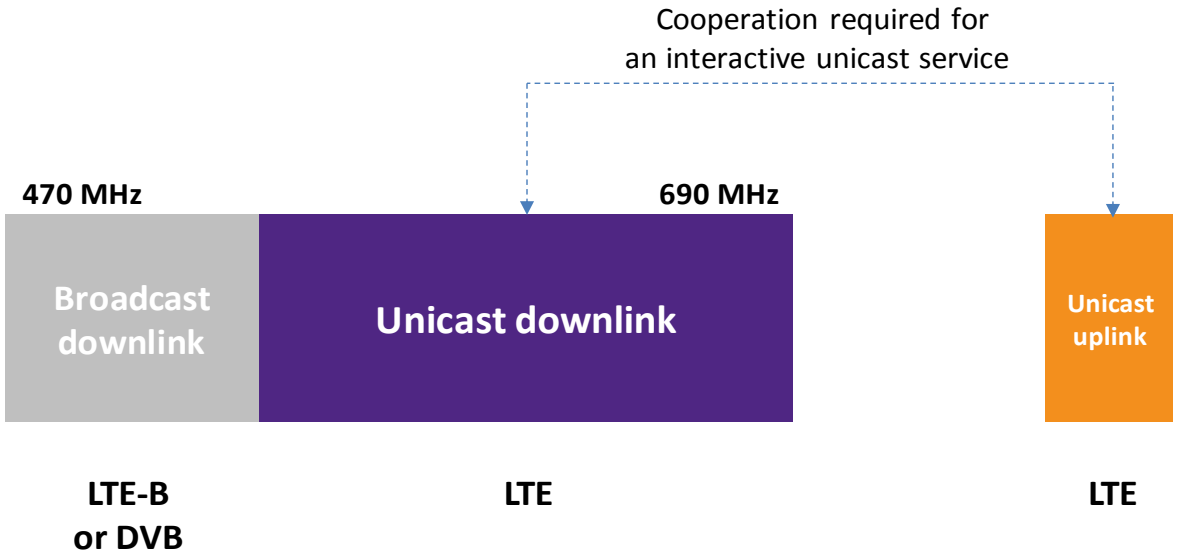
The options for evaluation



- Both selected options allow for a range of business models for the licensing of sub-700 MHz spectrum and the delivery of converged services eg:
  - Single operator for both broadcast and unicast DLs
  - Single operator for broadcast DL and single operator for unicast SDL
  - Single operator for broadcast DL and multiple operators for unicast SDL
- All require access to supra-700 MHz spectrum for uplinks to make sub-700 unicast SDL interactive

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Challenges and opportunities of broadcast-broadband convergence

Moving to a converged platform

William Webb

Third stakeholder workshop

4 November 2014

Spectrum constraints on moving to a converged platform

- A converged platform would use sub 700 UHF MHz spectrum with down links only (see last presentation)
- We do not expect transition to occur before 2025 given timing of:
  - Move of 700 MHz band to mobile use
  - Transition to DVB-T2 by DTT in many member states
  - Need for permanent solution for PMSE audio
- Such a move might displace other incumbents:
  - **PMSE audio**: Loss of spectrum access at UHF a problem especially in large cities. Will require additional band(s) for this this service – probably between 1-2GHz - but at a cost
  - **Cable**: We anticipate means of shielding cable networks from interference will continue to be developed
  - **Radio astronomy** and **wind-profiling radars** : Only used in a few locations so could be worked around
  - **PPDR**: Unlikely to be deployed in these bands before any transitional arrangements
  - **White space devices**: No specific protection offered and other bands may be used for this application

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Anticipated spectrum release

- We assume:
  - A TV broadcast payload varying between 60 and 180Mbits/s from country to country
  - A spectrum efficiency varying between 2bits/s/Hz for LTE-B to 3.5bits/s/Hz for DVB-T2
  - SFNs used throughout a country with border re-alignment and antenna re-orientation at the boundaries of regional content areas
  - Additional strips of frequencies between countries as required
- This leads to a release of between 110MHz and 170MHz
  - Further research is needed to confirm the assumptions made and provide more certainty to these figures
  - Less spectrum is available in border regions up to ~10km away from the border
  - May also need downward adjustment to compensate for reduced antenna performance at base stations where single antennas preferred across sub-1GHz bands

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The transition process is complex

1. Upgrade the LTE standard to LTE-B (LTE option only) and wait for (or stimulate) equipment availability to upgrade TV sets etc (LTE option only)
2. Equip LPLT sites with the necessary transmitters and backhaul capacity. This might require upgrades to ~1/3 of macrocell sites of one mobile network
3. Set aside simulcast UHF spectrum for use by the converged platform alongside the spectrum used by the HPHT DTT platform
4. Carry out frequency coordination to avoid cross-border interference with neighbours
5. Switch on the national LPLT broadcast transmission
6. Initiate a (publicly funded) programme to upgrade end-user equipment from DVB to LTE receivers (LTE option only)
7. Test the need for aerial realignment to receive the LPLT broadcast transmission and provide realignment support as required
8. Progressively switch off the HPHT DVB transmission

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Finding simulcast spectrum is hard

- We believe it will be necessary to simulcast (both HPHT and LPLT) for several years while antenna realignment and other adjustments are made
- This requires additional spectrum, especially if all services are provided on both HPHT and LPLT platforms
- We assume that the 700MHz band will already have been vacated by broadcasting
- There will be cross-border constraints on the use of the remaining spectrum
- It may not prove possible to find enough simulcast spectrum - especially in member states with a TV payload of 180 Mbit/s (6 muxes)
- Even where it is possible, costly retuning of the HPHT transmitters may be needed to create a temporary band for the LPLT transmission
- A pan-European planning round may be needed to coordinate all this
- Estimates of these costs are included in our cost benefit analysis

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The DVB and LTE-B options compared

- The DVB option has two main advantages over the LTE broadcast option:
  - There are no upgrade costs for TV receivers
  - DVB offers potentially higher spectrum efficiency (>3.5 bits/Hz compared to >2 bits/Hz for LTE). This makes migration easier and increases spectrum release
- The LTE broadcast option has three main advantages over the DVB option:
  - A single technology means lower cost networks and end user equipment
  - A single technology means less processing required for broadcast-broadband integration of services
  - It may be easier to reassign spectrum between broadcast and broadband use as market demand changes

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Summary

- The spectrum which is potentially available for a converged platform is the 470-694 MHz frequency range
- Implementation of a converged platform would not be practicable before 2025
- The problem of spectrum for PMSE audio has to be solved
- The move to an LPLT converged platforms based on a national SFN or co-channel regional SFNs could free up between 110 and 175 MHz
  - Such a topology could support extensive regional broadcasting if regional co-channel SFNs are possible
- Moving to an LPLT converged platform creates challenges both in terms of cross-border interference and finding the simulcast spectrum required
  - It may be impossible to find the required simulcast spectrum for a member state with a high TV traffic load without a substantial temporary reduction in the TV payload
- Significant effort is also required to mitigate cross-border interference – especially in the member states which first move to a converged platform.

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The cost benefit analysis

David Lewin

Third Stakeholder workshop

4 November 2014

Our approach

- Estimate the costs and benefits of the two options for LPLT converged platform relative to a counterfactual (CF) in which:
  - Sub-700 MHz spectrum is exclusively used by HPHT DTT network for DVB TV broadcast
  - There is commercial cooperation between TV broadcasters and mobile operators to develop broadcast-broadband converged services
- Calculate the NPV of these incremental costs and benefits:
  - At a 4% discount rate over 20 years with costs and benefits all at 2014 prices
  - For a hypothetical member state with 20 million people and a population density of 250 people per sq km
- Carry out sensitivity analysis for:
  - Uncertainty in parameter values
  - Size and population density of member states

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The benefits of a converged platform

Potential benefit	Incremental benefit vs CF?	Quantification/comment
1. Spectrum release for unicast downlink	Yes	110 to 175 MHz at €0.1 to €0.4 per MHz pop
2. Delivers near universal FTA broadcast	No	Benefit also offered by CF
3. Enables personal unicast mobile video	No	Counted already in spectrum release benefit
4. Enables eMBMS	No	eMBMS development possible under CF
5. Better linear TV on mobile devices	Possibly	Evidence to date shows benefits are small
6. Easier integration of linear TV and personal unicast mobile	Possibly	Value of integration still uncertain – even for fixed broadband and broadcast High % of such benefits possible under CF

We just count the spectrum release benefits

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The costs of a converged platform

- Three main cost components:
  - The cost of building and operating the LPLT network (less the cost of operating the HPHT network)
  - The transition cost of ensuring end-users can use new platform:
    - Converting TV receivers (LTE option)
    - Re-orienting TV aerials (both options)
  - Transition costs of freeing simulcast spectrum and dealing with cross-border interference
- These costs vary substantially depending on:
  - The characteristics of individual member states in terms of current DTT household penetration
  - The impact of OTT and IPTV on demand for DTT over the next 10 to 15 years
  - The option chosen (DVB vs LTE)

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The NPV of the costs and benefits compared - 1

The costs are uncertain and vary by member state

The benefits are uncertain because the value of sub-700MHz is currently uncertain

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The NPV of the costs and benefits compared - 2

Under what circumstances do the benefits exceed the costs?

Benefits assumed at	Lower limit		Mid-point value		Upper limit	
OTT/IPTV impacts	**Low**	**High**	**Low**	**High**	**Low**	**High**
Central case (120 Mbps)	No	No	No	Yes	Yes	Yes
Low TV payload (60 Mbps)	No	No	Yes	Yes	Yes	Yes
High TV payload (180 Mbps)	No	No	No	Yes	Yes	Yes
DVB rather than LTE option	No	No	Yes	Yes	Yes	Yes
10% DTT HH in 2014	No	No	Yes	Yes	Yes	Yes
70% DTT HH in 2014	No	No	No	Yes	Yes	Yes

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The impact of qualitative factors

- Factors which might **strengthen** the case for a converged platform
  - LPLT DTT network offers greater flexibility in terms of:
    - Lower cost of change to meet evolving market requirements for broadcast TV
    - Better able to take advantage of daily variations in TV payloads to release spectrum for unicast downlinks
- Factors which might **weaken** the case for a converged platform
  - Reduces reliability of TV broadcast service (but is it good enough?)
  - Challenging to meet ICNIRP RF emission limits without incurring significant additional costs?
  - Higher transmission costs for radio broadcasters?

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Conclusions – 1

- The economic case for a converged platform is not yet made – net benefits might be positive or negative
- Big market uncertainties (which might largely be resolved by 2020):
  - Value of sub-700 MHz spectrum release
  - Impact of OTT/IPTV on demand for HPHT DTT
- Significant other uncertainties still unresolved:
  - Will co-channel SFNs work with an LPLT topology?
  - What would be the impact of ICNIRP limits on radio emissions?
  - Would TV payload need to be reduced to create the necessary simulcast spectrum?
  - What are the costs of upgrading mobile macro cells to create an LPLT DTT network?

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Conclusions – 2

- This uncertainty points to:
  - A further review in 3 to 5 years when market uncertainty is reduced
  - Further work on key parameters/technical issues to remove uncertainty.
- Need to use any future review to consider other options in parallel with LPLT converged platform e.g.
  - The flexibility option proposed by Lamy
  - A single national HPHT SFN (with more limited regional broadcasting?)
  - A mix of free-to-air satellite DTH and IPTV
- For example FTA satellite is more cost-effective than an LPLT converged platform – but an imperfect substitute

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Conclusions and possible next steps

Phillipa Marks

Third Stakeholder workshop

4 November 2014

Our recommendations identify broad areas where further work is required

- **Issue**: *Viewing of linear and OTT audio-visual services are not measured consistently or on a EU-wide basis. There is no reliable data on viewing in and out of home, on fixed vs portable devices and between WiFi and portable devices.*
- **Recommendation 1:** The Commission and industry should consider how best to develop and implement comprehensive metrics for measurement of video consumption, which are consistent across EU member states over time, so as to inform future policy decisions.
- **Issue**: *A converged platform requires an broadcast capability. We have not identified any initiatives to define broadcast capabilities for 5G.*
- **Recommendation 2:** The broadcast community should provide relevant guidance to 5G research programmes. Broadcasting and 5G communities might research:
  - The viability of a broadcast capability in 5G networks at low incremental costs
  - Ways of integrating existing HPHT broadcast networks into 5G heterogeneous networks (which may include LTE, WiFi and other networks)

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Areas where further work is required- 2

- **Issue:** *Future spectrum access for PMSE audio given likely loss of access to sub 700MHz caused by a converged platform and anticipated growth in requirements especially in major urban areas*
- **Recommendation 3:** The relevant spectrum authorities should specify a long-term spectrum home for PMSE audio services, including whether to reserve part of the UHF band for PMSE
  - EC Decision identifies 800MHz, 1800MHz centre gaps to address 800MHz migration
  - Many bands in the range 1-2 GHz are under consideration by individual member states to address 700MHz migration and future requirements
- **Issue:** *The benefits of a converged platform depend crucially on spectrum release which in turn depends on being able to implement co-channels SFNs*
- **Recommendation 4**: The broadcast and mobile communities should investigate further the feasibility and cost of implementing co-channel SFNs.
  - Studies by the BBC and ATDI (for Qualcomm) give very different simulation results in terms of interference and costs

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A further review in 3-5 years

- **Recommendation 5:** The Commission should initiate another review to reassess the merits of a converged platform in three to five years from now. The review should examine all options for use of sub-700MHz spectrum not just a converged platform
- Our proposed timescale is shorter than proposed by Lamy. It is determined by:
  - 700MHz auctions in next 3-5 years will give information about value of sub-700MHz spectrum
  - Impacts of convergence in fixed environment should be much clearer in 3-5 years
  - Work in the areas identified above will help reduce uncertainty in cost-benefit analysis
- **Recommendation 6:** Those carrying out such a future review should resolve uncertainties in CBA parameters and technical assumptions.
  - Reliability of a LPLT network; Safe emission limits; finding spectrum for simulcasting; costs of upgrading macro-sites to provide a LPLT converged network

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Subsequent steps if a future review is positive

- Develop the (LTE) mobile broadcast standard that
  - Minimises interference between adjacent rural base stations (longer cyclic prefixes)
  - Removes limits the proportion of a carrier that can be used in SDL mode
  - Allows free-to-view broadcasts
- Review national regulations governing DTT platforms e.g. those imposing technical, coverage and other restrictions on UHF spectrum use and requiring broadcasters to use the DTT platform
- Develop commercial and licensing models
  - Who may run a converged network and with what spectrum?
  - What role might government have in enabling commercial models?
- Develop the necessary spectrum management and frequency coordination arrangements e.g. a band plan, arrangements for incumbents and bi-lateral and possibly EU-wide co-ordination arrangements

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Factors that affect possible role of EU institutions

- There would be benefits from an EU-wide commitment to a move to a converged platform in terms of spectrum co-ordination and release, equipment production and EU-wide service provision
- This needs to be weighed against the following considerations:
  - Diversity of audio-visual markets may point to the need for a flexible approach to implementing a converged platform
  - National content rights may limit the availability of services on an EU-wide basis
  - Industrial policy benefits could be limited as other world regions have not yet shown any interest in a converged platform

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