Abstract

This article examines the appisation of television: the emergence of apps as a mainstream means of delivering television services/content through smart TVs, connected devices, smartphones and tablets. Exploring the interrelationships between TV content, discovery and aggregator apps, the article demonstrates how content/software providers, device manufacturers and infrastructural platforms vie to control our access to and experience of television in a market underpinned by datafication, commodification and selection. This control is enacted within a multidimensional software, device and platform ecology where discoverability is central because it determines which content, services and apps are most prominent, accessible and easy to find.

Keywords

Launching the new Apple TV digital media player in 2015, Tim Cook (Apple CEO) claimed that 'the future of TV is apps' (cited in Briel, 2015). Cook's pronouncement may seem surprising given that apps are most commonly associated with smartphones and tablets, while the vast majority of television viewing (in the UK and US) takes place on a TV set.[1] However, over the 2010s the TV set has been transformed. Smart TVs and connected devices that attach to the TV set (such as digital media players, set-top boxes and games consoles) deliver on-demand and online TV services via apps, making apps a pivotal component of the contemporary television ecosystem.[2] Despite this, apps rarely feature in the growing body of academic literature on internet-connected and online TV.[3] At the same time, the majority of academic work on apps focuses on mobile devices and neglects the rise of apps delivered and accessed through the TV set.[4] Apps, as a form of 'mundane software' (Morris and Elkins, 2015: 65), have insinuated themselves into our quotidian television viewing habits so seamlessly that their role in our contemporary media ecosystem has been overlooked. This article argues that focusing attention on the appisation of television – that is, the emergence of apps as a mainstream means of delivering television services and content – is essential if we are to understand both the transformation of television by the internet and the wider industrial, economic, social and cultural impact of apps.[5]

In focusing on the appisation of television this article aims to contribute to a growing body of academic research concerned with the impact of the internet on the distribution of television (see, for example, Johnson, 2019; Lotz, 2014, 2017). At the heart of this transformation is the changing hardware and software through which television content and services are delivered to, and accessed by, viewers. David Hesmondhalgh and Ramon Lobato (2019: 967) argue that in the internet era television is situated within a 'device ecology' characterised by a proliferation in the number and combination of devices used to watch television. They write,

> when accessing internet television services some households only use a smart TV; others will use a "dumb" TV with an attached STB [set-top box] or streaming media player; others will have a full range of peripherals including smart TV, streaming

media player, STB, smart speakers; and so on. Each combination of devices

introduces specific issues of interoperability and integration. (2019: 966)

Hesmondhalgh and Lobato go on to argue that the device ecology of internet TV raises important questions related to prominence and privacy. Devices can shape which content and services are most visible, whether through preloading or prioritisation within the device's interfaces. At the same time, devices routinely gather data concerning user behaviour, often without our knowledge. As viewers range across a potentially complex array of separate and integrated devices the industry is engaged in a battle to control the content and services offered and the user data generated.

The internet-connected devices used to access television depend on, and are shaped by, software programmes. Lev Manovich (2014: 189) has argued that 'Software has become our interface with the world [...] a universal engine on which the world runs.' Once television is accessed on internet-connected devices (from connected TVs to tablets and smartphones), software also becomes the engine on which television runs. The increasingly central role of software to the television industry has been noted in some of the academic literature on internet television (Evens and Donders, 2018; Robinson, 2017; Wilken et al., 2011). There has also been valuable work examining the role of interfaces in shaping the experience of television in digital and online environments (Chamberlain, 2010, 2011; Johnson, 2017, 2019; Sanson and Strierer, 2019). However, this literature rarely interrogates the nature of internet-related software, failing to examine the differences between apps (for example) and other forms of internet-related software, such as HTML. Furthermore, software tends to be treated in this literature as a static form in ways that overlook the changes to computer software since the mid-to-late-2000s when internet-delivered television began to be more widely adopted in developed media economies. Yet, as we shall go on to see, internet-connected television emerged at a specific moment in the history of software in which apps were altering the nature and structure of the software upon which the internet runs. If the internet era marks a moment of convergence between television and the internet, this is a convergence that takes place in the wake of changes to the internet itself that have an impact on how we understand the meaning of *internet*-connected television. In particular, apps are inculcated not only into the emergence of a

new device ecology for television (and the internet) but also in relation to the development of a broader platform ecology that has, and continues, to play a profound role in shaping the nature, structure and operation of the internet. Focusing on the appisation of television, therefore, situates the development of internet-connected television in relation to the broader software, device and platform ecologies that have emerged since the late-2000s.

This article draws primarily on secondary research from television, internet, software and media studies about developments in internet-connected television, apps and platforms. This is combined with analysis of trade press and examples drawn largely from the UK and USA, two countries with advanced online TV industries. Apps are understood here, not simply as new means by which organisations seek to deliver television content to viewers, but also as indicative of the shifting strategies of media and technology companies as they adapt to the economic and industrial realities of the emergent internet-TV marketplace. Through this analysis the article identifies three different kinds of TV app that speak to the ways in which contemporary television is situated at the intersection of new device, software and platform ecologies: content, discovery and aggregator apps. In doing so, this article argues that control over content, viewers and data, through which it is possible to exert influence over the prominence and discoverability of programmes and movies, is at the heart of the appisation of television. It is important to note, however, that this analysis is drawn from Western developed economies with large and advanced television and internet markets. The appisation of television will not play out in the same way in all countries and it is necessary for there to be more research that offers comparative and alternative accounts of the ways in which television is being transformed by the internet around the world (Lotz, Lobato and Thomas, 2018).

The device, software and platform ecologies of (TV) apps
Although the term app had gained widespread use in the tech industry by the early 1980s (Morris and Elkin, 2015: 68), it was with the launch of the iPhone in 2007 that apps gained broader salience (Morris and Murray, 2018: 4). For Jonathan Zittrain (2008) the launch of the iPhone marked a pivotal moment in the history of the internet in which 'generative PCs attached to a generative network' were threatened by 'sterile *appliances* tethered to a network of control.' For Zittrain (2008: 70), technologies like the PC can be understood as

generative because of their 'capacity to produce unanticipated change through unfiltered contributions from broad and varied audiences.' By contrast, 'information appliances' like the iPhone are non-generative because they restrict usage to that which the manufacturer envisioned (Zittrain, 2008: 109-10). Since Zittrain was writing in 2008, there has been an expansion of information appliances that connect to the internet, such as smartphones, tablets, smart TVs, digital media players and games consoles. Central to the ways in which these information appliances operate as 'tethered' devices is through their use of apps. The apps made available through information appliances are standalone and self-contained software applications designed to perform specific functions. In contrast to the 'openness, interconnectivity, and accessibility [that] were fundamental characteristics of "Web 1.0"', apps silo users and content into specific, contained spaces (Daubs and Manzerolle, 2016: 53).[6]

This can be illustrated by comparing the experience of accessing television programmes through a website and through an app. Most online TV services available as apps are also provided as websites. For example, the BBC's VOD service, iPlayer, can be accessed as an app on smartphones, tablets, smart TVs, digital media players, STBs and games consoles, but is also accessible through the BBC's website, bbc.co.uk. Although the interfaces of BBC iPlayer are almost identical on its web and app versions, there are important differences to each. The website version of BBC iPlayer consists of browser-based HTML pages that contain images, texts, data and video. The different pages of the website version of iPlayer are hyperlinked, allowing the user to browse within the service and to follow links to other parts of the BBC's webpages or even to sites outside of the BBC's online domain. By contrast, the iPlayer app is a specific package of code that has to be downloaded by the user to a device (or information appliance, to use Zittrain's terminology), such as a smartphone, tablet, games console, smart TV or digital media player.[7] Andrew Gazdecki (2016) argues that apps invite a more direct relationship between user and provider than websites because users have to make a specific decision to download an app and, once downloaded, apps can offer users alerts and notifications. Although websites are available in near-real time, apps can perform actions faster by storing data locally on the device to which they are downloaded. This also enables them to be used offline. For example, the iPlayer app enables users to download certain programmes which can be viewed without

access to the internet. Unlike the iPlayer website, the iPlayer app is not connected through hyperlinks to other parts of the web and serves a singular function – facilitating the viewing of audiovisual content. Once opened, the entire screen of the information appliance is dedicated to the functionality of the iPlayer app. Although the design of the app and website versions of BBC iPlayer might appear identical on the surface, there are crucial differences at play here. In contrast to the hyperlinked interconnectivity of websites accessed through browsers, the iPlayer app operates as an enclosed site that contains users within a space specifically for viewing television.

Apps are transformative not simply because they offer a new way of organising and accessing the internet, but because they have ushered in a broader commodification of the web and the internet. Michael Dieter et al. (2019: 1) write that, 'Contrary to the Web, which was originally imagined as a shared information space (Berners-Lee, 1996) and only later turned into a commodified space, apps were conceived as informational commodities from their inception.' As a consequence, the rise of apps 'is inextricably linked to the evolution of the internet from an open web to a controlled distribution channel for proprietary data' (Vonderau, 2018: 24). Where Zittrain's 'generative' internet depends on the openness of software, the source code of apps is not easily accessible beyond the programmer (Dieter et al., 2019: 7-8). The greater reliability and more consistent functionality that apps offer over programs accessed on the web (Matviyenko, 2014: xviii-xix) comes at the expense of the ability for the software to be modified by third parties. As a consequence, apps 'limit and control software's long-standing status as a free and hacked good and give it a more standardised articulation as a commodity' (Morris and Elkin, 2015: 70).

Apps, therefore, position software as commodities that are embedded into everyday routines and designed not to be engaged with as software (hacked, altered or tinkered with) but to facilitate specific experiences – from finding a place to eat, to messaging a friend, to watching television. Apps are, therefore, 'first and foremost operational media; they are applications, things for doing' (Dieter et al., 2019: 5). In this sense, apps facilitate the emergence of what Søren Bro Pold and Christian Ulrik Anderson (2014: 17) refer to as the era of 'cultural computing' in which 'cultural content – music, games, social and cultural software – are at the very backbone' of a new range of information appliances, from games

consoles and smart TVs to tablets and smartphones. Apps are the software engines upon which cultural content is delivered to information appliances, expanding the market for software and 'further integrating it into leisure, commercial, educational, interpersonal, and other spheres of everyday activity' (Morris and Murray, 2018: 2), including television viewing.

Although apps offer limited opportunities for modification by third parties, this does not mean that they are (as Zittrain argues) entirely non-generative. Apps lower the barrier to market entry for software development (Nieborg, 2015: 5) and make the production and distribution of software easier and more accessible (Pold and Anderson, 2014: 23). Software development kits (SDKs) and application protocol interfaces (APIs) open up the production of apps by offering sets of tools, samples of code, documentation, processes and guides to assist non-specialists in developing apps. This democratises access to the means of app production. However, the SDKs and APIs upon which app production depend are created by a small number of tech companies that occupy wider positions of control within the internet ecosystem. By creating the SDKs and APIs upon which apps are built and operating the app stores through which apps are primarily distributed, the major tech companies like Apple and Google exert control over the production, distribution and circulation of apps.

Apple, Google, Microsoft, Amazon and Facebook are what José Van Dijck et al. (2018:12) refer to as the 'Big Five' 'infrastructural platforms' that have come to dominate the internet ecosystem upon which other platforms, apps and services can be built.[8] These companies control the 'search engines, browsers, data servers and cloud computing, email and instant messaging, social networking, advertising networks, app stores, pay systems, identification services, data analytics, video hosting, geospatial and navigation services' upon which the internet ecosystem depends (Van Dijck et al., 2018: 13). They operate internationally and with relatively few regulatory limitations (Balbi and Magaudda, 2018: 107). Through controlling the basic infrastructures underlying the modern internet, Van Dijck et al. argue that the Big Five infrastructural platforms are increasingly determining the economic processes underlying the wide range of different sectors now dependent on the internet. They write that, 'As platform operators develop and control the interfaces,

algorithms, and data flows that facilitate and shape the exchange through infrastructural connectors, they can set the economic rules of the game' (2018: 40).[9]

Van Dijck et al. (2018: 4) identify three mechanisms underlying the platform ecology that has come to shape the economic operations of internet-dependent services: datafication, commodification and selection. Platforms have created a market for the kinds of user data that can be captured as people use the internet, enabling online (and offline) activities to be transformed into tradable commodities. In doing so, platforms engage in processes of selection, shaping user behaviour in ways that influence the visibility of content, services and people (Van Dijck et al., 2018: 40-1). Apps emerge, therefore, in the context of both a new device ecology (characterised by the expansion of information appliances) and a new platform ecology in which the economic and industrial processes that underline the sectors and organisations that operate on and through the internet are increasingly determined by the logics of a small number of US infrastructural platforms.

The software, device and platform ecologies that have emerged since the late-2000s are intricately interconnected. The platform ecology described by Van Dijck et al. depends on the information appliances that have facilitated the integration of apps into everyday life. In relation to television, the major infrastructural platforms have moved into the production of devices, such as Google ChromeCast, Amazon Fire TV Stick and Apple TV, that deliver TV apps to users.[10] These devices contribute to the broader mechanisms of datafication, commodification and selection that underlie the platform ecology. Devices provide their owners with access to valuable consumer data while simultaneously playing an intermediary role in the presentation and selection of content, services and apps. Google has also extended its infrastructural software for internet-connected television, making its Android TV operating system freely available to manufacturers and pay-TV operators in exchange for access to viewer behaviour data, a 30 percent commission on apps purchased from the Google Play Store and use of Google's search technology (Lobato, 2019; MTM 2019: 31). Dieter et al. (2019: 2) argue that although apps might appear self-contained, they are entangled into the data flows (and I would add the broader economic and socio-cultural operations) of the multisided platform and device ecologies that make their operations

possible. The appisation of television, therefore, functions to insinuate television into the mechanisms of a wider and interconnected software, device and platform ecology.

A typology of TV apps:

To explore the ways in which the appisation of television situates television within the software, platform and device ecologies that have emerged since the late-2000s, I want to look at three different kinds of TV app that have emerged within the internet era: content, discovery and aggregator apps. The dominant form of TV app at the time of writing (autumn 2019) is the content app, such as BBC iPlayer, Netflix, Shudder, Virgin TV Go and Hulu, that are designed specifically to deliver television programmes and movies to viewers. Content apps have particular value in the new global platform ecosystem described by Van Dijck et al. because they enable the app owner to control the environment within which their content is distributed, the relationship with the viewer and the collection and exploitation of the viewer's data. Apps construct spaces online that are tightly managed by the individual or organisation that designed them (Gardner and Davis, 2013: 6). In relation to content apps, the app owner controls the design of the interface, the selection and organisation of content within that interface and the functionalities that are available to the user, through which it is possible to exert influence over what programmes and movies are watched. This control is exercised not just through interface design (see Johnson, 2019: 113-121) but also through the monitoring and datafication of user behavior (Johnson, 2019: 135-6; Van Dijck et al., 2018: 33). Apps create programmed environments in which every user interaction can be observed and converted into actionable data.

The data generated from tracking individual user behavior in real time not only shapes user experience within the app, but also enables app owners to better understand their users in ways that can provide competitive advantage. Data gathered within an app can be used to evaluate the potential market for content, which can inform content acquisition, production and marketing decisions (Smith and Telang, 2017: 182-5). Content apps, therefore, commodify user data and put it to work in shaping the selection of content, both in terms of decisions about what programmes and movies to produce/license and in terms of how content is selected, ordered and prioritised within the app itself for and by users. In the media landscape of the twenty-first century when television companies find

themselves competing with a growing range of digital media entertainment, data provides knowledge of customers' needs and the ability to manage customers' attention (Smith and Telang, 2017: 185-6). Although Hesmondhalgh and Lobato usefully caution against buying too readily into industry rhetoric about the transformative power of data, they also recognise the extent to which the television industry is adopting datafication. They write, 'There remains great uncertainty about whether such big data really provide meaningful insights, but there is great fear about the dangers of being left behind, across many industries, including television' (2019: 970). Content apps generate value in this industrial context by facilitating the ability to render individual user behavior into proprietary data that can be utilised to inform content selection and promotion and to construct user experiences within the app designed to capture audience attention and generate loyalty.[11]

These processes of datafication, commodification and selection are not exclusive to the appisation of television. Television has always operated on business models (whether advertising or subscription-led) that depend on the commodification of user data. For example, ad-funded linear television functioned through transforming viewers into ratings (data) that was used to determine the cost of advertising slots and the production and selection of content. Digitalisation made it possible for far more detailed and individualised data to be captured about every viewer. This data can be captured by the owners of specific devices and services; a process that Hesmondhalgh and Lobato (2019, 964-5) argue began with the roll out of STBs by cable and satellite companies in the 1990s. Rather than the generation of ratings by third party companies, such as BARB and Nielsen, that extend across the industry and operate as a shared market information regime (Kosterich and Napoli, 2016: 255), data has become a proprietary asset generated within devices, apps and services that can be used for competitive advantage. Apps are particularly suited to this new business logic because they centralise content and users within one space where they can be monitored and monetised.

By centralising content and viewers into specific spaces that are not automatically linked or searchable on the web, content apps raise concerns about the discoverability of television content/services, particularly in relation to existing prominence legislation designed to ensure that public service media is 'easy to find, watched and enjoyed by

viewers' (Ofcom, 2019: 9). By safeguarding the discoverability of public service content, prominence legislation aims to facilitate the sustainability of public service broadcasters, given that they have additional regulatory requirements related to original production and news provision. Current prominence regulation in the UK, for example, protects the visibility of public service broadcasters by allocating them to the highest slots in the EPG. However, the emergence of VOD services and internet-connected devices has disaggregated programmes from linear channels and increased the number of ways in which viewers can encounter and select content, including the introduction of algorithmic and editorial recommendations, and text and voice search. In the online TV context, the user interfaces (UIs) of devices and apps are playing more of a role in shaping the prominence and discoverability of content and services. This has led to an economics of prominence, in which device manufacturers, app providers and platforms sell access to the most prominent positions within their UIs. Users have limited opportunities to influence the prominence and visibility of content through customisation of the position of third-party apps within the UIs of some devices and apps, and through expressing preferences for specific content in order to influence recommendations (MTM, 2019: 42).

Most of the academic scholarship related to the discoverability of apps has focused on the role of app stores. App stores function as distribution markets whose owners can determine access to and visibility of content and services. They play a gatekeeping role in exercising control over which apps are included within their stores and 'how apps are categorized, how the collection of apps can be navigated, and how specific apps are introduced and highlighted' (Gillespie, 2018: 57; see also, Dieter et al., 2019; Li, 2018; Morris and Elkins, 2015; Pold and Andersen, 2014: 25; Snickars, 2012). Focusing on TV apps, however, draws attention to the overlooked role that devices also play in shaping the discoverability of apps (Dieter et al., 2019: 3). Although Google and Apple dominate the app stores for smartphones and tablets, many smart TVs and digital media players have their own proprietary stores through which users can download apps.[12] Furthermore, most devices, whether smartphones, tablets, smart TVs, digital media players or games consoles, come with some apps preloaded. For smartphones and tablets, the preloaded apps tend to be those created by the device owner, such as Apple TV, iTunes and FaceTime on Apple devices. The preloading of apps, therefore, functions as a means by which device owners

can prioritise and promote their own services over those of their competitors. For those companies that offer both devices for accessing television and TV content apps, such as Amazon and Apple, this can provide them with competitive advantage by controlling the critical infrastructure within which their own and their competitors' apps appear.

However, the preloading of apps can also help to make devices more attractive to consumers and can generate valuable income for device manufacturers. Most smart TVs, for example, come with a number of content apps, such as Netflix, already pre-installed. Indeed, because screen space on smartphones, tablets and television sets is restricted, device owners can generate income by selling the opportunity to be preloaded or occupy a prime position within their interface (Hesmondhalgh and Lobato, 2019: 966-7). There is industry consensus that 'certain areas and positions for promoting content or apps within a TV platform's UI are more desirable than others, which each "click" away from the homepage seen as a barrier to discovery' (Ofcom, 2019: 19). What is most desirable varies from platform to platform, but strong presence at the top of the homepage is seen by device manufacturers, TV app providers and content producers as critically important (MTM, 2019: 22).[13]

Issues of discoverability extend beyond control over the circulation and availability of apps, to the ability of people to identify and locate the television content that they want to view. Content apps themselves can shape the discoverability of the content that they offer through their interface design, search functionality and editorial and algorithmic recommendations (Johnson, 2019). Again, there is an economics of prominence at work here with content owners engaging in commercial deals with apps for position within their interface, recommendations and/or search results. The significant increase in the number of content apps has also led to the emergence of apps focused on facilitating the discovery of content. These are particularly important in the context of the appisation of television because it is not always possible to search within and across the apps downloaded onto information appliances. This can make it challenging to discover what content is provided within specific content apps. Discovery and aggregator apps address this problem by providing spaces within which it is possible to search across a range of different content apps.

Discovery apps are an emergent part of the internet television ecosystem populated largely by start-ups like Yidio, Reelgood and JustWatch. By enabling search and tracking across a range of different streaming services, discovery apps are designed to help viewers to identify what to watch. Typically, users are presented with lists of programmes that can be filtered according to certain categories, offering far more sophisticated search and browsing functionality than is available in most content apps. Reelgood, for example, allows users to search by service, genre and timeliness (content that is about to arrive or leave specific streaming services). JustWatch additionally includes the ability to browse or filter according to price, IMDB and Rotten Tomatoes ratings. The level of personalisation within discovery apps varies. Yidio, for example, offers recommendations based on previous activity within the app. Central to the appeal of discovery apps is the ability to browse and search within one database that aggregates the content of a large number of content apps, regardless of whether the user subscribes to that service or not. This makes it possible to identify where content is located and to discover content beyond those apps already downloaded by the user. Discovery apps also allow their users to create watchlists and track the availability of content, so that they can wait for content to move through distribution windows and onto a service that they access or compare the costs of PPV content across different services and apps.

The business models underlying discovery apps follow the same platform logics of datafication, commodification and selection (Van Dijck et al., 2018: 4) that are shaping the development of content apps. Reelgood and Yidio's business models are based primarily on exploiting user data to enable targeted advertising. JustWatch (2019a) generates economic value by turning its user data into a commodity that underpins the production of targeted promotional campaigns for movie studios, distributors and VOD services, including targeting users on social media sites, such as YouTube and Facebook. JustWatch (2019b) claims that because they are able to access data on the viewing habits and intentions of millions of users its campaigns are on average more than twice as effective compared to Google and Facebook industry benchmarks. These campaigns, combined with the interface and algorithms that run JustWatch's app, can influence the visibility and discoverability of movies and TV programmes. JustWatch, therefore, demonstrates how discovery apps

operate as intermediaries that can shape the discoverability of content both within the operations of its own app, but also in terms of how its user data is exploited to generate targeted promotional and advertising campaigns.

Although it is possible to click to view content from within Reelgood, Yidio or JustWatch, the chosen title will open within the content app that offers the programme, rather than within the discovery app at hand. However, another form of 'aggregator app' is emerging that aims to operate not just as a site to discover what to watch across a range of apps, but also as a centralised hub through which to view content. Aggregator apps provide access not only to a database of audiovisual content but also to other content apps. In doing so they act as intermediaries able to control the transaction of subscribing to third party apps and to shape how the apps and content of other providers appear within their interface. The central ambition of aggregator apps is to become what Evan Niu describes (referring to the Apple TV app) as 'a centralized destination that integrates a plethora of services, including traditional cable packages, over-the-top (OTT) streaming services, and just about everything in between' (Niu, 2019). These aggregator apps, such as the Apple TV app and Amazon Prime Video app, can be differentiated from discovery apps in a number of ways.[14] Principally they are designed as sites that facilitate the viewing of content. While discovery apps offer advanced search, filtering and tracking options, aggregator apps have interfaces that are far closer to content apps where the emphasis is on presenting a recommended list of programmes selected by the app, rather than by the user. Crucially, unlike discovery apps, aggregator apps enable users to watch content from other providers within the interface of their app. On the Apple TV and Amazon Prime Video apps this is facilitated through the 'channels' feature.[15] Channels are effectively the content apps of third-party streaming services that can be subscribed to through the Amazon Prime Video and Apple TV apps. Content within channels can be viewed directly within the aggregator app and can also appear in the aggregator app's recommendations and search results. In this way, aggregator apps operate as hubs through which it is possible to locate and view content from content apps beyond those owned and operated by the aggregator. This enables aggregator apps to offer other features not readily available on discovery apps related to the management of the viewing experience, such as the ability to download third-

party content into the app and resume watching across different devices. However, it also has the potential to usurp the control that content apps have over their content and users.

Aggregator apps have three strategic advantages over content apps that again map on to the mechanisms of datafication, commodification and selection that Van Dijk et al. (2018) point to as structuring the economic logic of the platform ecology. First, aggregator apps have access to commercially valuable usage and viewing data for the content apps hosted on their devices. Second, aggregator apps can sell access to third party content apps and take a commission for doing so. Third, aggregator apps are able to control the selection and presentation of third-party apps and content (including through recommendations and text and voice search), many of which compete directly with their own TV services. Device owners, such as Apple and Amazon, have the additional advantage of being able to preload their aggregator apps onto their devices in an attempt to position their service as the default means by which to access online TV.

Aggregator apps are still at a nascent stage. However, their emergence points to the significance of aggregation as an industrial strategy not just at the level of television content, but also at the level of apps. Aggregation has long been a feature of the television industry, from television channels as aggregators of programmes, to cable and satellite companies aggregating bundles of television channels within single subscriptions. Leopold W. Hofmann (2018) argues that we are rapidly reaching a tipping point at which aggregator apps will emerge that not only offer centralised access to multiple content apps, but also bundle them into a single subscription package, potentially at a reduced fee. At the same time, however, aggregator apps face a challenge from device manufacturers who are also seeking to 'aggregate content and draw recommendations from across third-party apps, which allow users to enter and browse within different content providers' VoD services' (Ofcom, 2019: 21). The role of both apps and devices in shaping the prominence and discoverability of content depends upon the level of collaboration and data sharing between content app providers, device owners and aggregator apps, agreed through commercial negotiations.

Although there is some cross over, device manufacturers and aggregator apps control different components of the market for prominence and discoverability. Deals between content apps and device manufacturers can include shortcuts to apps on remote controls, the preloading of apps on devices, cross-promotion, the prominence and integration of content/apps within their user interfaces, and the visibility of content in text/voice search results and recommendations (Ofcom, 2019: 23). Between aggregator apps and content apps, commercial deals can relate to commission on the sale of content app subscriptions through the aggregator app, the availability of content apps, cross-promotion, the prominence of content and apps within the user interface, and the visibility of content in text/voice search results and recommendations.

There is a power dynamic to these commercial negotiations. Research by MTM (2019: 29) in the UK found that device manufacturers struck deals at an international level with international content apps (such as Netflix and Amazon Prime Video), including for hardware shortcuts (such as Netflix/Amazon buttons on remote controls), joint promotions (where TV sets are advertised as recommended by Netflix/Amazon) and pre-installation of apps. Such deals were harder for national content apps to access because device manufacturers are reluctant to make changes to hardware design on a country-by-country basis and international content providers are able to secure in advance the most prominent positions within the UIs of devices. The market dominance and brand recognition of international content apps like Netflix and Amazon also provides an advantage when negotiating prominence and cross promotion with pay-TV providers, many of whom offer both devices (through the provision of STBs) and aggregator apps. As a consequence, national and more niche content apps could find that the most prominent positions within the UIs of smart TVs, STBs and digital media devices are already taken by international content and aggregator apps (ibid.). At the same time, the market dominance of the infrastructural platforms (such as Apple, Amazon and Google) across the software, device and platform ecologies could leave smaller national content providers with less leverage than international content providers in commercial negotiations.[16]

One consequence of integrating into the recommendations and search results of devices and aggregator apps is that it tends to require the sharing of metadata, assets (such

as images and trailers) and proposed recommendations (MTM, 2019: 36-39). The device or aggregator app will also be able to collect data on the behaviour of users engaging with third-party content within their device/app. The extent to which such user data is shared between devices, aggregator apps and content apps when integrating content into search results and recommendations is again subject to commercial negotiations (MTM, 2019: 41). This means that content providers may receive less data on the behaviour of their viewers than if the content was watched directly through their app. Niu (2019) speculates that Netflix has so far refused to integrate into the new Apple TV app because it does not want to give up its user data, which it regards as one of its most powerful and closely guarded tools, to a competitor.[17] For smaller niche and national content apps, however, integration into recommendations and search results and prominence within device and aggregator app interfaces could help to reduce the challenges of new customer acquisition by placing their content and apps alongside other, more high profile, apps/content. There is also an incentive for device manufacturers and aggregator apps to include national content apps that viewers would expect to be able to access. However, the ability for smaller niche and national content apps to negotiate prominence is likely to be limited compared to larger international services and may require sacrificing access to the user data upon which the logic of content apps operate. The market underlying the economics of prominence and discoverability is, therefore, an uneven one, where international platforms, device manufacturers and app providers have a competitive advantage over niche and national content apps.

Conclusions:

This article has argued that in developed media economies, television is undergoing a process of appisation in which apps have emerged as a mainstream means of delivering television services and content. I have adopted the term 'appisation,' rather than the more commonly used 'appification,' for specific reasons. Appification is used by technology critics 'where the functional and design aspects of apps become increasingly central to user experiences with all kinds of software and technology' (Morris and Elkins, 2015: 77). Although television is certainly being 'appified', the term appisation is adopted here to signal that this process if not simply one of changes to function, design and user experience, but part of a broader industrial, economic, political, social and cultural transformation of

television by the internet. Specifically, the appisation of television reveals the ways in which contemporary television is embroiled in the multidimensional software, device and platform ecologies of the internet that have emerged since the late-2000s. Appisation is, therefore, not simply a new means of delivering content and services to viewers, but indicative of the shifting strategies of the media and technology companies operating within a contemporary television industry increasingly driven by the platform logics of datafication, commodification and selection.

Within this context, I have argued that it is possible to identify three different kinds of TV app: content, discovery and aggregator apps. There are parallels here to the industrial configurations of the linear television marketplace, reminding us of the importance of recognising continuity amidst change. Content apps, in focusing on delivering programming to viewers, are akin to television channels and are provided by what I have previously (2019: 64) referred to as 'content businesses' 'focused primarily on the production and delivery of audiovisual content to viewers.' Aggregator apps, in combining access to a range of apps and content, are akin to pay-TV providers and are provided by what I have referred to as 'technology businesses' where 'the provision of TV services supports a wider portfolio of business operations focused on controlling the technological infrastructures and devices necessary to access online TV' (2019: 66). Discovery apps function paratextually, akin to the role that television guides and EPGs have played in helping viewers to locate what to watch.

However, there are crucial differences between TV apps and linear television. TV apps silo content and users within self-contained spaces, making discoverability central to the dynamics of the contemporary television marketplace and leading to an economics of prominence that informs which content, services and apps are most prominent, accessible and easy to find. Unpacking the economics of prominence draws attention to the relatively overlooked role of device manufacturers in shaping the discoverability of television programming, and the emergence of new kinds of aggregator apps attempting to position themselves as centralised hubs for accessing a range of TV apps and content. It also points to a new site of industrial consolidation, given that the technology businesses that are developing aggregator apps (such as Sky, Apple and Amazon) also provide television devices to viewers. That Apple and Amazon also operate as infrastructural platforms that dominate

the internet ecosystem through which apps and services can be built should raise questions of regulatory concern. For PSBs, and the regulators and policy-makers seeking to secure public service media, the appisation of television raises wider questions about how to maintain public value in a media market increasingly dominated by infrastructural platforms operating through the mechanisms of datafiction, commodification and selection. Any attempt to secure the public value of television in an era of appisation must ask how the mechanisms of datafication, commodification and selection might be adapted, adopted or subverted to operate in the public, rather than for corporate, interest.

Situating the development of internet-connected television within the broader device, software and platform ecologies that have emerged since the late-2000s, demonstrates the importance of device manufacturers, software providers and infrastructural platforms in the contemporary television marketplace. This is a complex and multifaceted market in which different players from content and software providers to device manufacturers and infrastructural platforms are vying to control our access to and experience of television. To understand this market, we need to examine the power dynamics, not just of the content producers and providers that have dominated studies of the television industry, but also of software providers, device manufacturers and infrastructural platforms that have figured less prominently within television studies.

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[1] BARB (2019: 14-17) noted that in the UK in 2019 TV viewing primarily took place on the TV set. Their data indicated that 'time spent with BVOD [broadcasting video-on-demand] services on PCs, tablets and smartphones only adds approximately 1.3% to TV set viewing,' with the 9pm peak of TV viewing in the UK 'accounting for over 500 billion minutes on the TV set and just over 6 billion minutes on devices [smartphones, tablets and PCs]'. In the USA, Nielsen (2017) claimed that in 2017 92.4 percent of total TV viewing was on a television set with only 7.6 percent on a PC, smartphone or tablet.

[2] In the UK context, Ofcom (2018: 14) claimed that 67 percent of all video-on-demand (VOD) viewing in the UK was via an internet-connected TV set, either through a smart TV or a connected television set. In the USA, 74 percent of US TV homes had at least one connected TV device in 2018 (Baumgartner, 2018). Most smart TV interfaces do include the electronic programme guide (EPG) as part of their homepage, along with a selection of apps (MTM, 2019: 10).

[3] The term 'app' does not appear in the index of any of the major recent monographs on internet television (Evens and Donders, 2018; Jenner, 2018; Johnson, 2019; Landau, 2016; Lobato, 2019; Lotz, 2017; Robinson, 2017; Smith and Telang, 2017; Strangelove, 2015). Apps get three brief indexed mentions in two articles in Kevin McDonald and Daniel Smith-Rowsey's (2016) edited collection on Netflix (Lindsey, 2016; McDonald, 2016). Amanda Lotz's (2017) re-definition of television as 'portals' does go some way towards situating television within the contemporary platform and device ecologies outlined in this article, even if she does not directly examine TV apps.

[4] Paul D. Miller and Svitlana Matviyenko's (2014) edited collection and Howard Gardner and Katie Davis' (2013) monograph on apps both position apps as a feature of mobile media. Two articles in Jeremy Morris and Sarah Murray's (2018) collection on apps explore television. Sapnar Ankerson's (2018) analysis of Periscope focuses on the differences between television and live video streaming apps. Gerrard Goggin (2018) argues that the varied historical and regional specificities of television undermine the realisation of a single global app for accessing television content.

[5] The reasons for choosing the term 'appisation' rather than the term 'appification,' which is used by technology critics, will be examined in the conclusions.

[6] Examining the development of HTML5, Michael S. Daubs and Vincent R. Manzerolle (2016: 53) argue that the web is being transformed from an open network into a 'platform for applications' comprised of apps. On the transformation of the internet and the web by apps see also Ben Light et al. (2018: 884-5), Svitlana Matviyenko (2014: xix) and Pelle Snickars (2012: 159).

[7] Some apps are preloaded onto certain devices.

[8] Van Dijck et al.'s (2018: 27) analysis is focused on Europe and the United States. They acknowledge the emergence of a platform ecosystem specific to China, while also noting that the US-based infrastructural platforms have expanded into Africa and elsewhere in Asia.

[9] Jean-Christophe Plantin et al. (2018) offer a useful discussion of the difference between platforms and infrastructures and argue that the rise of what they term 'infrastructuralized platforms' (such as those operated by Google and Facebook) points to the move of corporate power into infrastructural realms previously operated in the public interest.

[10] Apple TV has been adopted by pay-TV operators to replace their aging STBs (Hesmondhalgh and Lobato, 2019: 966) and Amazon is planning to launch a TV set in the UK (Williams, 2018).

[11] For advertiser-funded VOD services, the data generated through TV content apps can also facilitate the sale of more targeted and accountable advertising (Johnson, 2019: 147).

[12] For example, apps are downloaded to Vizio and LG smart TVs through their proprietary app stores. It is also worth noting that it is possible to download a wide range of different kinds of apps to a TV set, not just TV apps, but also games apps, productivity apps, smart home apps and so on.

[13] Homepage here refers to the first page that viewers encounter when opening an app or turning on their device (whether a smart TV, digital media player, set-top box, games console, smartphone or tablet).

[14] The Apple TV app is not the same as Apple TV, which is a digital media player that can be attached to a television set to facilitate access to streaming services. The Apple TV app is available through Apple TV but can also be downloaded to iPhones and iPads and some smart TVs, with plans to roll it out to other streaming devices.

[15] Some pay-TV operators' VOD services, such as Sky Q, can also be understood as aggregator apps. For example, the Sky Q app can be used to watch Netflix and if users subscribe to Netflix through Sky then Netflix content is integrated into the Sky Q interface, appearing in recommendations and search results.

[16] For example, Apple offers an aggregator app (Apple TV app), a content app (Apple TV+) and a number of devices used to watch television (Apple TV, iPad, iPhone, and so on) and controls one of the major app stores (Apple App Store) that shapes the production and distribution of apps to mobile devices.

[17] At the time of writing, the Netflix app is available on the Apple TV app, but it is not integrated into it, such that it is not possible to watch Netflix content directly through the Apple TV app.