Telecommunications Policy 38 (2014) 684–692

Contents lists available at ScienceDirect

Telecommunications Policy

URL: www.elsevier.com/locate/telpol

Cloud TV: Toward the next generation of network policy debates

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ARTICLE INFO

Available online 30 December 2013

Keywords:
Future video
Cloud
Policy
Television
High-speed network

ABSTRACT

We are entering the 4th generation of TV, based on the online transmission of video. This article explores the emerging media system, its policy issues, and a way to resolve them. It analyzes the beginning of a new version of the traditional telecom interconnection problem. The TV system will be diverse in the provision of technology, standards, devices, and content elements. For reasons of interoperation, financial settlements, etc., this diversity will be held together by intermediaries that are today called cloud providers, and through whom much of media content will flow. Based on their fundamental economic characteristics, the cloud operators will form a concentrated market structure. To protect pluralism and competition among clouds and of providers of specialized elements requires the protection of interoperation. This can be accomplished by a basic rule: by the principle of an a la carte offering of service elements.

What will the regulation of television look like in the future? That question is on the minds of policymakers and media companies around the world. In the past, television was tightly controlled through restrictive licenses and other rules that do not exist for print media. Yet when these print media originally emerged centuries ago, they, too, were censored and licensed. This history raises expectations that television would follow a similar path. It would be set free when television would migrate from the limited over-the-air broadcasting to a delivery over the wide-open open internet. Is this indeed the scenario for the future?

This article will explore the emerging video media landscape that is due to such a migration of television to online platforms, and the policy consequences. It argues that this rapid evolution will not simply add still another form of distribution of familiar content operating under familiar rules, but that it will deeply transform the industry structure and the regulation of what we now call television. In particular, the article analyzes the likely emergence of a new version of the traditional telecom problem of interconnection. It proceeds in a step-wise fashion:

1. The fourth generation of TV is characterized by the technological rate of change of ICT rather than of traditional TV.
2. In this diverse environment of technology and content provision, the central integrators will be the cloud providers.
3. The cloud TV environment will be characterized by significant oligopolistic market power and fragmentation.
4. There are several ways to deal with this, and an a-la-carte system without price regulation would resolve the interconnection issue with the least intervention.

It may be early to discuss this scenario, but the issues will emerge soon enough. Already, at the end of 2012, during evening peak hours, entertainment usage on the internet in the US accounted for 68% of all internet data traffic. Netflix

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0308-5961/$ - see front matter © 2013 Published by Elsevier Ltd.
http://dx.doi.org/10.1016/j.telpol.2013.10.004

accounted for about half of that, i.e. 33%.[1] Together with other video use on the internet, the overall video percentage is over 2/3 of all internet traffic. Thus, the future is almost here.

1. The role of interconnection rules

For a hundred years, the main issue for telecom regulation had been *interoperation* and its cousin, *interconnection*. Telecom's biggest battles were fought over this issue (Brock, 1998). Typically, the largest networks seek to interoperate with non-rival international partners but to avoid doing so with direct domestic rivals. They have the advantages of scale and scope on the supply side, and of network effects on the demand side. Why share these advantages with a smaller rival? A second factor in the battle over interconnection was that large networks wielded a gatekeeping control over market access by providers of content and hardware, and thus were able to extract economic rents. A complex structure emerged to assure, through interoperation, a system with some diversity and competition. The elements included technical standards; regulatory agencies; numbering systems; common carriage; unbundling; and much more.

In America, the main chapter headings in the story of establishing interoperability were (Noam, 2001):

- Interconnection requirement (The "Kingsbury Commitment", 1913).
- Long-distance competition (MCI Execunet, 1975).
- End user equipment competition (Carterfone, 1968).
- Structural and functional separation of regulated and competitive network elements (Computer II Inquiry, 1980).
- The AT&T Divestiture (1982/4).
- Unbundling (ONA, 1986 and LLUs, 1996).

These steps and similar actions in other countries aimed to create a network of networks in which the users of one network could reach the users of rivals. And devices from different technology firms could connect and interoperate, giving users choices and encouraging innovation. The network effects of a large system would not overwhelm those of a small one. Even so, large networks still had the advantage of economies of scale.

But is this the end of history? Today, the next generation of interoperation is emerging under the radar, the interoperation of clouds. Clouds is the current term for server-based services to end-users. The basic idea has been around for decades, to move data processing and smart operations to big central servers, and to leave the periphery of end user "clients" that are relatively "skinny" and "dumb." Today, clouds are still mostly a storage and access system for text and media files, with some synching and sharing. But in the near future, this article argues, they will become the main players of the converged media world (Noam, working paper). And this will lead to yet another round of debates over interconnection and access.

Why is there a next generation of issues? Is not by now everything interconnected and interoperating? Not really. The rules for interoperability for telecommunications and for television were different from each other. Basically, they do not exist for television (including cable) networks. What exist are technical standards of transmission so that a user's TV set can receive several stations. There was also a mandated access to cable distribution platforms by over-the-air broadcasters, as well as by some community, government, and leased-access channels (US Senate, Cable Act, 1992). On the hardware end, the FCC established in the US rules for the interconnection of third-party-provided set tops, but several decades later few such devices were in actual operation (FCC 98–116, 1998). But otherwise, these transmission systems were closed operations and nobody had a right to interconnect or interoperate.

But now, these two network types – telecom and television – are converging, with powerful pipes for individual use, point-to-point, peer-to-peer, video communication. And the question is what the interoperation rules of this converged system will be.

2. Into the fourth generation of television

Television has gone through three generations. First there was over-the-air broadcasting. Thirty years ago, the second generation emerged: multichannel over cable, satellite, and now also over telecom networks. In the 1990s, all-digital forms of TV arrived (ACATS, 1995) that enabled high definition TV, but did not make much of a difference on industry structure or regulation (IDATE, 2011; Screen Digest, 2009). We are now entering the 4th generation of TV, based on the online transmission of broadband internet connectivity. This type of TV will include some of the following elements, in various combinations:

- 4 K and 8 K resolution, which sharpens the picture for large screens (Sugawara, 2008).
- 3-D in quality (Surman, Sexton, Bates, Lee, & Yow, 2004).
- Peer-interactivity (Smart, 2010).
- Person-to-computer interactivity.
- Computer-enhanced reality.

[1] Reisinger, Don. "Netflix gobbles a third of peak internet traffic in North America," *Cnet.* Nov 7, 2012.

- User-generated, peer-to-peer content.
- Asynchronous viewing and individualization.
- Branching plot lines and user participation.
- Multi-platform distribution.
- Globalization.

Putting together these and other elements enables TV as a high-resolution, immersive, participatory, personalized, social, world-wide experience. What will such a system look like? Perhaps the best answer is that there will not be "a" television but multiple ones. Technological change in the medium is moving from the tightly controlled, standardized, harmonized, and slow-moving process that has characterized the TV world of broadcasters and cable-casters, to the much faster-moving world of ICT and the internet. In such an environment, numerous developers, firms, industries, and countries seek their approaches and products to prevail. There is simply no way for these contending and creative efforts to be shoehorned into a single definition of "television". Nor is it desirable or necessary. The consequent emergence of video centrifugalism, in turn, leads to the emergence of new types of video integrators. These integrators will be some form of what is called today 'clouds'.

3. The central role of cloud providers

The central nodes in an online TV system will be "clouds". Before we analyze the reasons, let us look at who they are. The concept of "cloud" has undergone an evolution, which can easily mean that people talk past each other. Originally the term connoted the network (at the time, the telecom network) as a whole. Later, it became to mean a provider of a network-based service, in particular of storage and soon online server-based value-added services such as software and processing, with a taxonomy of SaaS, PaaS, NaaS, or IaaS[2] cloud providers, typically servicing large organizations. On the consumer end, server-based online services that provided content were also called clouds, first as remote storage facilities but soon with functions of music and video providers, P2P social networks, and user-generated content.

What we call today a 'cloud' is really just a continuation of concept that earlier was called 'time sharing', 'grid computing', 'utility computing', 'thin clients', 'terminal computing', and 'network computer'. The words change, the players rotate, but the plot stays familiar. The basic idea is constant: for a user to obtain computing resources such as storage, processing, databases, software, networks, platforms, etc, from somewhere else.

On the consumer side, a cloud might start out as a content provider, such as Pandora or Spotify for music. They then might expand to provide storage services such as music "lockers" of content owned by users, such as Apple iCloud, Google Music, or Amazon Cloud Player. They also enable a sharing of music files among users, and social networking among them. They might enable users to post their own content and share it with others, such as YouTube or Facebook.

There are several reasons why clouds will play a central role. They will now be discussed.

3.1. Scale and integration

To produce immersive, interactive video content is difficult. It requires creativity, many programmers, and many new versions. The film *Avatar* credited the participation of over 800 computer graphic artists and spent $50 million on special effects alone. And that was still without interactive story lines, user participation, and multi-platform formatting. Similarly, high-end video games take now dozens of millions of dollars to develop.

Such expensive content exhibits strong economies of scale on the content production side and network externalities on the demand side. Both favor content providers with big budgets who can diversify risk, distribute over multiple platforms, distribute globally, and coordinate specialized inputs. Few firms can do this. Many firms, however, can contribute specialized elements. Therefore, most likely to emerge is a two-tier structure, with a few major "tent pole" companies serving as intermediaries and integrators for the elements that are supplied by many smaller specialists.

The role of major media companies therefore becomes, to a significant extent, that of integration and quality control of content produced by others. Clouds or similar intermediary organizations are such integrators. They will put together the resources of IT processing, storage, transmission, routing, ubiquity, and mobility, as well as content production, editing, software, and apps provision. They will enable the interaction among users and among various types of providers. For example, they will enable the interoperation of consumer electronics devices, multi-player games, social networks, and user-generated content. This role of clouds is depicted in Fig. 1, which illustrates their central role in coordinating, marketing, financing, and interoperating the diversity of specialized inputs and services.

[2] The abbreviation stands for "Software "- or "Platforms", "Networks" or "Infrastructure" - "as a service". These categories are overlapping. There are also services beyond computing and processing such as content, aggregations, interactions, the bridging of standards and other applications. Better yet, one could drop these sub-classifications altogether.

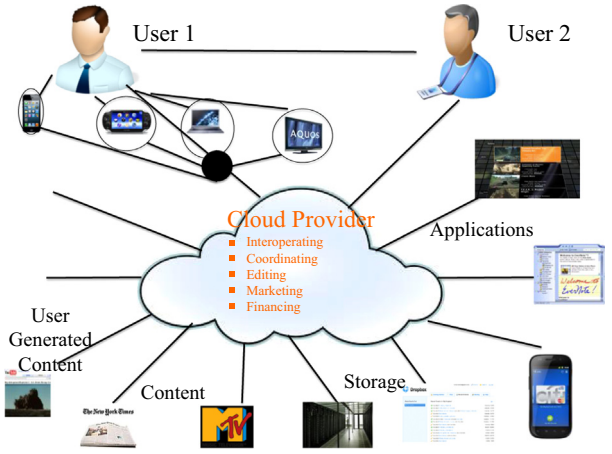

Fig. 1. The central role of cloud providers.

3.2. Standards

The second reason for the cloud to emerge as central media institutions are technical standards, or rather, their absence. For next-generation type TV, an interoperability is required of content types, users, devices, networks, as well as of prioritization of traffic, of software operating systems, payment systems, and IPRs. Add the dimensions of interactivity, P2P, virtual-worlds, global distribution, copyrights, and many more. The next-generation video environment, whose elements we described above, includes a wide and diverse number of technical elements of hardware and software. No single firm would be capable of developing those on their own. But they need to interoperate.

There are two options:

1. Comprehensive standards (Seel, 2012). But realistically, full end-to-end, cross-device, cross-platform, cross-national standards are unlikely to emerge. There are too many companies, countries, stakeholders, technologies, and rivalries. Any such standard that might arise is likely to be out-of-date and inefficient, yet hard to change.
2. Let intermediary organizations create interoperability. Again, Fig. 1 depicts the basic concept. Clouds translate and interoperate various systems of hardware and software, thus making technical conformity less important.

3.3. Convenience

The third advantage of clouds is convenience. As everything electronic – even kitchen appliances – gets connected with everything else, interoperation becomes a challenge. Instead of amateur users struggling with connecting devices at home with each other it is more effective to let the IT professionals do it at a distance. This has implications on consumer electronics. They would move from the self-contained hardware boxes such as TV sets or game consoles to virtual appliances, put together into ever-new configurations. On the consumer end, all that is needed are input and display devices. The rest of the hardware will migrate to the facilities of remote applications providers with more powerful equipment, expertise, and security. In such a scenario, consumer electronics move from hardware to service. A familiar example is voicemail by a phone company that replaces an answering machine. Much of the actual hardware will then be bought by the clouds rather than by consumers. In that marketspace, enterprise-oriented IT equipment vendors gain significantly at the expense of household-oriented consumer electronics companies.

3.4. Law

The fourth factor in favor of clouds is legal and regulatory in nature. Each country has its own rules on protection of children, morals, privacy, consumers, politicians (libel laws), media producers (copyrights). Each country wants to collect taxes. It is unrealistic to expect these rules to be the same worldwide, and it would, in fact, be undesirable for them to be so. Countries, societies, governments, histories are different. Attempts to 'harmonize' will only result in acrimony, delay, disappointment, and unstable compromises. It is more realistic to expect that different countries will have diverse arrangements in the online world, just as they have in the offline world.

National sovereignties over the rules under which our media operates will therefore persist in the online world. And the question is how the providers of content, apps, and networks can comply. To comply with dozens and hundreds of different rules would be an impractical burden. They might simply apply the strictest national rule to everything, so that they will not be in violation anywhere. The toughest national restrictions would thus become worldwide.

But another possibility is going through intermediaries who would tailor the material to comply with the various national laws before it goes to that country. This would be one of the cloud's functions. These intermediaries could be large and sophisticated enough to deal with the multiplicity of national rules. There are economies of scale in compliance, too. This intermediate sanitizing by privately owned clouds is not a particularly desirable arrangement. But it is the one likely to emerge. And the question is whether there would be an undue gatekeeping by such intermediaries based on risk-avoidance and their own judgments on morality, politics, etc. It is therefore important that there are multiple intermediaries in this role, and that content need not go through any particular intermediary but has options.

A related issue is the role of liability of a party in an interactive communication for the actions of another participant. Violations by some part of a system would affect the others and expose them to legal risk. This leads to intermediaries who establish usage policies, police them, and lower risk to users.

3.5. Financial distribution

The fifth dimension favoring intermediary clouds is the coordination is that of financial flows. The various providers of special elements, whether of services or copyright licenses, require compensation from users. Once the linear relation of a specific user consuming the product of a specific provider is replaced by a multiplicity of interacting users using a diverse and changing menu of elements, financial flows need to be channeled through intermediaries.

Other functions favoring cloud intermediaries are those of marketing and branding; of quality control; and of privacy, and the protection of security.

The conclusion is therefore that clouds will become the central online media organizations, because they offer operational advantages in terms of economies, standards, convenience, law, financial flows, and more.

4. Market power in the cloud market

The conventional prediction for the future of media has been one of domination by large and vertically integrated media conglomerates. But the above analysis concludes that the key media institution of the future will not be those traditional firms but rather the cloud companies. Some of them might be traditional media companies that have morphed into technology, such as traditional American broadcast TV networks with their online service Hulu. But it is doubtful that traditional media firms can whole-heartedly embrace the integrated function which gives them a wider scope but lessened control. The same can be said for traditional public service TV providers, though as the BBC or NHK might have a chance. More likely is a major role for tech companies that morphed into media, such as Google or Apple, or of hybrid "tech-media" firms such as Netflix or Amazon.

Thus, clouds will be central organizations for an emerging online media system, and there will not be many of them for reasons of scale and scope. And this means that the media of the future will be more concentrated than that of the past. The conventional wisdom is, of course, that the new media system is less concentrated than the old. But even today, that is not what the data shows Fig. 2.

This graph depicts media concentrations for three types of media in six regions of the world. The left-most bars are traditional media such as newspapers, books, and magazines. The middle bars are "20th century media" such as film, radio, TV, cable TV. And the right bars are internet media such as online news, search, and ISPs. The data shows that each newer generation of media is more concentrated than the preceding one, and that this is true almost everywhere. Traditional media have a concentration

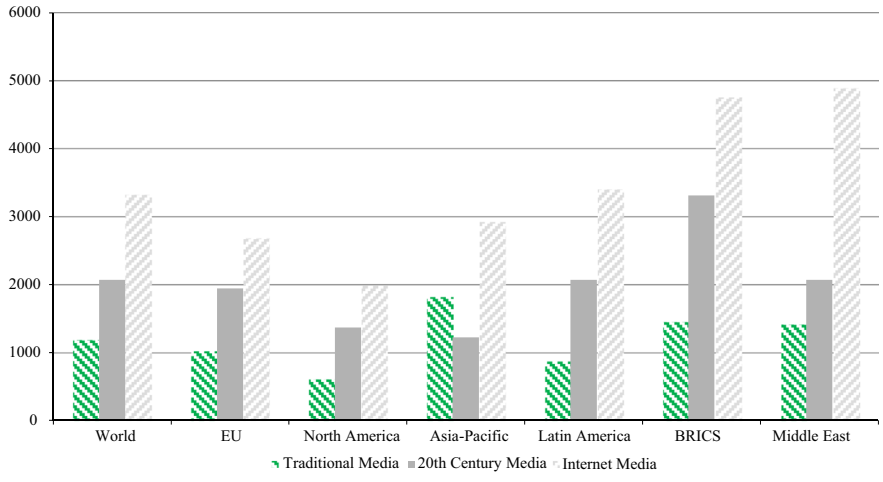

Fig. 2. Old and new media concentration by region.
Source: Noam (in press).

index, worldwide, of about 1100, which is almost unconcentrated. In contrast, twentieth century media have a concentration index of about 2000, which is highly concentrated. (Moderate concentration is defined as an HHI index of 1000–1800.) Internet media have an index of over 3000, which is very highly concentrated. These are the industries that were believed to be wide open and competitive, and which would open things up for the rest. But they exhibit strong concentration trends. The underlying economic factors are high fixed cost and low marginal cost on the supply side, and high network effects on the demand side. This creates high advantages to scale. These cost elements and network effects characterized cloud operations. One should therefore expect a highly concentrated market for general cloud provision.

5. Policy options

If clouds are not competitive, the results might be:

- Market power over users who could not easily switch ("Lock-in").
- Difficulty of users of one cloud to interact with users and elements of other clouds ("Fragmentation").
- Market power over providers of hardware, software, transmission, and content ("Gatekeeping").

The important question then is how to keep a cloud-based system competitive and diverse? The history of networks strongly suggests that the remedy to deal with market power by dominant players is through interoperability and interconnection, enabling smaller providers to access users and the provider specialized inputs to reach customers and other clouds.

The major policy issue of a cloud-based media system will therefore be how to maintain an interoperability among the various clouds, and with the providers of specialized services and technologies. There are several approaches to generate such interoperations. The first category of options is to rely on market forces – through the activities of users, cloud providers, and third parties. The second category is the regulatory one. We begin with the first category.

5.1. *Self-interconnection by each user*

Users′ can create their own interconnection by being linked to multiple clouds and service element providers. In Fig. 3, a user connects directly to several competing clouds and service providers. But that would require major transaction costs by users. For example, a user wanting to access cloud A could not easily also use Input 4 (Fig. 3).

5.2. *Peer interconnection*

The second market-based interconnection is on the supplier side, by the peering of clouds with each other based on commercial deals. The peering of clouds has emerged through, for example, by agreements by Google, Salesforce, Dreamforce, and Facebook. In Fig. 4 clouds A and B interconnect and a user who is connected to one of them is also connected to the other. But, because it is a contractual system, Cloud C might not be included, and its users and input providers might be cut off.

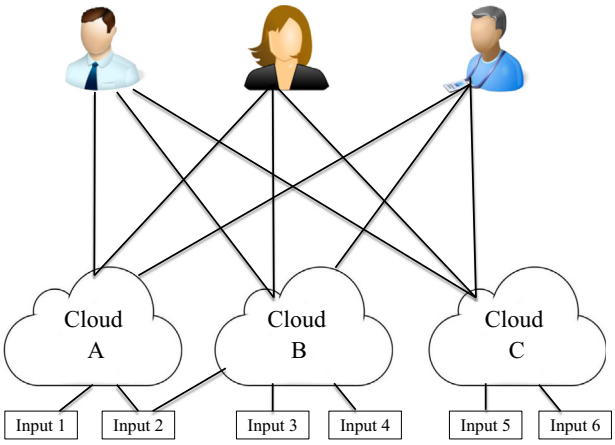

Fig. 3. Connectivity on the user level.

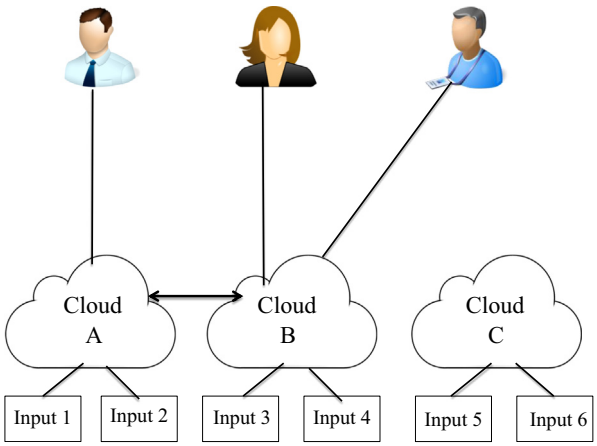

Fig. 4. Peer interconnection by clouds.

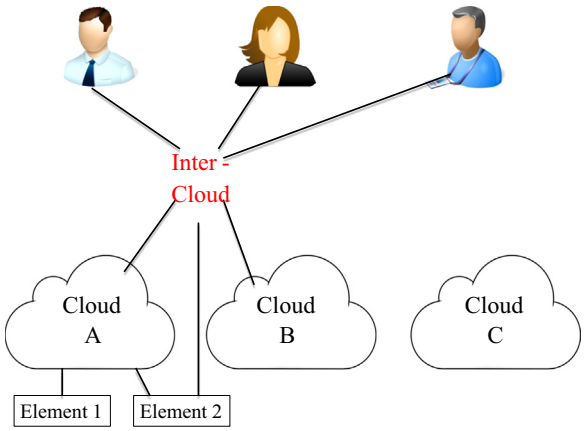

Fig. 5. The cloud of clouds.

5.3. *The "Cloud of Clouds"*

The third market-based option is the emergence of a 'cloud of clouds', into which other clouds interconnect. (Fig. 5) This could be a purely commercial arrangement and hence might still not incorporate Cloud C. Early versions of commercial "meta-clouds" or "cloudbrokers" have emerged. Examples are:

- RightScale – runs on Amazon, GoGrid, Flexiscale
- Cloudshift by Cloudkick, moves files fom Amazon to Rackspace
- Kaavo, enStratus
- Oxygen Cloud
- Backup Box
- Salesforce, Force.com

The meta-clouds provide intermediation, aggregation, and arbitrage across cloud providers. The initial capabilities of these meta-clouds has been adequate for simple file transfer, but more complex transactions have been a challenge.

5.4. *Regulated clouds*

The market-based system of meta-clouds thus may leave out rival clouds and potential competitors. This then leads to the second potential approach to the interoperation of clouds – that of a regulated mandate of interoperation and access by all clouds to each other or to a meta-cloud. While it may seem fanciful to even discuss this policy question today, one must take a clear-headed view. What the analysis shows is that the major nodes of the media system will be oligopolies, due to fundamental economic characteristics. This oligopoly will increasingly be transnational, so that globalization will not solve the issue either but actually make it more controversial.

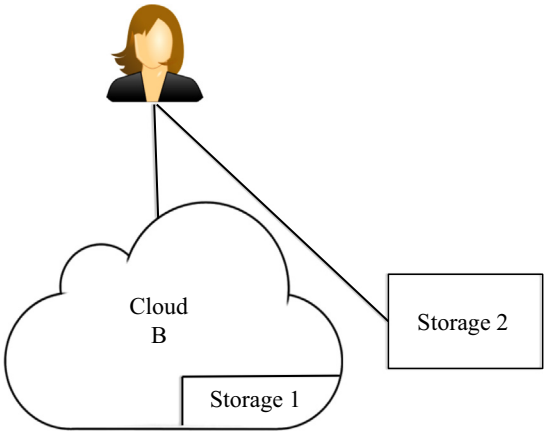

Fig. 6. Bundled cloud element.

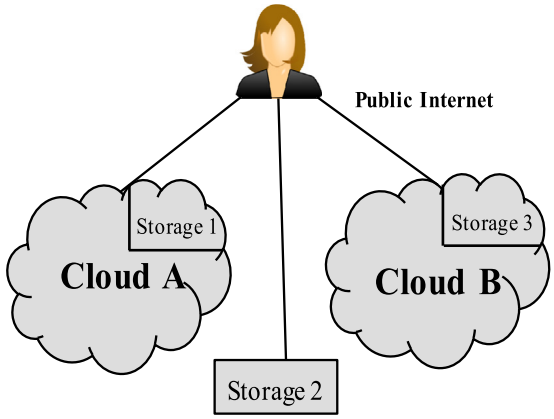

Fig. 7. A-la-carte cloud elements.

The traditional responses by traditional governmental regulation are market structure interventions, behavioral regulation, and access requirements. They often end up either backwards looking or protecting established stakeholders. An example is the imposition by the EU Commission in Brussels of traditional TV rules on linear online TV. Interoperation can be established through standardization and access mandates. These would be intrusive measures that might retard innovation. Take, for example, the role of telecom providers in this system. Basically, they provide, in the graphs above, the various lines that connect the various components. They would mostly have to connect to a cloud provider, and with only a few such clouds around, their service – transmission – becomes a commodity input facing a non-commodity intermediary.

One remedy might be a regulated access by networks to clouds, such as access rights by networks and the traffic they carry to clouds. Consider what this means. In the past, it was the cloud providers that clamored for neutrality and non-discrimination the ISP network providers. But in the new environment, it would be they who would be challenged to open up to the network access. Would there be regulatory "cloud-neutrality" requirements, with access rights and regulated pricing?

5.5. *A-la-Carte provision of cloud services*

A much simpler approach would be to require clouds to make their service elements also be available on an a-la-carte, stand-alone basis. No price regulation or access mandates would be required.

If a cloud provider offers Storage 1 as part of a take-it-or-leave-it package, the user desiring the alternative Storage 2 would have to pay for it twice (Fig. 6). Therefore, Storage 2 would not be competitive, ceteris paribus. There are regulatory ways of price regulation to tackle both of these problems, but they are burdensome and meddlesome. An alternative exists – a la carte pricing: *A cloud provider can charge what it wants and bundle as much as it wants, as long as the elements are also available in unbundled form.* A user or other service provider can then substitute elements and combine them.[3]

[3] This approach must be distinguished from that for traditional cable TV. There, a vertical stand-alone system exists.

For example, we may have a cloud that uses an internal (or external) element of Storage 1 (Fig.7). It can offer this as a bundle. But it must also offer it on an unbundled basis at a price of its choosing, so that the user can take Storage 2 or Storage 3 in the alternative. This generates competition on the user level for storage. The various elements can be integrated by the user, or by an intermediary integrator, a "cloud of clouds".

One question is whether a cloud can cross subsidize Storage 1 from monopoly rents of the remaining cloud services. But this is not likely to work. Most of these elements, or close substitutes, are also provided by competitors, and overcharging for them in an unbundled environment would create competitive problems for their provider. The interoperation of clouds enables competition among clouds and specialized providers for those over-charged elements. There might still be some elements left where monopoly and pricing power exist. In the dynamic IT sector this is not likely to persist, especially not for an isolated element without the advantages of a take-it-or-leave-it bundling. A related question is how the elements are defined that would be offered separately. This would be best handled by an inter-industry technical forum. Some market power might persist for a time, but one should not let the perfect be the enemy of the good.

6. Conclusion

Cloud-based next generation media are potentially gatekeepers with significant market power. There is a need to protect pluralism and competition. What is required is one principle: a default a-la-carte offering.

Much of next-generation media – television, music, film, games, online news – will run over the internet and its fixed-line and wireless pathways, and through intermediary media cloud providers. Therefore, the regulatory rules that underlie the intermediaries become the underlying rules for the functioning of the TV system as a whole.

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