

Internet Architecture for Innovation

Internet Architecture Task Force

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Note from the editors

This paper has been prepared by a task force from the Future Internet Architecture Group, cluster of EU projects from 6 units of DG INFSO. It contains information about the two different view points about the evolution of the Internet Architecture (telco view point vs. current internet approach).

The main message is that the Internet Architecture is a new policy tool (no longer only a matter of techies). It could be used by policy makers to shape the future EU economy by favoring some industry sector while perhaps hindering others.

Disclaimer: This paper has been written jointly by their authors but it does not imply an agreement of all authors on all sections of the paper. This paper reflects the, sometimes, contradictory views on the relation between Internet Architecture and Innovation. The authors are a subset of the Future Internet Architecture Group under the umbrella of the Future internet Assembly. The views expressed are those of the authors and not necessarily those of the European Commission or any of its officials.

Executive Summary

In general terms there is a consensus about the Internet architecture principles that the aim is connectivity, the tool is the Internet Protocol, and the intelligence is end to end rather than hidden in the network. These characteristics of the current Internet architecture are the same characteristics that promote innovation. For example the end-to-end principle leads to general-purpose end hosts being managed by users rather than by third-party gatekeepers. Internet Protocol as a protocol provided a high level of flexibility and modularity, which provided a formidable starting point for encouraging innovation. Connectivity itself is more valuable than any individual application and requires technical cooperation between service providers. There are a number of general design issues of the current Internet architecture which must be supported, such as heterogeneity, simplicity, modularity and scalability if innovation is to be promoted.

Having said this, some of the good principles of current Internet architecture at the same time have some drawbacks that hinder innovation. Frequently the same characteristic that promotes innovation in some fields hinders innovation in others. For example, what is good for quick deployment of services: flexibility, at the same time may impede security and standardization and services dependent on them. The end-to-end approach makes control of Quality of Service (QoS) very difficult, as it is not possible to create an ecosystem of interdependent services. But probably the most acute problem of this freedom is the difficulty to provide global services through the Internet. The Internet is strong on freedom but suffers from lack of authority; the Internet has stimulated innovation because one of its principles is "end-to-end", but the business ecosystem is different: nobody in the Internet is able to exercise control end-to-end.

Public Administration decision makers need to know the importance of Internet Architecture for all economic industries. The evolution of the Internet affects all economic actors, benefiting some industrial players while perhaps hindering others. Thus any steps taken towards modifying the Internet, whether in terms of technology and architecture or whether in terms of governance can be seen as a policy tool for modifying the economic situation in Europe. As such, this policy tool should be utilized to favour European business and entrepreneurship and to create a playing field that can foster innovation.

Although the architecture of the Internet has an important influence on the business ecosystem and as a driver to spur innovation, it is not the only factor, albeit a more and more decisive one. If we take as a given that successful entrepreneurs need to have a commanding knowledge of the field they are in, need to be not risk averse, and need to have access to funding capital - given these important prerequisites - then the Internet architecture will have a growing importance among the set of infrastructures that mold the 'playing field' in that global entrepreneurs will have to compete.

1) Internet Principles that Have Fostered Innovation

When looking at the Internet architecture's ability to foster innovation we have to look back at the evaluation of the Internet architecture itself. With the publication of RFC 1958¹ the Internet Architecture Board (IAB) documents some of the architectural principles and provided a number of important remarks, namely:

- *"The Internet and its architecture have grown in evolutionary fashion from modest beginnings, rather than from a Grand Plan." "A good analogy for the development of the Internet is that of constantly renewing the individual streets and buildings of a city, rather than razing the city and rebuilding it."*
- *"... the community believes that the goal is connectivity, the tool is the Internet Protocol, and the intelligence is end to end rather than hidden in the network."*

The Internet Protocol (IP) provides a connectionless delivery service for variable size packets, which does not guarantee ordering, delivery, or lack of duplication, but is merely best effort (although some packets may get better service than others). Senders can send to a destination address without signaling a priori, and receivers just listen on an already provisioned address, without signaling a priori. This does, however, not mean that access is granted to every IP node on the Internet. Application layer functionality may restrict communication attempts based on a number of security techniques.

IP has not changed much since 1978 and even the introduction of IP version 6 has not been a shift away from the basic model. However, an evolution took place in how IP is exposed to higher-layer protocols and applications, largely based on how networks have been deployed and operated².

One of the most frequently cited architectural principles of the Internet is the "*end-to-end principle*", which is discussed in detail in by Saltzer, et al.³. We do not attempt to repeat the argument in this document but instead want to point to a number of documents published by the IAB to offer additional background information and to advance the discussion:

- Reflections on Internet Transparency"⁴
- ""The Rise of the Middle and the Future of End-to-End: Reflections on the Evolution of the Internet Architecture"⁵

¹ Carpenter, B., Ed., "Architectural Principles of the Internet", RFC 1958, June 1996.

² D. Thaler, "Evolution of the IP Model", draft-iab-ip-model-evolution-02.txt (work in progress), Oct. 2010.

³ End-To-End Arguments in System Design, J.H. Saltzer, D.P.Reed, D.D.Clark, ACM TOCS, Vol 2, Number 4, November 1984, pp 277-288.

⁴ Carpenter, B., "Internet Transparency", RFC 2775, February 2000.

⁵ Kempf, J., Ed., Austein, R., Ed., "The Rise of the Middle and the Future of End-to-End: Reflections on the Evolution of the Internet Architecture", RFC 3724, March 2004.

- "Reflections on Internet Transparency"⁶

An important pre-requisite for innovation at the application layer is the need for end-to-end connectivity with networks that do not filter or transform data it carries, i.e. a network that is "transparent" or "oblivious" to the content it carries. This "oblivious" transport allows fewer parties to be involved when deploying new services, i.e. a company web page can be published without the need of an agreement with network operators, other content providers or some guild or market consortium. These concepts have been explained in the following remarks:

- *"Networks that provide oblivious transport enable the deployment of new services without requiring changes to the core of the network"*⁶
- *"One desirable consequence of the end-to-end principle is protection of innovation. Requiring modification in the network in order to deploy new services is still typically more difficult than modifying end nodes. The counterargument - that many end nodes are now essentially closed boxes which are not updatable and that most users don't want to update them anyway - does not apply to all nodes and all users"*⁵

How to address the needs raised by the introduction of a new class of applications and the changing usage patterns for existing applications in an eco-system with many stakeholders whose interests are adverse to each other represents an ongoing challenge. All IAB documents published during the last 10 years conclude that the degree of transparency has diminished. This can be attributed to the desire to deploy a number of technologies, such as NATs (Network Address Translation), firewalls, proxies, deep packet inspection equipment. The reasons for the increased usage of these technologies are complex and are largely rooted in the ongoing public policy debate and the conflicting interests of stakeholders in the Internet milieu.

Ensuring high speed of innovation seems to be inevitably bound to networks providing oblivious transport. This does, however, not mean that new applications do not require the deployment of network-side infrastructure, such as mobility anchor points, relaying proxies, content storage, and various server-side elements.

As argued by a few IAB members in a recent publication for the "Real-Time Communication in a Browser" workshop⁷ new types of applications deal with the loss of network transparency by changing the waist of the hourglass from IP to HTTP/HTTPS. Nevertheless, the ability to update software at end hosts with the help of downloadable code (browser plug-ins, widgets, browser executable code) seems to point into the direction of increased flexibility leading to shorter innovation cycles.

Oblivious transport may seem to imply the introduction of severe security and privacy challenges. Security challenges indeed exist and they are often a by-product of a successfully deployed technology and not entirely a consequence of architectural design. Criminals today

⁶ Aboba, B., Ed., Davis, E., "Reflections on Internet Transparency", RFC 4924, July 2007.

⁷ Aboba, B., Peterson, J., Schulzrinne, H. Tschofenig, H., "The Future of Web Applications or How To Move into the Post Standardization Area", available at: <http://rtc-web.alvestrand.com/papers> (Nov. 2010).

are heavily driven by financial motives and select their targets based on the best potential outreach. Steady progress in dealing with these challenges is being made as risks are being re-evaluated and new countermeasures are researched and deployed. As most recent examples of technologies the increasing deployment of DNSSEC as well as the work on secure inter-domain routing can be mentioned. Security and privacy are both impacted by architectural choices, some during the early design and many others based on deployment decisions. From the complete set of available solutions there is a sub-set that does not lead to reduced transparency while still offering substantial benefits. Particularly with regard to privacy the need for taking careful design decisions in the early phases of protocol and software development is being asked for by data protection authorities.

2) Internet Driven Innovation in Europe

In the following table some examples are given of European innovations and/or business opportunities that have been made possible by the current architecture of the internet. While it is true that almost all of the biggest success stories in the Internet have been American (Yahoo, Google, iTunes, Apple App Store, Amazon, Netflix, Hulu, etc.) there have numerous examples of mid-sized European Internet successes. Some of the best known are:

Category	Name of Company/Service	Innovation / Business Case
Telephony	Skype, Fring, SIPGate	The world leaders in VoIP telephony. Skype has effectively “changed the rules of the game” in the telecom industry.
eCommerce	Barrabes, Tiscover, Virgin, PixMania, Huoto, Geizhalsbilliger.de, geizkragen.de, comparis.ch (Insurance comparisons)	Online sales platform allows for greatly reduced costs. Easy comparison and ratings (wisdom of the crowd) of products from different vendors
Social Networks	Hyves, Tuenti, Badoo, Netlog, StudiVZ, dailyMotion, XING, iwiw, AKA-AKI, IRC-Galleria	From very broad target (Badoo, 73.000.000 registered users of all types) to very specific target (Tuenti, several million Spanish teenagers)
Community-driven Content	SAP Developer Network, ciao.de (and other product review sites)	People supporting each other, but also feedback for manufacturers
Collaboration environments	BSCW, Alfresco, SAP StreamWorks	Content management systems and collaboration platforms enables people in different locations to work together on common tasks
Content players, webTV	iPlayer, Joost, Internet TV of most cable companies	Long tail access to content, new distribution models
Web-based business services	Enterprise Services – SAP	Mash-up of services from different providers enable quick development of new applications and integration of

and applications		company networks
Cloud-based Enterprise Computing	SAP ByDesign, Atos Sphere, Strato, Host Europe, JiffyBox	Full ERP functionality available on demand also for small and medium enterprises European based cloud computing, hosting and managed operations services.
Search	FAST, Exalead, Autonomy	Enterprise search engines - far more refinable than generalist search engines such as Google or Yahoo
On-line banking	EU banks and insurance companies	Banking without banking or complementing offices
Online payments system	Atos Worldline	Application development business model entirely based on pay-per-use (no development costs for customer). 90% of online payments in France.
Internet radio	Spotify, Last FM, Wimp,	Highly developed individualized recommender systems
Gambling	BWin, BetFair, Veikhaus	World leaders in online gambling
Online gaming	Zed, playfish, Digital Illusions	World leaders of onliner, mobile and social gaming
Security	Avira, F-Secure	

While the list presented above provides a list of successful larger companies the long tail must not be forgotten, i.e. every small and medium enterprise that is able to offer their products, services and solutions to a global market based on a very low barrier of entry. Small players today may become the big players of tomorrow.

3) Entrepreneurship and Innovation in Europe

The importance of the Internet as a driver of innovation and competitiveness in Europe is undeniable. One way to achieve jobs and growth in Europe is by turning more people into entrepreneurs taking advantage of the web. We need to ignite entrepreneurial drive that is able to turn ideas into actions, and finally into new web-based products and services. It is here where the Internet architecture plays a pivotal and unique role.

In time of crisis such as the one we have been facing, businesses have more than ever a sharp focus on reducing capital and operational expenses. The advent of cloud service providers, for example, may now allow specialized business process outsourcing (BPO) providers to focus on knowledge and still provide compelling scale in the infrastructure by using shared services online. Business Process (BP) execution is assisted often by web-based software tools that should be able to adapt to dynamic business conditions and organizational changes.

The most dynamic entrepreneurship and innovative business models, however, are yet to come. It should combine dynamic links and transformation of partnerships with technological enablers such as ad-hoc composition of shared services for ICT support. The existence of “dynamic e-service markets” in the future Internet will enable hybrid value proposition. Service Oriented Architectures (SOA) have been the main building block that allows integrating services and components across organizational domains, reusing them in different business settings, and building applications through orchestrating services following the business needs. The future architecture, however, should not only deal with the increased complexity and scale of modern business networks, but also focus on flexibility and adaptability, which are necessary precondition to execute innovation within entrepreneurship networks. These future architectures, however, are characterized by challenges such as scalability, privacy concerns and distributed security management, to mention few important issues which need to be overcome to ensure that innovation can flourish.

The move towards services also increases the emphasis on relationships, negotiations, and agreements. This brings particular challenges for the area of management and measurement of distributed architectures, as well as accountability, all of which are vital to create an ecosystem which fosters entrepreneurs and innovation. When it comes to governance, flexible business models (“X-as-a-service”), vendor relationships and technological applications shift continuously, so there is a need to make decisions in a more automated yet responsible way. One universally accepted set of governance rules would enhance accountability’s potential to bridge various national and regional legal regimes. We have to consider what will be required of accountability agents, how and when organizations will validate their accountability, and incentives for organizations to attain different degrees of accountability in distributed architectures.

From an entrepreneurial point of view, we should particularly put the focus on the needs of SMEs in Europe as regards Internet innovation. In fact the bulk of new jobs to be expected in the next decade will be created by small, smart companies that are agile and can move fast enough to grasp a particular market potential using Internet. SMEs are crucial for innovation in Europe and Europe's economy. SMEs are to gain productivity by having access to a better Internet and being able to streamline and reinvent their productive cycles. The focus should be for new and advanced web-based solutions to support entrepreneurs and SME’s Asymmetric access is no longer sufficient in a world where creative processes require the handling of large files and data sets. Is a redesign of the Internet architecture necessary in order to empower SMEs? For sure new and reliable and low-cost solutions for a next generation Internet are needed to unleash the potential of future pan-European SMEs in order to facilitate and foster job creation and growth with advanced networks for SMEs.

4) Innovation Hindered by the Current Internet Architecture Principles

In order to address a disruptive approach that really constitute a new generation of architectural technology we should bear in mind that the same current Internet architecture principles that are good for rapid improvement in popular services may hinder some aspects of innovation. We should take into account both advantages and disadvantages to provide an overall solution that outweigh the current Internet architecture. Considering that the fundamental principles that define the behavior of the Internet are: Flexibility, end to end service and collaboration, let us present some of the negative influences of these good principles:

- **Flexibility has enormously hindered security** approaches in the Internet: due to the freedom to work at any 'level' of the IP protocol, any IP service living in the open internet is exposed to misuse. Any router/server in the open the Internet is exposed to subtle attacks based on the mechanisms designed for open communications. A less flexible approach to communication protocols may have produced a more secure stack of communication protocols. The Internet is a forced playground for security solutions and that maybe seen as an opportunity for security innovation, but at the same time the excessive effort that everyone needs to do in security is reducing the time and resources devoted to service innovation. Protocols are open. No one can block misuse effectively as no one can block legitimate use of an open protocol. For example, recently a man-in-the-middle attack from a Chinese company had caused Internet traffic to be rerouted through servers in China. Today's **DoS** (Denial of Service) and **DDoS** (Distributed Denial of Service) attacks are serious problems that plague the Internet. These attacks are extremely difficult to deal with. Anyone can work out a distributed system that sends millions of messages to an IP address (the one under attack). Due to the flexibility and openness, any IP can be discovered by any other, any IP can communicate to any other and any possible type of message can be sent from any IP to any other. You can easily see that being able to send bogus control messages (ICMP) or bogus multicast messages (ICMP) or address special ports on given machines can only be used to disturb legitimate services. The counter attack involves filtering (firewalls) but you cannot effectively filter every site against any possible malicious message (due to legitimate uses that need go through the filter). Filtering is expensive. Not every internet endpoint can have proficient firewalls. Filtering scales very badly (due to expensive hardware). At the end such a flexible Internet is good for innovation in software: we can create virtually any communication service, but at the same time the Internet is a wild place in which it is easy to be attacked by millions of anonymous users.

- **End to end approach seriously hinders scalability of service ecosystem, network service standardization and QoS:** needing to work all the way between two endpoints, without being able to rely on previously constituted intermediary services, stops any development to a network of layered services. This is the kind of network that **IMS** precludes. A network in which there is no freedom to set endpoints, but you need to go through rigid hierarchies of network roles. The good side to this is that it is easy to plug small services here and there and the network takes the responsibility to keep on working, self routing and self healing. Deployment of value added services becomes easy. An ecosystem of services that can grant QoS has been

blocked by the impossible task of standardizing QoS treatment in different network segments. There are many examples of the inefficiency of end-to-end: there is a plethora of messengers (Microsoft, Yahoo, ...), P2P file sharing (eMule, BitTorrent, ...), video conferencing (Skype, ...) tools,.... This abundance of applications is one of the best things of the Internet, but at the same time there is no real-time common service in the Internet, there is no end to end common messaging service and there are no standard P2P file sharing facilities. These services will always need to be created from the ground up again and again because there are no intermediary common services that you could use. The 'de facto' communal functions are starting to appear (think of Facebook, Google docs, Skype, in-network storage systems like Amazon S3, ... and the many applets written to cooperate with them), but remember that 'de facto' does not mean open or free or reliable. Many of these popular platforms are closed or are under the suspect of an unknown future business model. Creating services on top of Internet is easy, and some of them become incredibly popular, but services repeat themselves over and over creating options for the end user but also confusion. Many of the good things a particular service brings can be lost if the service just ceases business. There is a lack of incremental utility for service development.

- **Compulsory Collaboration and lack of public authorities has hindered deployment of Internet and critical public services and applications:** compulsory cooperation is there as a result of Internet freedom and the lack of Internet authorities. As a *critical example* we may consider DNS and peering (peering as a Telco concept means cooperate to create a traffic exchange). **DNS** will never work if companies did not manage cooperation at a global scale. **Peering** at the traffic level makes it possible to have a global Internet. The *lack of authorities* that support core services in the Internet result in companies relying extensively on cooperation which leads to an unreliable playing field for a business web. It has been always difficult to create an Internet business model. The **End to end approach clashed against the reality of the business ecosystem:** Internet bases its foundation on the end to end principle but the reality is that nobody can control the Internet end to end. As the Internet grows and citizens believe that it is very valuable, they request a better one making the Internet an "emerging property" that comes out of a very complex system, the sum of all interconnected networks. In order to control and provide self-sustainability to this "emerging property" appropriate economic models are needed. We may try to look into the future for a reasonable economic model that could be sustainable for the Internet. We need to innovate also in the economics ecosystem. Internet needs a sustainable economic model that seamlessly pays for the network expansion and maintenance.

5) Principles to Inspire FI Architectures to Foster Innovation

The "relaxed" layering and end-to-end principles led to an Internet architecture with a thin generic network layer on one hand, and transport and application functionality on the hosts on the other one. The modular approach has allowed new applications to be developed and deployed rapidly, as no coordination with the network is required for application innovation.

As design principles always constitute a compromise, the open playfield for application innovation comes with a price. First, the thinness of the network layer in a composed global Internet poses a challenge for network providers to monetize investments in the network, leading to a pace of capacity build-up that is slower than the appetite of application consumers is requesting. Second, the limitation of the network layer to generic services for all application types, leads to sub-optimal performance for certain application classes, for instance frequent retransmission of popular on-demand multimedia content.

Attempting to solve these suboptimalities by introducing additional functionality in the network layer creates however serious dangers for the continued success of the Internet: application innovation could seriously slow down, and what is introduced to the benefit of a certain application class may exclude development and deployment of novel application classes we haven't imagined yet.

The following paragraphs propose a set of topics for debate when considering the evolution of Internet and its defining principles.

1. Measure and comprehend before considering modification of successful principles

The limited measurement capabilities and data we currently have on the operation of the Internet and the lack of performant analysis tools and theoretical frameworks to interpret such data, make it impossible to assess the value of modifications of the network layer in current and future conditions. The generation of such data and tools are the minimal condition to start considering modification of design principles for future Internet architectures.

2. Quality of Service for Critical Applications

Although the end-to-end principle doesn't exclude the deployment of Quality of Service mechanisms in the Internet, it certainly limits the available options to do so. The lack of Quality of Service may be an annoyance for the Internet users when consuming rich multimedia applications, makes it difficult for network providers to offer differentiated services, but constitutes a real problem for critical applications like emergency services and telesurgery.

3. Relaxed Layering and Security

The flexibility of the protocol structure that allows all layers above the network layer at the end-hosts to address the network layer creates security issues: malicious attacks endanger the operation of the Internet and security concerns slow down adoption of novel services by concerned consumers. Although a more rigid protocol structure with stricter layering principles could have a negative impact on the innovation pace, the higher security guarantees would render Internet operation more reliable and would increase consumers' trust in Internet services, thereby increasing the adoption pace of applications.

4. Framework for Intermediary Common Services

A set of additional services provided by network operators that would be of benefit for large classes of applications is starting to emerge. Example functionality being offered would be storage and content distribution, and media processing. The deployment of such services as

application modules in intermediate nodes is in line with the end-to-end principle of the current Internet.

5. Transport Layer Innovation

The suboptimal performance of certain application classes, like distribution of popular on-demand multimedia content and real-time multimedia communication, can also be improved by modified transport delivery solutions, which are in line with the layering and end-to-end architectural principles. Although several proposals exist, their deployment is very rare because of a set of reasons: first, the usage of novel transport solutions by application developers depends on their availability in the protocol stack in the OS, second, end-to-end principle violating intermediate nodes like firewalls hinder their deployment, third, application developers are seldom aware of the existence of these solutions because of too limited interactions between application development and network engineering communities. Measures to drive innovation (i.e. experimentation and deployment) in the transport layer would be beneficial for application innovation, and could furthermore provide tangible inputs for network layer optimization if this would ever be considered.

6. Application Component Eco-System for Continued Application Innovation

The productive possibility of application innovation of the internet architecture has led to an increasing complexity of the application functionality. Remote management and web applications may hide the complexity for the users but certainly doesn't decrease it. Application innovators increasingly depend on software building blocks to create novel applications. Although strictly speaking these components are part of the web architecture and not of the Internet architecture; for application innovation which is seen as the success factor of the Internet, they are crucial. Therefore the availability of performant modular software components for Internet applications, implying for instance sufficient incentives for developers of such components to make them available, will be a key factor to continue to fuel future application innovation. In the rich audiovisual environment of current Internet applications, the border between software modules and multimedia content is sometimes difficult to draw, so the same concern holds for reusable media content components.

7. Long-Term Disruptive Approaches

Although it is dangerous to modify the design principles of the Internet architecture and introduce changes in its network layer, it is difficult to imagine that the current solution is the one we will continue to use for eternity. But rather than introducing optimizations and variations - that are typically driven by short to mid-term concerns - we should explore disruptive approaches that really constitute a new generation of architectural technology. Ideas for self-organizing dynamic protocol stacks are explored, and long term research programs should include room for such endeavors.

6) Conclusions

Public Administrations decision makers need to know the importance of Internet architecture for all economic industries. The evolution of the Internet affects all economic actors, benefiting some industrial players while perhaps hindering others. Thus any steps taken towards modifying the Internet, whether in terms of technology and architecture or whether in terms of governance can be seen as a policy tool for modifying the economic situation in Europe. As such, this policy tool should be utilized to favour European business and entrepreneurship and to create a playing field that can foster innovation. For example, in Estonia there is the ability of citizens to do most of their interactions with the government via the Internet. Since there was no infrastructure in the beginning and very little money was available, so the government decided to minimize infrastructure investment and invested into computer education instead resulting in that the tax board saves a lot of money every year.

But we must be aware of the tradeoffs that any changes in the Internet may bring. An increase in security on the net could, for example, foster innovation in health or policing or citizen services. But, unfortunately, this increase in security could hinder innovation in some other areas such as social networking, peer-to-peer or content aware networks. As an example, an attempt to increase in security on the net by mandating service registration by users using their passports could foster innovation in health or citizen services. But, unfortunately, this increase in administrative overhead could hinder innovation for services that do not need such a high level of user registration. In general, while we need to protect people, their identities, their property, etc. we also need to protect the ability of people to share information, ideas, contents and products. The future Internet design should be such that both of these considerations (openness, flexibility and performance on the one hand, security, privacy and reliability on the other) need to be included and possible. And in cases where they are completely in conflict, a holistic approach should be taken where these tradeoffs are considered explicitly and not merely the result of decisions taken previously.

As explained above, some of the issues to be taken into account for future Internet design include:

- Measure and comprehend before considering modification of successful principles
- Quality of Service for Critical Applications
- Relaxed Layering and Security
- A Framework for Intermediary Common Services
- Transport Layer Innovation
- Application Component Eco-System for Continued Application Innovation
- Long-Term Disruptive Approaches

Policy makers should consider these and other Internet architectural design decisions and considerations, as another possible policy tool that can have far reaching positive effects in the European economic space and that allow innovation to increase leading to more and better jobs for Europeans.

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