Next Generation Internet Initiative
Background information
regarding the stakeholder consultation

Next Generation Internet 2025

1. Introduction

Introduction

The internet is a technology 'commons' unlike anything before – a shared benefit and shared responsibility for all of its users. It was never designed to perform the tasks it is expected to perform, and it is certainly not future proof as-is.

We need to do better in making sure that the internet as a shared global technical and social infrastructure is able to carry its heavy responsibility. This is especially relevant as we are about to embark on fascinating new journeys where we depend entirely on a safe, secure and open internet as a carrier - including an expected flood of connected devices on the outside and inside of our bodies, vehicles, buildings and infrastructure.

Trust at a global scale does not come for free: at the heart of sustainable trust lies actual **trustworthiness** that requires significant investment of time and resources. Research shows that while users may not always understand the way the technology works, they understand very well that the internet they want and need is an open, reliable internet that they can trust without any reservation whatsoever.

In recent years it has become all too clear that in addition to the obvious scalability issues there are many unforeseen persistent security and privacy challenges. Many of the challenges can be solved, and in fact working solutions are often known, but the transition at internet scale requires a systemic approach in addressing deep underlying technical issues, creating transition mechanism - as well as (in some cases) changing legal and governance parameters.

Introducing the Next Generation Internet initiative

This complex and precarious situation won't fix itself, and needs significant research investment as well as a concerted strategic effort. If we want people to trust the internet with – in essence – their private and social lives, as well as their business and government, the technology itself needs to be entirely trustworthy. The European Commission's DG CONNECT is therefore embarking on the Next Generation Internet initiative.
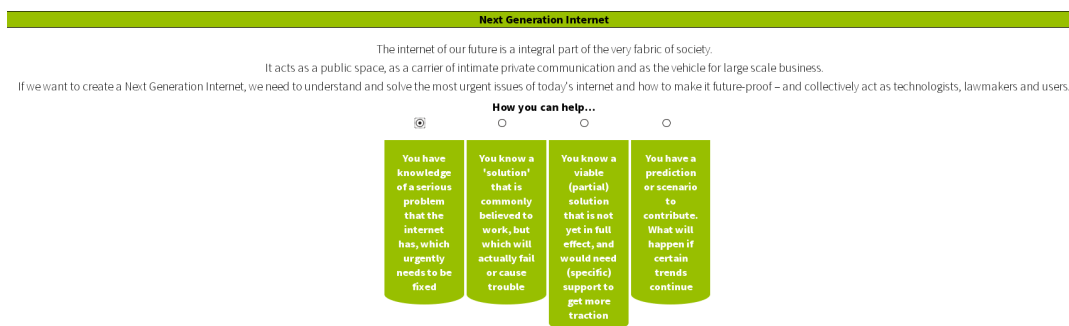
The NGI initiative wants to support the creation of an internet that supersedes the current internet, which supports citizens and businesses push further the frontiers of technology, an internet which retains people's trust in the online environment as well as their internet engagement, which is more human-centric and which offers the same fair opportunities to everyone (level playing field). Europe aims to shape this future Internet as a powerful, open, data-driven, user-centric, interoperable platform ecosystem.

Which brings us to **you**, to the **here** and **now**. If you were given the opportunity to suggest funded research and development, what would you suggest to make the Internet better? The key thing we ask you to help us with, is to understand the issues and possible approaches to solve them.

2. Your contribution

The **NGI vision** will be the main frame of reference for subsequent significant public investment in the Internet, that should have a noticeable impact on its evolution– provided the right choices are made. Certainly, history has proven that such an intervention is very hard to get right. Despite a number of well-funded attempts over a span of even decades, we still have not been able to address many shortcomings of the legacy design of internet – including security aspects that were kept intentionally weak for strategic purposes. We believe this is a unique opportunity to actually overcome that collective impotence.

During the stakeholder consultation, which is open until October 15th 2017 we ask you to bring in your unique perspective and ideas how we can make this collaborative effort work. We have launched a dedicated online platform[1], which helps us to structure the many ideas from the different communities of the internet.

Next Generation Internet

The internet of our future is a integral part of the very fabric of society.
It acts as a public space, as a carrier of intimate private communication and as the vehicle for large scale business.
If we want to create a Next Generation Internet, we need to understand and solve the most urgent issues of today's internet and how to make it future-proof – and collectively act as technologists, lawmakers and users.

How you can help…

| You have knowledge of a serious problem that the internet has, which urgently needs to be fixed | You know a 'solution' that is commonly believed to work, but which will actually fail or cause trouble | You know a viable (partial) solution that is not yet in full effect, and would need (specific) support to get more traction | You have a prediction or scenario to contribute. What will happen if certain trends continue |

 Each idea or suggestion is a single submission (so we can keep separate issues separate), and you can provide as much detail for your analysis as you want or need. Obviously, if issues are interconnected you can flag that as well. The whole process works from the browser, and requires no setup. It will take time to think through – what is needed to make an actual difference at internet scale.

If the structured approach of the online platform does not work for you, please send us your ideas by email to NGI@nlnet.nl – the internet really needs your input. We not just want to know solutions, but also why solutions that others believe will work can fail – and to know how you would mitigate if possible. Without at least some level of understanding of the problems of the whole, no meaningful change can be brought about.

We look to you for useful suggestions for new or undervalued research topics, intervention strategies such as open source deployment, legal barriers that should be brought down or erected, as well as motivations for prioritisation and urgency in the context of the next generation internet. Even a short summary of topics you see as essential could be very helpful.

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[1]   Visit: https://nlnet.nl/NGI

Think free

We encourage you to think free, there does not have to be a solution – asking the right questions is already a major contribution. We want to know what it takes to bring the internet forward, how we can reduce its technical debt and increase its resilience, robustness, openness and fairness – as well as its general utility for users. What is needed at the system level to create a better future?

Obviously the problems of the internet are manifold, as are the perspectives and strategies towards resolving them. Some issues are known to many, while other technological 'skeletons in the closet' are known to only a few people in very specific roles or to researchers. Sometimes the political or social scope or impact of a certain aspect is not obvious to those that know the technical parameters. This is exactly why we strongly believe the success of the NGI initiative hinges on the ability to involve different communities.

Please contribute as soon as possible, if you wish to do so – this will gives us the possibility to dig deeper and follow up with other experts.

Go to the consultation

HTTPS://NLNET.NL/NGI

Classification

The team will triage all the input, and classify in a number of categories:

- **Bugs** - Errors, flaws, failures or faults in the fabric of the internet which cause it behave in undesired ways.

- **Features** and **services** – Something that adds new generic functionality to the internet without requiring changes to the core

- **Security** and **hardening** – ideas that reduce the attack surface of users

- **Architecture alternatives** – ideas that try to replace problematic parts of the internet architecture with an alternative, in order to increase choice, or allow support of emerging features and services

- **Dependency management**/**refactoring** – ideas that are necessary to propagate the innovations identified, and help develop/redevelop sanitize critical software tools at the infrastructural level

- **Dissemination** and **propagation** – ideas to propagate the research innovation outcomes

- **Internet Governance** – ideas that primarily impact the governance of the internet

- **Anti-competitive** and **regulatory issues** - ideas for tackling market obstacles and strengthening opportunities

- **Measurement requirements** – ideas to gain understanding about the value delivered and the assumed severity of certain technical issues

- **Social justice**/**inclusiveness** – ideas that address universal accessibility and equal rights

- **Transition technologies** – ideas that provide short to mid term practical relief to tackle issues

3. Why Europe needs to invest in the Next Generation of Internet

The Internet is profoundly changing society and business

The Internet has become part of the fabric of society, enabling citizens, businesses and governments to collaborate, exchange and build knowledge and create value. It is providing the main platform for new businesses, enables new ways of doing business and changing business boundaries and dynamics for both large enterprises, small and medium ones and individual businesses. It is one of the key underlying elements for optimizing value chains and business operations. It is changing the way governments interact with citizens, how we educate and learn, how we manage our health.And last but not least: it has enabled collaboration across dispersed communities, and has forever changed the way culture and societal discourse takes place.

What enabled such a large diversity of services is the "permission-less innovation": the internet and the web today are open platforms, without gatekeepers. Even an anonymously created open source-project like Bitcoin can introduce and deliver a new, ground-breaking service without asking anyone for permission. This is an important aspect of inclusiveness, diversity and equal opportunities.

The Internet needs to technically evolve

The NGI vision has clear social and economic objectives that need to be met and articulates into a powerful vision for the internet.

This makes the Next Generation Internet initiative radically different from historical efforts undertaken in this area in Europe and elsewhere, because rather than merely stimulating research and development in a number of interesting technology areas, the NGI initiative aims to affect the whole of the internet - and intends to have an actual impact at the system level.

Policy making in the area of internet research has until now been largely focused on keeping up with the perceived speed of development of "the internet", by which is normally meant the speed of adoption of technology and services on top of the internet. Typically, policy makers and governments are expecting and driving more innovation and increased performance in the digital economy, new opportunities for smart cities and regions and public services, driving on one hand citizen engagement and direct democracy and on the other hand public sector operational efficiency and effectiveness. Industry is pushing for growth and competitiveness, targeting new markets and new consumers. Corporations and small and medium businesses renovate and expand their service and product portfolios levering digital technologies while facing new entrants.

The Internet in 2025 and beyond should enable this growth with open connectivity but also provide more and better services, more intelligence, access to more knowledge and information while allowing the freedom to access, participate and collaborate.

A tragedy of the commons

The actual technical fabric of the internet itself is another story entirely: much of today's problems with the internet stem from the fact that its technology stack is ossified. As the internet got catapulted into the mainstream economy in the nineties, it became a victim of its own success: the legacy technology from that era is still entirely dominant. Not a single technology upgrade designed by the Internet Engineering community has actually been adopted at true internet scale since, actually

negatively affecting both cost and risks: the old, insecure, technically limited and often very expensive technologies have to be kept up and running.

In 2013, the Internet Architecture Board (the technical committee that provides the architectural oversight of the activities of the Internet Engineering Task Force, and oversees the Internet Standards Process) organised a high level workshop in Cambridge on Internet Technology Adoption and Transition (ITAT).[1] The workshop involved the top of the internet standards world, as well as handpicked thought leaders from around the world. The conclusion was that the core internet technologies are failing to evolve, due to the complexity of interdependencies and the enormous pressure of the mass use of its legacy technologies. The asymmetry of allocation of cost (who should invest) versus the distribution of benefit creates a 'tragedy of the Commons': society is unable to reap in full the abundance of potential benefits of technology upgrades to the core technologies of the internet because lack of ownership for any solutions.

Unprecedented security challenges

While the observed inability to evolve the most important driver already would be enough to warrant immediate action, the situation became even more urgent in 2013. That year the internet world was shocked by the revelations of a whistle-blower called Edward Snowden, in what is considered by many the biggest IT scandal in history. He revealed fundamental security gaps in the core infrastructure of the internet that were actively exploited at a scale never before experienced in history for intelligence activities conducted by US and UK national intelligence agencies, particularly the US National Security Agency (NSA) and the UK Government Communications Headquarters (GCHQ). Pervasive surveillance capabilities undermined even the most common security measures and thus constituted an immediate attack on the trustworthiness of the Internet.

In response, the technical community started work to address or mitigate the vulnerabilities exploited in these attacks. But the decentralised setup of the original internet – from a technological point great because it allows to adopting new technology on top quickly – remains counterproductive at an economic level. Nobody can be held responsible and the asymmetry of cost and benefit has been halting progress.

The European Parliament demanded action to safeguard citizens' fundamental rights, urging the EC to take the initiative to repair the issue. In 2015 the Parliament repeated this with a motion saying that "too little has been done to ensure their full protection". With the NGI Initiative, the European Commission is putting its weight behind the Internet community.

Coping with high demand versus technical debt

With an all-out security crisis at the system level on one hand, the technical and operational internet community at the same time has to deal with carrying the weight of enormous growth and expectations.

Policy makers and governments are pushing for more innovation and increased performance in the digital economy. Business is pushing for growth and competitiveness, targeting new markets and new consumers. (Proprietary) technology platforms in for instance mobile and cloud fight for global dominance, knowing that a likely outcome could be 'the winner takes all'.

It should be clear that the massive overall problems with security, scalability, resilience and cost effectiveness need to be fixed yesterday rather than today, as they pose a real and very significant threat to users and to the health of the future internet. The pervasive surveillance adds additional

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[1]   https://www.iab.org/activities/workshops/itat

urgency to this, to the point of threatening the autonomy of our community and our economic viability. The cost of cybersecurity is already exponential, and this trend can only continue when not addressing the underlying technical issues. From a societal point of view, every investment made now on new services and products is made on top of instable, insecure and deprecated technology, and will potentially have to be redone in part or in full in the near future. If such is even possible at that point, otherwise it will cost yet more to be kept alive while the rest of the internet is transitioning away.

Delay to act will contribute to grow long term societal cost for the benefit of short term individual profits. The accumulation of the "technical debt" of the internet accelerates over time as we continue to increase dependency at an alarming rate through massive investments in new technologies on top of a fragile basis - such as 5G, IoT, cloud and data. This makes the Next Generation Internet initiative a vital and urgent effort for all of European economy.

Moving ahead strategically

Investments in the infrastructure of the 21st Century are needed in order to provide a privacy-aware decentralized secured environment for open data and open collaboration supporting democracy and innovation "spaces". Distributed architectures and public common frameworks are needed to allow the design of new services underpinned by open protocols, open standards, open formats, regulatory mechanisms and collective governance models based on democratic and participatory processes.

The Commission and the Consortium team want to create the conditions where digital businesses, new entrepreneurs, incumbents, communities and individuals can thrive with a vision of "connected freedom" and great economic integration, efficiency, opportunities and high rewards for those who compete and innovate successfully. For citizens, the power of cultural values and belonging must be preserved in a global context. Europe is faced with many challenges, including technological change, globalisation, energy and food safety, climate change, transformations of gender roles, migrations, economic and social exclusion and the ageing of the population. These concern key social and ethical values, and technology will be a key factor while the trust of users in the currently dominant actors in the internet industry is at a historic low.

Innovation was one of the main focuses of the Lisbon Agenda which placed knowledge at the core of social and economic development, and remains a core component of the Europe 2020 strategy. The Internet is one of the key enablers for knowledge circulation and for connecting ideas, capabilities, targets and funding at scale. Restarting the innovation engine of the internet through industrywide collaboration in the NGI initiative will mean new opportunities, a reshuffling of the card deck.

With new technology the business opportunities that respect European values such as privacy and human dignity, as well as restore the trust of users, Europe can reclaim its rightful share of the digital economy. The Internet in 2020 and beyond can enable growth with open connectivity, more and better services, more intelligence, access to more knowledge and information while allowing the freedom to access, participate and collaborate.

Partnering across the internet community is critical

The vision behind the NGI initiative means addressing the deep underlying technical issues with the core internet technologies (the "plumbing" of the internet) identified earlier and understanding how far it needs to go into the application layer.

However, having the technology on paper is one thing; getting it deployed throughout the fabric of the network is another. The internet is not owned by a single entity, it is a network of network as well as a layer cake of independent protocols - operated in different ways by different communities under

different economic circumstances. This 'layer cake' requires that any initiative needs to make a good fit with the operational requirements of the technical and operational communities that have to deploy new technologies while keeping the internet (and the weight of large parts of the economy) running as it is being upgraded.

Unusual needs call for an unusual approach: the collaboration between NLnet, as a not-for-profit deeply interested in keeping the infrastructure of the internet healthy, and Gartner as a global company with a deep understanding of the key trends and market forces and understanding of the business and applications leveraging the infrastructure of the internet, is such a unique approach. But we need more. The ambitions put forward in the NGI initiative are broadly shared among the technical community of the internet. The idea is to engage the technical community, digital civil rights groups and other key communities directly into the scoping of the initiative. And to do so directly in the context of their own activities.

Major European and global platforms and communities see the need for the NGI initiative: the European regional internet registry, the domain name organisations, ISP associations, the open source community, the digital civil rights community and Internet Society. So not just the separate communities that operate different layers of the technology but also the 'ethical guardians' of the internet: communities that aim to protect basic tenets such as accessibility, openness and digital civil rights and the 'users' that expect to continue using it for education, healthcare, citizen services or thriving business activities.

We believe that there is no adequate substitute for the collective engagement and intelligence of these communities - at the risk of missing out on essential input that will make the whole initiative moot. A next generation initiative will simply not happen without proper embedding into the technical internet community that constitutes and run the current generation.

We believe that the aspect continuous collaboration and dialogue is key to the Next Generation Internet initiative, and should make a huge difference.

Traditional funding does not entirely match

Most of today's research cycles in the EC Framework Programmes and elsewhere are multi-year efforts technologically specified entirely upfront, with an involvement of the funding entity more focused on evaluation at the end. That has become a mismatch with the interactive, meritocratic and self-structured bottom up process of the Internet world, as well as with its operational practices.

Running the internet is a major operation involving many actors and high operational demands, and one cannot just throw some technologies at them and expect (let alone demand) these to be adopted in the actual infrastructure.

Without adequate input and early involvement from the right actors in the technical and operational community the chances of getting the technological requirements for a smooth integration and deployment at internet scale right are very low. A project done without any stake in or responsibility for what happens after the project ends is also unlikely to be sustainable. In the sector this type of project is sometimes unaffectionately referred to as "code dump" practices - actually more harmful that not funding anything because it creates confusion and expectation that the problem is being solved while in reality that is not going to be the case.

The fact is that research and development projects need to do a lot more than just produce some running code: they need to have proper licensing management and code governance, use good software quality practices such as secure coding and accessibility guidelines and have test frameworks in place. External security audits for any security-critical code may be a baseline necessity. Most

historical projects already have a hard time adhering to even simple best practices such as 'release often, release early'.

In addition, when a project to be actually deployed across the internet one needs to factor in the projected maintenance cost and support available to the community that needs to adopt it. In most cases there will be significant effort and cost, which is only acceptable if there is enough trust in code quality and in integrity. Neither are common to achieve within a traditional short-lived project effort. Who would want to use a technology in any critical infrastructure when the short-lived project that created it will be unable to follow up on any bug reports (or even accept patches from external contributors)? Issues like these and the transformation of project results into value for citizens and business in general will be considered to be part of the design of the NGI initiative.

Technology operates in a complex and fast changing environment.

The methodology of using a top-down gap analysis in combination with long-lasting and broad programmes fulfilled by consortia means some resulting projects will already be outdated the day a call for proposals is published; observations of what happens outside Europe shows that the static type of funding typical for consortia is uneconomical and ineffective in the context of the internet or digital in general where technology is often created in small specialised teams. Global and rapid interaction between engineers from different background and with different use cases is the norm, and is vital to achieve quality. Consortia are limited to the subset of talent they got out of the global talent pool, and only compete with a small set of consortia with equally limited access to talent. The requirement to set up consortia artificially raises the cost of entry, and it would be better if the NGI would work with a smaller granularity and scale of funding - such as individual grants. Industry will need to be involved to ease adoption and fast deployment into the market. Eligibility criteria will need to be adapted in order to allow start-ups to participate.

In any case, in line with the Juncker Commission focus on results and transparency, the set-up of the NGI initiative programme will need to be adapted in order to allow early validation by the technical and business community as well as dynamic realignment and goal iteration when a project is no longer known relevant. This will allow to rapidly validate approaches and results, to get new people and actors involved and to fail fast. A lot of lessons learned within the Commission and through the analysis of external practices have already generated a lot of other ideas on what could be improved or changed.

The internet as an open technology platform excels with regards to incremental innovation possibilities that enable different stakeholders to iterate in parallel based on different use cases. At the same time, the NGI initiative will have to fit into the trust system that characterises the technical communities, building on trust earned by sustained contribution and fostering continuous dialogue and consultation of external experts, stakeholders during initiatives to increase quality and prepare marketability, while as a consequence increasing transparency.

Creating an internet of values

The internet has nested itself into the most intimate parts of the very fabric of humankind. It is a remarkable, universal superstructure, built from and interwoven with local private, public and shared infrastructures. The internet bridges ideas and images across languages, cultures, and media. It has become our primary public space, a carrier of our most private communications with loved ones and a global theatre for business, public engagement with citizens and virtually every aspect of human creativity and imagination. And we are just getting started.

The NGI initiative is strongly committed to shaping the next generation internet as a **resilient, reliable, responsible** and **people-centric** infrastructure in the knowledge that it will likely shape generations of humans in return. The original technologies that grew into the internet were never designed to perform many of the challenging tasks the internet is expected to perform today and tomorrow. In the light of the ever increasing intimacy and scale of our use of the internet across all domains, it is obvious that we need to urgently address the outstanding issues before accidents start to happen. It is clear we are not just investing in mere technology, but in an **internet of human values**. An internet that is **fair, open and democratic** – that embodies, strengthens and protects democracy, human rights and our way of life. Not just in Europe, but across the globe.

The internet as a phenomenon really belongs to us all, not vice versa. The internet and its standards and shared applications like email and the world wide web are technology 'commons' at a global scale. Anyone has the fundamental right and ability to use the underlying technologies to improve their quality of life, for whatever purpose and without discrimination. To use here also means also to study and incrementally improve upon, to suit ones individual and local needs - and thus the collective ability to spawn newer, better future networks and services over time. We need to build on those capabilities, and even strengthen them by fostering new shared domains, creating new commons. The future of internet innovation depends on the ability to actively avoid the formation of single points of failure, control or surveillance. So by innovating now, we protect all of innovation in the future.

To achieve sustained growth and keep new opportunities open, we need to do better in making sure that the internet as a shared global technical and social infrastructure is able to carry its heavy responsibilities. This is especially relevant as we are about to embark on fascinating new journeys where we depend entirely on a safe, secure and open internet as a carrier - including an expected flood of connected devices on the outside and inside of our bodies, vehicles, buildings and infrastructure.

Internet is here for the long term, and with the NGI initiative Europe takes the global lead in investing in a technically robust and morally solid internet to rewire our future economy and society. An internet that – by engineering, by spirit and by law– delivers on core principles and ideals of our society like fairness, inclusiveness, diversity, privacy and personal safety. That is robust against manipulation and threats. The right overall growth of the internet cannot be primarily driven by volatile forces of global tech capital or political will, but shall comes from a collective bottom-up design. We aim not for short term gain, but for creating the best possible internet that mankind can have. **A sustainable and fair internet itself is of immense strategic value, implicitly and explicitly setting the rules and conditions for the entire economy.** Fixing the known flaws of the internet is fundamental (in the most literal sense) to rebuilding trust, which in turn is vital to the success of unimaginably huge future investments in our economy, science and culture and collective knowledge - as well as having a major beneficial impact in our social and private lives.

The mere existence of the internet is the undeniable proof of the willingness of societies across the planet to create common understanding and trust in order to live, play and work together. Internet is a tremendous shared benefit for all its users, and Europe is willing and able to take up its responsibility and address the systemic issues that need to be dealt with. We all own the internet together, which also makes us responsible for the brightness of its future. The technology may have been invented by a few, but only the trust and buy in of our society has allowed it to flourish. By our strategic investment in the long term sustainability and openness of our infrastructure, the internet can lead the world and mankind into a future society that safeguards our shared values of human rights, of equal chances, of freedom and heart.

4. The NGI Roadmap

In 2016 the European Commission kicked off its Next Generation Internet (NGI) initiative, aiming for a more human-centric Internet supporting European values of openness, cooperation across borders, decentralisation, inclusiveness, transparency and protection of privacy. The NGI initiative is a broad and long-term initiative, mostly focusing on new technology areas like a better protection for private data, new internet architectures, decentralized data systems and new discovery and identification tools.

More information on the EC NGI initiative is available at:

- https://ec.europa.eu/digital-single-market/en/next-generation-internet-initiative

- https://ec.europa.eu/futurium/en/next-generation-internet.

5. Contact and questions

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NLnet as a public benefit organisation with well over two decades of unique experience in grant making for and supporting of bottom up internet infrastructure efforts. It has firsthand experience in deploying both 'open calls' and thematic funds to empower independent researchers and developers from around the world able to come up with unconventional solutions for the problems the internet is facing.

NLnet has funded essential work on important infrastructure parts of the internet, from the technologies with which the answers from the DNS root of the internet can now be trusted, all the way up to key standards for email security, transport layer security, email authenticity, and a lot more - on virtually every layer of the internet, from securing core routing protocols to browser security plugins, from firmware security to open source LTE networks.

NLnet is proud to be part of a global community in the technical and operational realm of the internet organically grown since NLnet's inception in 1982 when Teus Hagen launched the very first networking activities in Europe in 1982 (as president of NLnet, Hagen was one of the first Europeans appointed to the global Internet Hall of Fame).

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