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The internet at forty

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A mid-life crisis threatens its future

THIS past week marked the 40th birthday of the internet. And, like most other things on the brink of middle-age, the internet is struggling with its own mid-life crisis. At issue is whether it can continue to provide equal access for everyone and everything, or must evolve into something entirely different in order to cope with changing circumstances.

Such contentious issues never dawned on the dozen or so engineers who gathered in the laboratory of Leonard Kleinrock (pictured below) at the University of California, Los Angeles (UCLA) on September 2nd, 1969, to watch two computers transmit data from one to the other through a 15-foot cable. The success heralded the start of ARPANET, a telecommunications network designed to link researchers around America who were working on projects for the Pentagon. ARPANET, conceived and paid for by the defence department's Advanced Research Projects Agency (nowadays called DARPA), was unquestionably the most important of the pioneering "packet-switched" networks that were to give birth eventually to the internet.

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Packet switching slices messages (whether text, graphics, audio or video) into suitably sized blocks of data, like a series of letters in the mail. Each "letter" has an address on the front, a sequence code on the back, and a chunk of the data inside the envelope. The network over which the packets travel routes them independently of one another, allocating the path that each is to take according to the resources available at that instant.

The goal is to get the best use out of the limited capacity of the various links in the network. As a bonus, packet switching ensures that, thanks to the many different routes individual packets can take, the message will always get through—even if it has to wait for errant packets that have taken the long way round. Such redundancy makes packet networks—unlike traditional circuit-switched networks—extremely robust.

Several weeks after the demonstration at UCLA, the Stanford Research Institute in the Bay Area joined the fledgling packet-switched network, to be followed shortly thereafter by the University of California, Santa Barbara, and the University of Utah. By December 1969 the first four nodes of

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ARPANET were up and running.

One crucial thing was still missing before ARPANET could become the internet as it is known today. There was no way of connecting it to other packet-switched networks, especially those based on the X.25 standard developed (from ARPANET) by the International Telecommunication Union, and used widely in Europe and elsewhere.

The missing link was supplied by Robert Kahn of DARPA and Vinton Cerf at Stanford University in Palo Alto, California. Their solution for getting networks that used different ways of transmitting data to work together was simply to remove the software built into the network for checking whether packets had actually been transmitted—and give that responsibility to software running on the sending and receiving computers instead. With this approach to “internetworking” (hence the term “internet”), networks of one sort or another all became simply pieces of wire for carrying data. To packets of data squirted into them, the various networks all looked and behaved the same.

To its lasting credit, DARPA paid for the necessary software to be developed and made it open-source and freely available. The result was a suite of internetworking protocols known as TCP/IP (after the first two protocols defined by the standard, Transmission Control Protocol and Internet Protocol). So effective was the Kahn/Cerf approach that insiders used to joke that TCP/IP would even work over a pair of tin-cans connected by a piece of string. (Enthusiasts have, in fact, transmitted IP packets using pigeons.) The internet as it is now known was born when ARPANET was converted to TCP/IP in 1983.

It was a decade later, though, before it became a household term. Anyone with memories of using early online services such as CompuServe or Prodigy will recall how tedious it was to navigate their cumbersome menus just to send an e-mail or read a bulletin board.

That all changed in 1991 with the invention of the World Wide Web by Tim Berners-Lee and Robert Cailliau at the European Centre for Nuclear Research in Geneva. Within a year software packages such as Viola, Cello and Mosaic had made it possible for users to browse the web graphically, by clicking on highlighted links embedded in pages of information that would redirect them to other web pages, and so on. The rest, as they say, is history.

Or so it would have been if all that the world’s 1.1 billion internet users wanted to do was search the web for information, buy goods online and send e-mail messages to one another. But today such applications account for only a small fraction of internet traffic. The bulk of the bandwidth is hogged instead by people downloading or swapping music, television shows and full-length movies, or playing online video games.

Nowadays, YouTube streams more data in three months than all the world’s radio stations plus cable and broadcast television channels stream in a year. Justification enough, say the cable and telephone companies that provide access to the internet, to ration it, charge extra or even block heavy users altogether—as Comcast, America’s largest cable TV provider, was caught doing illegally a couple of years ago.

Proponents of “net neutrality” argue that, apart from charging or rationing heavy users, the telephone and cable monopolies want to act as gatekeepers to the internet, deciding which websites load quickly and which won’t load at all. In other words, they want to tax content providers to guarantee speedy delivery of their data, while discriminating in favour of their own search engines, internet phone services and streaming video. Tim Wu of Columbia Law School calls it the “Tony Soprano business model”.

Your correspondent thinks both sides are being disingenuous. There is no question that, if net neutrality means keeping the internet the way it has been for the past 40 years, it will stall and eventually collapse under the weight of the world’s burgeoning demand for online multimedia. It desperately needs a make-over as well as significant investment in additional capacity.

And beware of those who scream the loudest for net neutrality: a neutral internet that offers a first-come-first-served service only perpetuates the advantage that large incumbents like Google, Yahoo, Skype and Akamai already enjoy at the expense of smaller firms and start-ups.

But the phone and cable companies are themselves being duplicitous. Their argument for a tiered service, with heavy users paying more, is based on the need to guarantee a higher “quality of service” for time-sensitive data such as streaming video or internet telephony, which can freeze annoyingly if packets get lost or delayed. By contrast, no-one cares if an e-mail takes a few seconds longer to arrive—and it can therefore be allotted a lower quality of service.

Your correspondent believes some form of prioritisation for time-sensitive data is going to be crucial

in a world of video everywhere. But he is not convinced that the phone and cable companies should be allowed to charge for it, as it costs them little to provide. Besides, a technique called "over-provisioning" provides more bandwidth for less money than any of the quality-of-service approaches currently being touted. Anyone in doubt should check out the Internet 2 Abilene Network used by a number of American universities.

A bill that would guarantee net neutrality is working its way (for a third time) through Congress. The last two attempts by Ed Markey, a Democratic representative from Massachusetts, to get net neutrality onto the statute book faltered. But with a more sympathetic president in the White House and a new chairman at the Federal Communications Commission, the bill's political fortunes would seem to have brightened noticeably.

Whether the bill will do much for people wanting to watch their favourite TV shows on a computer or mobile phone is a different matter. Sooner or later, the dilapidated internet will have to be refurbished.

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