NET DRAG: NETWORK EXTERNALITIES AFFECTING NARROWBAND INTERNET CONNECTIONS IN A BROADBAND ENVIRONMENT

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ABSTRACT

Preliminary evidence from the qualitative phase of research being undertaken at two study sites in Australia indicates that significant network externalities are beginning to emerge as a result of increased broadband use. These externalities are reported to be having adverse effects for businesses and individuals utilising narrowband connections, and are suggested to be resulting in a migration to broadband services. This paper terms the effects of these network externalities net drag. In contrast to previous work in New Zealand this paper suggests that net drag resulting from network externalities generated on a hetergenous web-speed environment will become a primary driver of broadband take-up over the next two to five years.

INTRODUCTION

Australia, like many other countries, has been keenly monitoring broadband take-up rates, internally and externally (Alston 2002; Broadband Advisory Group 2003). Broadband connectivity is one measure used to monitor participation in knowledge-based economic activity (Australian Bureau of Statistics, 2002). High rates of broadband penetration are generally viewed to be an overall positive, if not inevitable, development to Australian telecommunications – offering economic efficiency and residential entertainment choice (Department of Communications Information Technology and the Arts 2003). Over the period of June 2002 – June 2003, subscription rates to broadband services have doubled, and broadband connections are currently used by over half a million households and businesses (Australian Consumer and Competition Commission, 2003).

A fixation by government and government bodies on take-up rates however may have overshadowed a crucial examination of network dynamics, and the possible impacts of broadband connections on other Internet users; users who are increasingly reliant on

Internet services and who now find themselves working within a heterogeneous web-speed environment. With many businesses and workplaces effectively dependent on Internet services for information, communication, and financial transactions, network externality effects need to be examined closely to avoid adverse developments in Internet accessibility. Decreased accessibility or increased cost of connectivity may have disproportionate consequences for the productivity and profitability of certain sectors of the marketplace.

Network externality effects

Network externalities effects refer to non-compensated benefits or disadvantages that a user of a network experiences as a consequence of other people connecting to, or using, the network (Liebowitz & Margolis, 1996).Network externalities can be positive (for instance, one subscriber to a telephone network benefits from other subscribers adopting the same network through greater range and connectivity) or they can be negative (for instance, more subscribers to a network, say a particular loop of coaxial cable, may create greater congestion and slow down the experience for all users on that particular section of cable).

Network externality effects in relation to broadband diffusion have been relatively understudied. Most work undertaken on network externalities in computer networks tends to concentrate on the positive network externality effects gained by communicating parties having greater connectivity with each

other (Capello & Nijkamp 1996; Goolsbee & Klenow 2000; Liebowitz & Margolis 1996). In the case of broadband diffusion these benefits may include two offices being able to videoconference when both parties are using a 256kbps data connection, or groups of gamesters being able to participate in new forms of interactive gaming when all participants are connected to a broadband link.

Prasch (2003, p. 481-3) however notes in his examination of the introduction and use of credit cards, cars, computers and e-mail, that network externalities related to technical change can create economic and social exclusion for people living in poverty.

> *The idea behind each of the above examples [of credit cards, cars, computers and email] is that a conjunction of high fixed costs with large network externalities can make it increasingly expensive for each of us to be full participants in our society*
>
> *...technical change, whatever its larger merits, may able have the effect of steadily increasing the cost of a minimum level of social functioning.*

Although there is a growing body of literature on 'the digital divide' and the 'information rich' and the 'information poor' (Haywood 1998; Horin 2002; Venkatesan, Eversole, Robinson, & Clarke 2002), there has been scant attention paid to the possible effects of broadband introduction to other users of the Internet.

A review of broadband (ADSL) diffusion factors in New Zealand by Howell and Obren (2002, p. 30) however found that :

> …*while there may be some advantages from standardisation among regularly communicating users, we can find no evidence to support the hypothesis that the existence of network effects is significantly accelerating the diffusion rate of ADSL, beyond the existence of some localised effects.*

Howell and Obren (2002) concluded that although distinctly different broadband take-up patterns appeared to exist for the two main broadband markets in New Zealand – the small office/home office (SOHO) market, and the business market – other factors appeared to be greater drivers for broadband take-up than network externality effects. These factors included information barriers (marketing and broadband knowledge), vintage capital replacement (replacing old equipment as it wears out with the latest model), learning effects (training and organisational capital), and asynchronous technology adoption (where more than one technology is adopted at different times – e.g. Internet technology is adopted first and ADSL adopted later).

In discussing network externality effects however Howell and Obren (2002, p. 30) do comment that:

> *Communication between an ADSL user and a dial-up user will be impacted by the speed of the dial-up connection, as the modem user will require more time to access and retrieve information and to transmit responses.*

RESEARCH IN THE ACT AND THE NORTHERN RIVERS OF NSW

Preliminary findings from a three-year study examining the impediments and drivers of broadband rollout in Australia appear to contradict Howell and Obren's findings and suggest that network externalities are become a primary driver of broadband diffusion in Australia. The research compares two study sites – a regional area represented by the Northern Rivers area of New South Wales (NSW), and a metropolitan area represented by the Australian Capital Territory (ACT). The Northern Rivers of NSW has a dispersed population and diverse economy based on a mix of primary industries, tourism, retirement, and education and health. It also has patchy broadband availability – offered by a number of national and local suppliers providing a range of ADSL, wireless and satellite connections. Telstra is considered to be the primary supplier of broadband connections in area. The ACT has a largely urbanised population and a significant public service sector – including health, education and government services, but very few primary industries. The main supplier of broadband is a local partially government-owned

telecommunications company, TransACT, who primarily supplies high speed broadband via fibre optic cable.

Research Methodology

The first phase of the study involves conducting semi-structured interviews with managers and employees within a variety of government and private enterprise organisations in each of the study sites. To date 20 semi-structured interviews with have been undertaken. Organisations were matched for type of business across the two sites (e.g. one university was interviewed in each site). Interviewees were asked about their current data connections, current and potential data requirements, organisational structure and daily work. This data was then thematically examined. The second phase of the study (to be completed) will involve sending out a survey to randomly selected residents within each of the study sites, and assessing telecommunications use, needs and desires of households. It is the preliminary findings from the interview phase of the research that will be discussed in this paper.

Early findings

Interviews with managers and staff in both the metropolitan and regional sites highlighted the ubiquitous pressure being felt by organisations to increase the bandwidth of their data connections. This pressure appeared to be the result of the combined effects of an increased dependency on the Internet for communication and business services, and an increase in the need to send and receive larger discrete files.

Applications and content that were reported to have caused problems for users included picture files, PDF documents, audio and video streaming, interactive news services, animated customer interfaces and power point presentations. These files were reported to be larger than most content sent two to three years ago, and were thought to be circulating the Internet in greater frequencies.

Staff interviewed from government agencies were commonly found to be working in networked branch offices of varying sizes. In a majority of cases broadband connections were being sought as a matter of urgency. When the manager of a Legal Aid office in Canberra was asked if her office of around 50 employees had experienced any problems with the network slowing down she stated:

> *Certainly that was happening when we were still connected via dial-up modems, and that was one of the reasons we upgraded. Particularly solicitors accessing sites and wanting to download large documents from the government websites – like 300 pages – that would slow everything down. But that's not happening now [after upgrading to ISDN services]. It's much better (Davidson 2002).*

A local council in the Northern Rivers area also experienced the same problem.

> *Don't really have the need to go onto broadband just yet but [we] will be examining it over the next year or so. Large emails - Acrobat PDF files - hold up the system sometimes (Golan 2002).*

However it's not just government that's starting to feel the need to upgrade. The private sector is also experiencing pressure from the external Internet environment to upgrade.

A financial services business in the Northern Rivers indicated:

> *Up until now most of the banking information has been text based and hasn't required large bandwidth data links. This is changing however as large emails containing graphics or large patches are increasingly common, and new graphic-based applications are being introduced. For example there is currently a new insurance system being trailed with Acrobat (JAVA script) forms that require higher bandwidth (Stewart 2002).*

A film producer living away from a major centre in the Northern Rivers also claimed the main problem he experiences on his narrowband service is the time it takes to download material. He stated that the lack of affordable broadband would affect the viability of his business in the next few years due digital formats he works with and the dysfunctionality of his current narrowband

connection in the evolving Internet and film industry environment:

> *Typically the files will be of animations in digital form - prepared at our direction or from storyboards and we need to see how they're going and what they're up to, whether they've followed the direction accurately. It will either happen at an animatic stage, - often [a] simplified low resolution form - and as it downloads it ties up computers for hours. Even downloading a 30 second animatic on low resolution can take hours, let alone some of the kind of high resolution images that are needed for the end product.*
>
> *… With more and more stuff being distributed by broadband, the absence of broadband here is becoming a real issue. It can affect whether we proceed with the project of not (Wiley 2002).*

NET DRAG

It is proposed that it is the discrete *size*, as opposed to the amount, of the traffic circulating the Internet that appears to be causing congestion specific to narrowband users. The retardation of the Internet experience due to large files mainly occurs at the end of the twisted pair copper telephone line, and is accentuated if the user is situated further from the exchange where bandwidth is already impaired. Although increases in the amount of general traffic circulating the Internet is likely to cause difficulties in certain areas of the Internet, it is the size of individual files that causes the most retardation to the narrowband user. For instance receiving 500 instead of 50 text only emails wouldn't cause the same problems as downloading 50 medium sized PDF documents instead of 50 text only emails. The narrowband congestion caused by increased file sized, which I will term *net drag*, is predicted to become increasingly disabling for users over the next few years as broadband take-up moves further into the mass adoption phase. Although problematic for narrowband users, net drag is likely to provide telecommunication companies with a convenient consumer push to facilitate the migration to more expensive broadband services.

As I have defined it, net drag specifically refers to the retardation of lower bandwidth experience over time due to a larger percentage of the Internet content (webpages) and traffic (files) being sent to and from higher bandwidth connections.

Net drag in Networked Offices

Net drag appears to be of particular importance to small to medium sized organisations and businesses (SMEs) with internal computer networks that utilise applications such as Windows NT or various Ethernet arrangements. As seen from the interviews above, members of staff from these organisations have claimed that large files combined with narrowband connections are significantly decreasing the productivity of their workplace, and driving the upgrade to broadband. Unlike someone working on a stand alone computer who finds that their individual computer is increasingly seized-up for significant periods of time as email or documents download, people working on internally networked computer environments where the network is connected to the Internet via dial-up modems are finding that all their computer-based employees working on the network may be affected when a large document or file is downloaded or sent. As one employee checks their email and starts downloading a large attachment, all the other employees in the networked environment find it difficult to open applications, print off receipts, download documents, or access information on the central server. The inefficiencies that net drag causes are likely to make a particular business uncompetitive, and so the push to upgrade in the business environment is accentuated.

Net Dependency

The move to place more government services on-line is also seen to be a driver for greater broadband take-up. This was acknowledged in the latest report from the Broadband Advisory Group (2003, p. 52), *Australia's Broadband Connectivity*, which states:

> *While the implementation of a large range of government services online has driven the take-up of broadband within government itself, it also encourages the take-up of broadband by businesses and*

> *individuals by providing services for online use.*
> *… Access to government services online is now a significant component of Internet use by Australians, and will be one of the drivers for broadband connectivity.*

The move by the Australian Government to commence serving the public via the Internet began in 1997 when Prime Minister John Howard announced the Commonwealth's 'GovernmentOnline' strategy. (National Office of the Information Economy 2002). The 1997 policy required government agencies to deliver all appropriate Commonwealth services electronically via the Internet by the end of 2001; establish electronic payment as the normal means for Commonwealth services by 2000; and establish a government-wide intranet for secure online communication (DCITA 2000). Government agencies found themselves in a new era of Internet dependency. Email became the major form of document delivery for all levels of government, and an essential way to communicate between agencies. Now the 'GovernmentOnline' policy has evolved further with the launch of the 'e-government' strategy in November 2002. 'e-government' is said to ultimately save the user money, and "that there were potential financial benefits to government agencies through reductions in costs" (DCITA 2002).

> *As a direct consequence of policies such as 'GovernmentOnline' and 'e-government' government agencies have been changing their work places to communicate electronically between each other and utilise the Internet to a greater degree to deliver services. "* (DCITA 2002).

In 2001-02 there was a sudden jump in business broadband connections, quite possibly in response to online government services – especially taxation services. Broadband connections for businesses rose by 299% for the year ending June 2002 (ACCC 2002; Alston 2002). For the same period residential connections rose only 85%. This would indicate that a significant number of businesses felt the pressure to connect to higher bandwidth services during this time. Although the growth has slowed over the last year there has been significant rises in residential connections (74%) while business connections still rose by 46% (off a higher base).

Predictions from Australia's major telecommunications provider, Telstra, state that Telstra will have one million broadband subscribers by the end of 2005. According to the 2001 National Census, 3,505,235 people

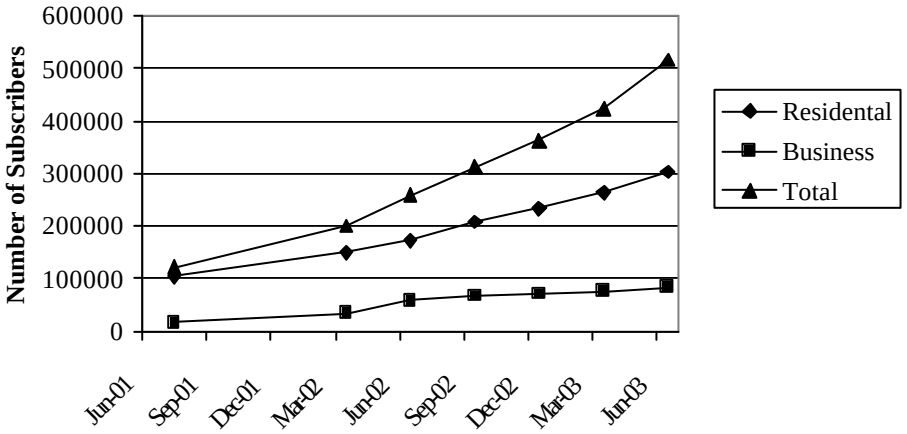

Figure 1. Broadband Take-Up in Australia, June 2001 - June 2003

Source Data: ACCC Snapshot of Broadband Deployment, June 2003

access the Internet at home, and a further 1,734,618 people use the Internet at work and elsewhere. Although the census measures *users* not *connections*, one million Telstra broadband subscribers alone would possibly account for a third of Australia's Internet connections being broadband by 2005. This may mean that the one third of Internet users in Australia who can afford broadband will be using and sending more applications designed for broadband use.

A recent Internet survey by the ACNielsen group has suggested that broadband use is changing the "userscape" of the Internet, and also suggests that 21% of active home Internet users were connected to broadband as of August 2003. The survey results suggested that compared to narrowband users, broadband users viewed double the amount of content and spent double the amount of time viewing, downloading and sending multimedia material – especially photographs, video files and music. Senior analyst on for ACNielsen Netratings, Markus von der Luehe, suggests that :

> *…the future for broadband will very much be driven by disenchanted narrowband users switching broadband, not necessarily to extend their current Internet usage, but to improve the efficiency of their online banking ticket booking, product information gathering , directories and general entertainment. (von der Luehe 2003)*

In addition to greater use and transmission of content via broadband connections to the home, the rollout of 3G mobile phones will also increase the frequency of larger files in the form of digital images, sound and video files to and from email accounts – either fixed or mobile. Australia has one established 3G network, Hutchison 3, while other carriers have introduced data-rich 2.5G functionality into their networks.

The Government's newly convened Broadband Advisory Group (BAG) has said that cost is the major impediment to broadband take-up in Australia, but they did not mention that the increasing cost of *not* upgrading may be also be factor in forcing SMEs to adopt the faster data speeds (Broadband Advisory Group 2003). The Regional Telecommunications Inquiry by Mr Dick Estens (2002, p.163) however made the comment:

> *The Inquiry believes strongly that the real issue facing many regional, rural and remote consumers is being faced by dial-up Internet users more generally—the performance of dial-up technology is not able to meet the growing expectations of many consumers for a faster and better Internet experience. In short, Australia has reached the 'bandwidth ceiling' imposed by conventional dial-up technology.*
>
> > *… Access to higher bandwidth services is becoming vital for the economic and social development of regional, rural and remote Australia.*

The Internet's first Upgrade

We seem to be approaching the Internet's first real upgrade. This upgrade will possibly be the first of many upgrades that will see businesses spend more and more on data capacity each year. These upgrades may or may not be offset by a worthwhile improvement in productivity – depending on the cost of upgrading and the type of business involved. The report from the Broadband Advisory Group indicates that greater productivity will be a direct consequence of upgrading to broadband (Broadband Advisory Group 2003). The graphs shown in the report indicated that firms with no Internet connections or narrowband Internet connections alone earn less per employee than firms with broadband connections. Correlation, however, is not causation and there could be a number of reasons for those figures – including size or type of business (Triplett 1998). Enterprises with higher earnings per employee may also be the first enterprises to able to afford broadband connectivity. There seems to be little independent research into the real economics of broadband adoption, however there is little doubt that the cost of data is set to become a higher proportion of the office budget, making affordability of data access a greater determinant of business development than it has been in the past.

One study examining the effects of state subsidized telecommunications in the United States demonstrated that lower data costs were able to attract businesses from neighbouring areas.

> *If information and communication technologies increase accessibility and support more locational freedom, the search by firms for the least-cost location is likely to reshape regional development patterns, which will lead to higher rates of growth for better-endowed regions. Therefore, such advanced technologies may alter location decisions of firms, increasing investments and output in some states, while causing disinvestments and possible job losses for other states (Yilmaz 2002, p 340).*

This creates an accelerating dynamic which appears to be set to continue. People on broadband connections of 256kbps may soon find themselves struggling to download files designed for 2Mbps connections, people on 2Mbps will need to upgrade to 10Mbps to stay in line with their respective industry standards, and it is possible that telecommunications companies themselves will continue to be active participants in creating the industrial and technical pressures for a series of network upgrades.

NET DRAG AND THE EFFECT ON AREAS WITH REDUCED BROADBAND COMPETITION

The problem of net drag is likely to intensify over time for those who don't upgrade, and is predicted to prove a particular problem in areas where there is reduced broadband competition resulting in higher connection costs. In a recently deregulated telecommunications industry where competitive broadband infrastructure has been carefully targeted at areas with higher incomes and lower service costs – what government reports and commentators have called the 'lower hanging fruit' markets of the state capitals (Besley 2000; Estens 2002) - businesses in regional and rural Australia may be waiting for some time before significant broadband competition develops.

Although new wireless technologies are showing potential to provide greater broadband access to many areas in regional Australia, the fall-back position for lack of access to a terrestrial broadband connection is connection via a one or two way satellite service. The trouble for people reliant on satellite connections – which includes people without terrestrial access living in large cities as well as people in regional and rural Australia - is that satellite is considerably more expensive than other forms of broadband delivery. For businesses and organisations that require a two-way satellite connection to send and receive large electronic files, the only current providers are Telstra and Optus, and for residential customers requiring a two-way satellite connection, the only current provider is Telstra. Competition in the satellite market hasn't developed, and this may leave many areas of Australia disadvantaged when it comes to broadband service, delivery and pricing. The Estens report (2002, p. 172-8) comments:

> *Enabling a single exchange [for ADSL] is an expensive exercise, so it follows that a large number of Australia's smaller exchanges are unlikely to be able to provide ADSL services in the short term, under purely commercial conditions. Further, due to a lack of customers within 3.5 kilometres of some more remote exchanges, many smaller exchanges probably will not be enabled with ADSL technology even in the longer term. This explains the concern of many submissions from regional, rural and remote areas that ADSL is not available to their communities. In these circumstances, satellite services are the only realistic option. While such services can be readily provided to isolated customers because the required infrastructure—satellite and telephone connection—is already in place, they are more expensive than ISDN and ADSL where these are available.*
>
> *… The price of installing the satellite equipment is still significant and tends to increase for customers living in more remote areas. Even with the SDDSO [Special Digital Data Service Obligation] subsidy, it is still considerably more expensive than ADSL. Combined with*

> *slightly higher usage charges, the cost of making local phone calls and the possibility of paying for an extra phone line to simultaneously have access to a voice service, the cost of a one-way satellite system can be significantly higher than an ADSL service. (Estens 2002)*

In July 2001 the Commonwealth Government offered subsidized access to one-way satellite broadband to people living in remote areas. That subsidy was then transferred to 2-way satellite services when they became available (Australian Communications Authority 2003). This subsidy however is only offered to people in remote areas; most people living in regional and rural Australia are not eligible for a subsidy under this scheme. For residents outside the designated areas or 'extended zones' the cost of 2-way satellite services is still up to four times the cost of a similar ADSL service (Colley 2002; Telstra Bigpond 2002). Unless significant competition develops in the satellite market and brings down the price of service, the double effect of net drag and the higher costs of data capacity is likely create a distinct geographic demarcation in business development, especially as other services – such as electricity, bank services and gas supplies - are also now subject to market segmentation as a result of full retail competition. Full retail competition – which has been sold to the consumer as the mechanism by which the price of services will fall to closely reflect cost of service or production - has in other service and supply industries created areas of distinct economic disadvantage, or areas where services (and sometimes essential services) are monopolised or withdrawn because of the low level of profitability (Sharam 2001).

The Problem with Trickle Down Models of Broadband Rollout

The pressures exerted on businesses and individuals by net drag raises some serious questions about geographic outcomes of trickle-down models of broadband access in Australia. The intertwining effects of net drag, the increased social and economic reliance on the Internet, and the large variation in broadband costs based on geographic location has the potential to create distinct demarcation in regional development. Users of broadband services, mainly centred in urban areas, may be pushing out predominantly regional users located in areas where broadband competition has yet to develop and costs remain high. Unless strategies can be developed to lift the bandwidth of the entire country almost simultaneously, large sections of the community may find their existing services becoming increasingly dysfunctional, which will in turn affect their profitability or viability. The most obvious strategies to avoid the negative consequences associated with the trickle down model in Australia would be those that delivered competition, price regulation or a universal subsidisation scheme in the broadband satellite market, to ensure that people dependent on satellite services are able to access 2-way data connections at prices comparable to those paid by people subscribing to other forms of broadband delivery. In what is now a competitive telecommunications market in Australia, however, wireless and cable broadband suppliers who have invested considerable funds in terrestrial infrastructure may resist any move towards price regulation or satellite service subsidisation. This is due to the price incentives that currently exist to facilitate customer migration from satellite services to terrestrial services – wireless networks, cable and ADSL where available. Without this price differential, investing in terrestrial services would be an even greater risk than it currently is.

Satellite Competition

There are signs that competition in the Australian satellite broadband market may be developing in anticipation of the deployment of further 3G mobile services. In late 2002 there was a series of announcements from the Department of Communications and Information Technology and the Arts (DCITA) that successful launches of the New Skies NSS-6 satellite, and the Government owned FedSat micro-satellite, would soon enable people in regional and remote Australia to access 'advanced broadband services'(ABC Online 2002; Department of Communications Information Technology and the Arts 2002; Larkin 2002). Optus was also scheduled to launch its high capacity satellite C1 in early 2003. Services and pricing schemes are yet to be offered however, and people in regional

areas are still waiting to see just how comparable they are to broadband services offered in metropolitan areas.

CONCLUSION

It could be argued that with the onset of exponential growth in subscription rates, Australia is beginning to move into the mass adoption phase of broadband take-up. Although this growth in subscriptions is generally seen to be a positive indication that Australians are embracing the move towards a more knowledge-based economy; something to be encouraged in order to keep pace with other nations in the advanced world, little research has done to examine the effects of widespread broadband use on other Internet users, and on the Internet environment in general. Preliminary evidence from the qualitative phase of research being conducted at two study sites in Australia indicates that significant network externalities are beginning to emerge as a result of increased broadband use. These externalities are reported to be having adverse effects for businesses and individuals utilising narrowband connections, and driving a migration to broadband services. This paper terms the negative externalities related to the increased use of higher bandwidth services *net drag*. Net drag results from the increased capabilities of broadband users to send and receive larger discrete files and applications. Net drag differs from other forms of Internet congestion (often created as a result of overall increases in Internet traffic) because it specifically occurs as a result of the movement of larger *individual* files and applications via Internet services, and primarily causes dysfunction at the end-user's connection, rather than within the Internet architecture. As reliance on Internet services expands (often due to the withdrawal of physical services), and cost of broadband connections continues to display geographic disparities, net drag has the potential to impede the network activity of people and businesses operating in areas with limited access to competitive broadband suppliers. This accentuates problems associate with trickle-down models of broadband access in Australia. Although competition in the satellite market and the further deployment of wireless technologies may help to alleviate some of the geographic cost disparities in the broadband market, users remaining on narrowband connections are likely to suffer from increased net drag over the next two to five years.

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