A comparative study of broadband technology in rural areas:
The availability and use by small office occupiers and the effectiveness
of use for e-commerce.

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Introduction

In recent years, there has been a transformation in the way that society has embraced new technology. Information and communication technology (ICT) has altered the way that communities (both business and wider society) operate, communicate and interact with one another, with information and data being exchanged at speeds that now make distance irrelevant.

These technologies have literally transformed the business environment. It is now suggested that every business today competes in two worlds; a physical world of tangible resources and a virtual world of information (Rayport and Sviokla, 1996). In such a virtual world, ICTs, e-commerce and e-business are becoming increasingly imperative for companies of any size aiming at improving their competitiveness in a constantly changing market (Chaumont et al., 1998; OECD, 1998).

ICT can have important effects on the productivity of economies. Recent studies (Dixon & Thompson, 2005 and Sing, 2005) have found evidence of a substantial and growing economic impact of ICT business adoption and usage. The UK Government has acknowledged the importance of connectivity in a report published in March 2005, setting out its digital and connectivity strategy for the UK which aims to increase the market penetration and use of ICT throughout the UK in all aspects of working and home life (DTI, 2005a).

Broadband is now available to most small and medium sized business enterprises (SMEs) and households in major UK conurbations (DTI 2005b) but rural areas still lag behind. The Department of the Environment, Food and Rural Affairs (DEFRA) identified that the challenges of ICT are greatest for rural populations (DEFRA, 2003); a view corroborated by the Commission for Rural Communities (2005) who assert that the problems of transition to a state of societal techno-dependency have particular resonance for rural areas where incomes are lower and public access points fewer and farther between. The provision of broadband has been slower in rural areas and it is only in the last year that a significant proportion of rural areas of the UK have had the ability to use broadband, as British Telecom (BT) has accelerated its roll-out of exchange enablement.

To date, ICT research has mainly focused on the urban case (specifically on the use of ICT in specific conurbations (Foley & Ram, 2002, Dixon et al., 2003) and the role of ICT in urban regeneration (Graham & Marvin, 1996); there has been relatively little research focussing on ICT in rural areas (exceptions include rural policy and ICT (Spurge & Roberts, 2005) and the nature of the urban-rural divide (CRC, 2005).

SMEs have an important role to play in any country's economy (Beaver, 2002). In most EU Member States, SMEs make up over 99% of businesses, generate a substantial share of EU GDP and are a key source of new jobs as well as a fertile breeding ground for entrepreneurship and new business ideas (EU, 2002). In the UK where there are 4.0 million businesses, 99.2% are classified as micro or small businesses. These businesses employ 12 million people, accounting for 58.2% of the workforce and 40% of GDP (DTI, 2004). In Europe, SME engagement with e-business technologies is described as "critical" if the EU collectively is to become a dynamic and competitive knowledge-based economy. Further to this, Taylor and Murphy (2004) suggest that if many businesses do not fundamentally rethink their business processes with ICT as the core enabler, they may not survive.

The take up rate by SMEs, which represent 93% of UK businesses and employ 58.2% of the workforce (DTI,2005b) has also been slower than for larger enterprises and this digital divide is most significant for rurally located businesses (DEFRA, 2005).

This paper aims to undertake a comparative analysis of the current availability of broadband technology for micro and small enterprises (hereafter MSEs) employing up to 25 employees in urban and rural areas. The study will focus particularly on office occupiers. Further to this, the study will explore the issues around the use of, and engagement with, e-business and e-commerce business functions. Following an overview of the current literature on broadband availability in the UK, government policy and engagement with e-commerce and e-business, the paper presents the findings of a comparative analysis of MSEs in urban and rural Oxfordshire to explore the availability and use of broadband technology and the engagement of these businesses with e-commerce and e-business.

Broadband Technology

Broadband is the term used to describe a wide range of technologies that allow high speed, always-on access to the internet. This is most often delivered via a connection through an ADSL (Asymmetric Digital Subscriber Line) connection or cable modem service, but can also be delivered using wireless terrestrial radio antenna or satellite connections. The latter two methods of delivery are more expensive to use and are particularly relevant for rural areas where other types of provision may not be technically feasible or economically viable. As broadband coverage expands, operators are now increasing the range of higher speed broadband services (2 to 10 m/bits and more) available to users, thus allowing users to benefit from faster connections and a greater bandwidth to increase the speed of transmission of information.

Stimulating broadband across the whole of the UK has been a Government priority (DTI, 2005), aiming to ensure that every community, irrespective of location, is able to access an affordable broadband service. The UK has now the third most extensive and competitive broadband market in the G7, behind Japan and Canada. (DTI, 2005a and EU, 2005). The key to future economic growth is now how to adopt and use this new technology for e-commerce and overcome the barriers to adoption.
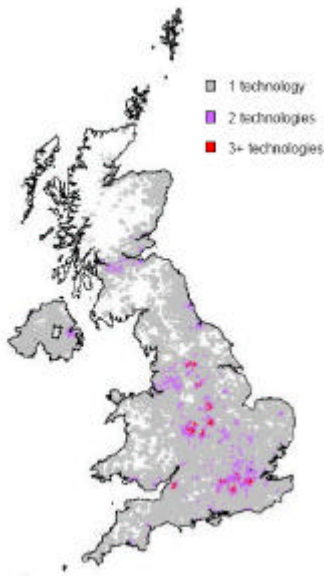
Ofcom (2004) states that 84% of UK businesses now have access to terrestrial broadband technology, being located in an area where the BT exchange has been upgraded and enabled to provide broadband services. BT plans to speed up the delivery of broadband services to rural communities and in April 2004 it announced a planned upgrade programme to roll out broadband to a further 1,200 exchanges, mostly in rural areas. This new approach replaced the broadband registration scheme, which relied upon consumer demand to prioritise the upgrading of services.

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Broadband in Rural Areas

Whilst there is little dispute that rural MSEs have much to gain from an effective engagement with e-commerce, the experience to date, particularly for firms operating in remote locations, points to considerable barriers to their involvement in the digital economy in the short term (Grimes, 2003). A study of 330 SMEs in a number of remote and accessible rural districts in three English regions concluded that a remote rural location did affect innovation levels in firms, and a lack of awareness of the advantages of the internet (North and Smallbone, 2000).

There are still more remote areas of the UK which still do not have access to a broadband supply by terrestrial means and these areas are indicated in white on the map set out below. Ofcom (2005) reports that 99% of urban households now have broadband coverage. This contrasts with only 88% rural households having broadband coverage. Whilst satellite technology allows coverage to nearly 100% of the UK (there are occasional satellite shadows), this is a costly alternative for most users to install.

UK Broadband Status Report, Ovum, 2005

The UK Government set out its strategy for the provision and use of broadband in rural areas in 2003 when it was acknowledged that too many rural communities remained excluded from the full opportunities of the new information age due to the lack of an affordable broadband supply (DEFRA, 2003). DEFRA created the DTI Rural Broadband Unit in 2003 to work across all levels of government to stimulate a sharper focus on the impact of broadband on rural economies. Initiatives aimed at addressing the requirement for broadband in rural areas have included the production of a Broadband Case Study CD-ROM providing case studies of broadband users, financial support for the Regional Development Agencies and for the Community Broadband Network which offers a collaboration network for community based broadband projects and the production of a broadband toolkit to help rural businesses understand the issues surrounding the access and use of broadband.

Recent research by DEFRA, 2005 has concluded that in general rural businesses adopt ICT significantly more slowly than their urban peers and this slower adoption is primarily attributable to a more limited range and intensity of 'influences' promoting the use of ICT, rather than 'barriers' to adoption. In particular, rural businesses are significantly less exposed to advertising, discussions with peers and the influence of new recruits. Moreover, ICT decision makers tend to be older in rural businesses and this factor appears to be associated with lower ICT adoption rates. The research considers that rural businesses are playing 'catch up' with broadband, now that it is generally available (c.40% of rural internet users, versus 60% of urban internet users). This is due to broadband being made available later in rural areas. The ICT adoption gap between rural and urban businesses is most pronounced in the 29 person employment band. The research concluded that the most important productivity advantages of ICT only start to be realised when businesses go beyond 'basic' adoption levels over and above the use of email and access to the World Wide Web.

Broadband and e-Commerce for MSEs

Over the last two decades, ICT has fundamentally altered the ways in which businesses are created, operated and managed (Keen and McDonald, 2000). The use of ICT has pervaded every area of day to day business, from finance, accounting and personnel, to production, servicing and marketing decision. In such a virtual world, ICTs, e-commerce and e-business are becoming increasingly imperative for companies of any size aiming at improving their competitiveness in a constantly changing market (Chaumont et al., 1998, OECD, 1998). Broadband is an enabling technology; it promotes progress towards an inclusive knowledge-based economy and ensures growth through improved competitiveness (EU, 2004). Timmers (1999) along with Rayport and Jaworski (2001) see e-commerce as either the undertaking of business electronically or as an electronic go-between for trading partners.

Significant opportunities exist for companies to use ICT (through broadband) to improve their performance (Tetteh and Burn, 2001) and to become more competitive and enhance their prospects for growth (Chadwick and Runfitt, 2002). Many of these benefits are unique to broadband (MacGregor and Vrazalic, 2004; these include new customers and markets (Ritchie and Brindley, 2000; Quayle, 2002; Raymond, 2001; Vescovi, 2000), improved marketing techniques (Sparkes and Thomas, 2001) and improved relations with business partners (Poon and Swatman, 1999). More generally, e-business and ICTs can be expected to bring significant productivity gains and higher economic growth resulting from the more efficient allocation of resources throughout the economy (Alston,2001).

Ofcom (2005) research shows that 68% of the UK's small and medium sized enterprises (SMEs) are connected to the internet, of which 37% use broadband as their main connection method. The statistics have not varied greatly since in the previous Ofcom survey in 2004 in terms of market penetration by SMEs.

The UK Government's 2004 ecommerce Survey of Business, (ONS, 2005) has found that the value of internet sales rose between 2003 and 2004 from £3.3bn to £71.1bn, while the proportion of businesses selling on-line rose by 24% from 5.4% of businesses to 6.7% of businesses. In the same period, internet purchases rose by 65% and the proportion of businesses purchasing on-line rose by 20% to 35.3% of businesses. The survey reported that just over 42% of businesses reported using broadband for their internet connection, a rise of 65% on 2003. By business size, the larger the business, the more likely it is to have broadband. The largest businesses,

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those with over 1000 employees report 94% use of broadband, while businesses with less than 10 employees report just 40% usage. Nearly 34% of businesses with less than 10 employees had a website in 2004, up by 10% over one year.

The DTI Annual Small Business Survey 2004 provides additional evidence of an increased use of e-commerce functions for MSEs reporting that only 19% of businesses, mainly those with no or few employees, did not use ICT at all. Uses of ICT were multiple, with 72% of businesses using ICT for accounting and record keeping, 70% for word processing, 69% for email communication and 56% for research. 55% of businesses had their own website.

Questionnaire Analysis

The survey sample was selected from the Thames Valley Chamber of Commerce database of members of over 15,000 companies. The sample was selected on the basis of organisation size (<25 employees) and location (by postcode). The latter were chosen on the basis of local knowledge of the general urban or rural nature of each area and double-checked by respondents' self-classification of their own location. Interestingly, although the sample was distributed to 50% urban areas and 50% rural areas; responses were skewed in favour of rural areas. 27.8% of responses were received from organisations in urban areas and 67.8% in rural areas. The remainder (4.4%) classified themselves as "other location"; follow-up revealed that all of these organisations were located in market towns in rural areas. For the purposes of this study, these were reclassified as rural.

Of 750 questionnaires distributed, a response rate of 14.8% was achieved. The sample can be classified according to their main sector of activity; 46.7% positioned themselves in the professional services sector and 15.6% were classified as computer services. A further 15.6% classified themselves as "other sectors" (these included creative and digital media) and 10% positioned themselves in marketing. Finally, 12% classified themselves as being involved in financial services, R&D or public sector. Several respondents identified multiple sectors as their major activities – telephone interviews were used to clarify the companies' major sector of activity to enable a more accurate analysis of the data.

As previous stated the survey targeted micro and small businesses (specifically organisations with up to 25 employees). Nearly 90% of responses were received from companies with between 1-10 employees; the remainder were received from organisations with between 11-24 employees. Table I summarises the nature of the sample by number of employees, sector and location.

Table I
Summary of responses according to sector, company size and location type

Location	Urban		Rural	
Employees	1 to 10	11 to 24	1 to 10	11 to 24
Professional services	12	1	24	5
Computer services	0	0	12	2
Financial services	2	1	3	0
Marketing	3	0	6	0
R&D	2	0	1	0
Public sector body	0	0	2	0
Other	3	1	10	0

The following section will firstly examine the availability of broadband technology to urban and rural MSEs and secondly explore their use of this technology and the level of engagement with e-commerce and e-business.

Availability of Technology

Firstly, respondents identified the technologies available to them in their work place. Analysis of the overall sample of respondents showed that email and internet access were most readily available to respondents, with 96.7% and 93.3% of respondents having access to these technologies. Two thirds of respondents work for organisations with a website and over half of respondents have access to local area networks (LAN). Fewer respondents identified the use of intranet (19%), wide area networks (WAN) (19%) and video conferencing (3.3%). Only two respondents did not have access to any of the aforementioned technologies.

However, more revealing are the combinations of available technologies used by respondents; the majority of respondents fit within a hierarchy of diminishing levels of use with increasing complexity of technologies. The hierarchy of technology is as follows; access to the internet, email, website, LAN, WAN and video conferencing; the majority of respondents adhere to this hierarchy. From an initial sample of 92, 85 respondents identified that they have access to the internet, of these, 98% also have access to email. Of the 81 respondents who have access to the internet and email, 70% (57) also have a company website; 18 of the 57 respondents use LAN in combination with the above technologies. 13 of those that use LANs also use WANs; 11 respondents also use these technologies in combination with internet, email and a website. Only 3 respondents use video conferencing, all using it in conjunction with all of the above technologies. Table II shows how the use of these combinations of technologies is split between the urban sample (27.8% of overall sample) and the rural sample (72.2% of overall sample).

Table II
Summary of responses relating to the use of technologies

Combinations of technologies	% urban sample	% rural sample
Internet	100	89
Internet & email	96	87
Internet, email & website	72	60
LAN	48	52
Internet, email, website & LAN	36	14
LAN and WAN	12	14
Internet, email, website, LAN & WAN	8	14
Internet, email, website, LAN, WAN & VC	0	3

Although the urban sample is smaller, the proportion of respondents with access to each level of the hierarchy of technologies is relatively higher than those in rural areas. For example 100% of the urban sample has access to the internet whereas in the rural sample, only 89% have access to the internet. Despite this, the rural sample have a more consistent presence at the higher end of the hierarchy – with 14 respondents having access to internet, email, website, LAN and WAN. Also, the 3 respondents at the highest point on the hierarchy, using video conferencing (in conjunction with all of the above technologies) are all located in rural areas.

Of those respondents whose organisations have access to the internet, 80% identified broadband access as their means of connection. Analysis showed that a greater proportion of the rural sample (83%) had broadband technology than the urban sample (72%). The remainder of respondents with internet access used narrowband (7) or wideband (11) internet access. The majority of the latter did not consider online technology as fundamental to the running of their organisation.

Of those respondents with broadband technology, 59 respondents consider the use of online technology as fundamental to the running of their organisation. Of these, 18 were urban businesses and 41 were rural businesses; this equates to 72% of the urban sample and 69% of rural sample. Of those respondents who have access to broadband technology, 88% use an ADSL connection. Other means of connection identified by respondents include cable (4), fixed wireless (3), leased lines (1) and satellite (1). Respondents identified a range of bandwidth capacities, with 54% of respondents having a bandwidth between 385K/bits to 2M/bits; only 2 respondents had bandwidth capacities of less than 385k/bits. 14 respondents had bandwidths between 2 and 10 M/bits and only 1 respondent identified a bandwidth above 10 M/bit.

Use of Technology

Of the 59 respondents who identified online technology as fundamental to the running of their organisation (53% of the sample), 41 have a website and 40 have both email and a website. Of the latter sample, 13 respondents are located in urban areas and 27 in rural areas. This equates to 56% of the urban sample and 41% of the rural sample respectively. In terms of the use of organisations' websites, the majority of respondents (76%) do not undertake financial transactions on their website. Of the

14 respondents that do undertake financial transactions, a majority (65%) are located in rural areas.

Of the respondents who have a website, 47% indicated that they evaluate the effectiveness of this website, with 53% of organisations not undertaking any form of evaluation. These evaluations are undertaken through a variety of means:

- Recording the number of hits on the website (19 respondents);
- Analysing the value of financial business generated by the website (16 respondents);
- Analysing pages viewed (13 respondents);
- Evaluating effectiveness of the website as a tool for marketing and advertising (11 respondents).

Many respondents also identified different combinations of evaluation techniques, for example; recording website hits and analysing pages viewed (3), recording website hits and analysing financial value (2), recording website hits, analysing financial value and evaluating effectiveness as a tool (3), recording website hits, analysing pages viewed and evaluating effectiveness (2), analysing financial value and evaluating effectiveness (2) and all of the above (3).

Of 74 responses, 59 identified that home-working was available within their organisation. This equates to 48% of the urban sample (12 responses) and 41.5% of the rural sample (27 responses). Of those respondents who explicitly stated there are no possibilities for home-working in their organisation, 7 are located in urban areas and 28 are located in rural areas. This equates to 28% of the urban sample and 43% of the rural sample. The remainder of respondents were unsure whether their organisation had the technological capacity for home-working and/or whether home-working was available within their organisation. Relatively more of the urban sample has access to home-working within their organisation.

Respondents identified the means of external communication most relied upon within the organisation. These were identified as email (60%) and the telephone (30%). Others methods of lesser importance are post (11 responses) and websites (6 responses). Respondents also identified a variety of different combinations of methods for customer contact. The most important communication combinations were identified by respondents as; telephone and email (identified by 23% of the rural sample and 16% of the urban sample as important) and email and website communication (identified as important by 8% and 4.7% of the urban and rural sample respectively).

Respondents identified the uses to which the internet is put within their organisation. Banking and other financial services are identified as the most popular use of the internet, with only 11% of the overall sample not identifying banking as an important use of the internet within their organisation. Other uses to which the internet is put within respondent's organisations are shown in Table III.

Table III
A summary of the findings relating to the use of the internet.

Use of the internet	Number of respondents
Banking and other financial services	62
Sales and marketing	39
Market research and business development	37
Government compliance and information	25
Employment / recruitment	14

Respondents identified a variety of combinations of uses to which the internet is put to within their organisation. The most popular combinations of uses are:

- Banking and other financial services and sales and marketing (10 respondents);
- Banking and other financial services, sales and marketing and market research and business development (9 respondents);
- Banking and other financial services and government compliance and information (5 respondents);

The above analysis reiterates the importance of the use of the internet for banking and other financial services, with this category being cited in every combination of uses of the internet.

Respondent were asked to identify areas of operation which had experienced change due to the introduction of the internet, specifically broadband technology. 41 respondents identified business development as the area where organisational change had been experienced most. This is followed by marketing (32 respondents), financial activities (26 respondents), after sales service activities (26 respondents), sales activities (24 respondents) and logistics and delivery (12 respondents). Several respondents identified multiple areas of change within the organisation, for example:

- Business development, marketing, sales activity and after sales activity (8 respondents);
- Business development and marketing (6 respondents);
- Business development, marketing, sales activity, after sales activity and logistics and delivery (4 respondents).

Respondents in rural areas identified significantly more areas in which they had experienced ICT-induced change. This is shown in Table IV.

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Table IV
Summary of responses relating to ICT induced change

Area of ICT-induced change	Number of respondents	
	Urban sample	Rural sample
Business development	10	31
Marketing	9	23
Financial activities	8	21
Sales activities	7	17
After sales service activities	7	19
Logistics and delivery	2	10

Summary of findings

To summarise, the survey identified greater use of broadband technology in organisations in rural areas than in urban areas of Oxfordshire, although respondents placed a similar emphasis on the role of online technology in their organisation, with the majority considering it fundamental to the operation of their business. The majority of respondents in urban and rural areas connect to the internet using an ADSL connection with a bandwidth between 385K/bits to 2M/bits. Those organisations lacking a broadband connection did not consider online technologies to be fundamental to the operation of their organisation.

The vast majority of respondents in urban and rural areas were found to use both email and the internet; although respondents continue to favour telephone and email contact with their customers and suppliers. Respondent's use of different technologies was found to decrease with increasing complexity. A hierarchy of technology use was identified as follows; access to the internet, email, website, LAN, WAN and video conferencing. The majority of respondents adhered to this hierarchy. Urban organisations were found to be present in greater numbers at the lower end of the hierarchy, but rural organisations have been found to have a more consistent presence across the entire hierarchy but particularly at the higher end with more organisations using greater combinations of more complex technologies. Further to this, relatively more urban businesses identified opportunities for home-working in their organisation

A greater number of urban respondents have a company website, although the majority of respondents were found not to undertake financial transactions through this medium. Those organisations that do undertake financial transactions are mostly located in rural areas. Of those organisations with a website, only half undertake any evaluation of the effectiveness of these. Respondents in urban and rural areas identified banking and financial activities as the primary use of the internet. Finally, business development and financial activities were identified as the key areas where organisational change has been experienced as a direct result of online technology. Rural respondents have experienced significantly more change as a result of the introduction of ICT than urban respondents.

Previous studies of SMEs and their use of Internet technology have been well-documented in the literature (Poon and Swatman, 1999; Senn, 1996). These studies identified the benefits of broadband technology for SMEs, such as of speed and ease of communication and the straightforwardness of searching for information as

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important factors of broadband use in SMEs. A previous study by the authors (Spurge and Roberts, 2005) also found that although broadband services were available, the engagement of SMEs with the technology was minimal, beyond communication and searching for information. None of those interviewed highlighted any e-business, e-commerce or marketing activities undertaken as a result of broadband technology. The findings of these previous studies have supported those of Taylor and Murphy (2004) who suggest that although current levels of engagement with these new technologies may be relatively extensive, they are also rudimentary. They state that e-business that goes beyond email and setting up websites is barely on the agenda of most SMEs.

The findings of this study do not wholly support the findings of these previous studies. The vast majority of MSEs in the survey have mastered email and internet access and a smaller majority have engaged with setting up and managing websites. Searching for information remains an important use of the internet (for example government compliance and information) but respondents are also heavily engaged with internet banking and other financial activities and to a lesser degree, internet sales and marketing and business development. Hence it is clear that rudimentary use of ICT is clearly on the agenda of MSEs in Oxfordshire. However, there is also evidence of more extensive and complex use of ICT, with respondents engaging to varying degrees with e-commerce and e-business. For example 50% of respondents undertake performance evaluation of the website, 25% of respondents currently undertake financial transactions on their websites and a smaller proportion use email, website and video conferencing to communicate with customers and suppliers. Other respondents use LAN in the workplace to facilitate data and information-sharing and WAN outside the workplace, the latter enabling tele-working for select individuals.

The results of this survey indicate that rural businesses are more engaged with the ICT hierarchy than urban businesses. Clearly more research is required in this area; initial results show that urban businesses are more engaged at the lower end of the ICT hierarchy, using email and websites. Although less rural businesses are using rudimentary technology, those that have engaged with ICT have connected to a greater degree, using more complex technologies in more effective ways. As a result, this survey does not wholly support the findings of Taylor and Murphy, concluding that rural businesses particularly are engaging with ICT on more than just a 'rudimentary' level. Although there is clearly room for improvement, with scope for both urban and rural MSEs to improve their use of ICT in the business environment, the authors feel that progress to date should not go un-recognised.

The level of change experienced by the introduction of broadband technology to the workplace is unprecedented, particularly in rural businesses. Respondents identified a wide range of areas where the business had experienced change as a direct result of broadband technology, with rural businesses identifying a greater number of areas, and a wider variety of change. As a result, initial findings suggest that rural businesses have 'come from behind' in the race for effective ICT use. These businesses have experienced significant change and engaged heavily with ICT; without a doubt improving both the operation and efficiency of the business. In some instances, these rural businesses have been over-taking their urban counterparts, whose engagement remains at a low level. As a result, the outlook for the penetration of advanced ICT skills into the MSE sector Oxfordshire, particularly in rural areas, as a direct result of broadband technology looks more promising than has been suggested by previous work.

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