Barriers and Opportunities for Cloud Computing Adoption and Use in Rural Ireland

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*Abstract*—This paper explores the barriers and opportunities of cloud computing adoption in rural Irish areas and communities, focusing on matters of personal experience and frustration I have experienced in remote education, entrepreneurship and online gaming. Despite the significant benefits of fast reliable broadband, rural adoption of such services in Ireland particularly rurally has been hampered by infrastructural limitations, economic constraints, digital literacy gaps, and cultural skepticism, recommendations include infrastructure investment, digital education, government support and community engagement.

Keywords—Cloud computing, rural broadband, remote education, digital entrepreneurship, gaming, Ireland.

# Introduction

During the Covid19 lockdowns, the country saw a massive switch toward online learning, business and entertainment. For me, this meant attempting to finish 6th year and prepare for my Leaving Certificate through video calls and online class platforms like Zoom and Microsoft Teams. At the same time, I was launching my first fully online e-commerce business and keeping in touch with friends through online multiplayer games. But living on a rural farm in Ireland, I encountered recurring obstacles such as, dropped calls, lag spikes, failed uploads, and slow downloads. These moments weren't just inconvenient they were constant hurdles and frustrations with seemingly no end in sight. They exposed a major gap between the promise of digital equality and the rural reality.

This paper is not just a research project it's also a personal account of the real barriers to cloud computing in rural Ireland and a call for solutions that make digital equity a national priority.

# Literature Review

Numerous studies point to a persistent ever present digital divide between urban and rural communities across the globe. In Ireland, this gap is especially visible in broadband availability and digital engagement. The OECD (2020) and European Commission (2021) both highlight rural connectivity shortfalls as a systemic issue affecting economic participation, education and opportunity.

International comparisons, such as with rural communities in the UK and Canada, provide models where government led broadband expansion and community based technology education programs have shown success in increasing digital literacy. We can take these examples to form a strategy for addressing similar barriers in Ireland, investment in broadband, local ownership of digital infrastructure, and tailored training programs to improve digital skills.

# System Architecture

Effective cloud adoption in rural Ireland requires rethinking architecture based on practical limitations. Below is a realistic, experience driven analysis.

**A.** Network Infrastructure

* **Broadband Access**: In rural areas like my own, patchy or slow broadband makes even basic cloud services unreliable. Fibre optic rollouts have increased but this needs to accelerate, and wireless/satellite solutions should be subsidized where cable is not realistic.
* **Wi-Fi Coverage**: Homes with multiple users and cheap or weak routers struggle to distribute bandwidth. Mesh networks and Wi-Fi extenders should be standard in subsidy schemes. As right now most Irish homes not just rural rely on transmitting signals through copper cables which is a significant downgrade but, in some areas, the only option.
* **Mobile Backup**: Improved 4G/5G coverage in rural areas can serve as a backup or primary source of connectivity in extreme cases. In my area 4G was recently introduced, subsequently all 3G networks here were then depreciated and shutdown. The sole 4G supplier here now being Vodafone. A single fault now means total network blackout.

**B.** Edge Computing

Edge computing could drastically reduce latency, especially in applications where milliseconds matter such as gaming or live classrooms.

* **Local Edge Nodes**: Edge servers placed in rural schools, libraries, or community centres could reduce round trip times to cloud services. Local libraries typically are placed centre piece in cities towns and villages, leveraging their strategic positioning to act as local network nodes would have a profound impact not only on locals accessing the network from home, but also significantly increase speeds and reduce frustration for those who use library computer facilities.
* **Modular, Renewable Powered Hubs**: Small scale hubs powered by local wind or solar can keep services online even during outages. Rural areas experience significantly longer down times compared to urban areas when services fail or experience outages, this can drag on for weeks and in extreme cases some smaller communities are down for months.
* **Hybrid Integration**: These hubs should link to national or global cloud services, balancing resilience and scale. This tackles regular and unexpected outages, while also having a myriad of knock-on effects helping people and communities online, all the time, regardless of circumstances bringing true network equality to Ireland across all of Ireland.

**C.** Hybrid Models

Given frequent outages, a hybrid model combining cloud and offline capabilities is crucial. Many applications and services that you would image having offline capabilities need persistent network uplink. For example, my own personal eBay seller account becomes completely inaccessible without a internet connection, even if I wish to use it to check data that does not update regularly such as the last 90 days of revenue. Most email services and apps allow you to check your inbox even without an internet connection, it wont update but allow you to access potentially crucial information and even send emails, once a connection is established again it will update your inbox and send any pending messages out.

* **Offline Mode**: E-learning platforms, e-commerce tools, and game libraries must offer offline modes to maintain usability and not become completely inaccessible or unusable as soon as a connection is lost or interrupted.
* **Sync on Reconnect**: Content syncing automatically when a stable connection return simplifies and eases use of applications and services regardless of their importance all applications should take these approaches.

# Use Cases

**A.** Education

Remote learning was a struggle in sixth year. Lag, frozen screens, and missed recordings were common. This shouldn't be the norm for rural students. Accessing large files of past examination papers while at home is frustrating enough without it taking five to ten minutes to load.

* **Platform Optimization**: Tools like Google Classroom and Microsoft Teams need better optimization for low-speed connections. Using better compression algorithms and loading files separately instead of in bulk would allow students/users to begin studying the first few pages as the last few continue to load rather than waiting for the entire file before being able to see any of it.
* **Device Access**: Irish Schools do offer device loans to students without them, these devices tend to be notably outdated, however. These slow low power devices paired with a user most likely unfamiliar with the technology, suggested by the fact they don’t have a device of their own, can cause severe frustration and challenges for them. An investment on supplying up to date hardware for students in need is essential for levelling the playing field across the country when it comes to education.
* **Teacher Training**: Teachers need support and training to deliver classes over cloud platforms effectively. From my own experience the mass migration to online learning left the faculty and lessons in disarray hindering their ability to teach and the student’s ability to learn. Training and a unified and simplified platform to do these remote classes over would mitigate this issue.

# Entrepreneurship

Starting an online business from a rural location shouldn't feel like running uphill. But the digital basics such as uploads, website tools, and customer service were frequently interrupted by slow speeds or dropped connections. Rural businesses have arguably the most to gain from accessing the worldwide market which would lead to reinvestments back locally to the community they’re in from large cities and countries across the globe.

* **Hardware:** Previously discussed network hardware infrastructure improvements have profound implications and knock-on effects in all areas and Entrepreneurship is one of them.
* **Affordable Services**: Small start up businesses in rural areas may struggle with certain services such as access to something as simple as post boxes. I have had personal experiences walking an hour to and from town daily to deliver orders to the local An Post post boxes in some of the hottest recorded Irish summers to give reliable next day shipping to customers. Services such as DPD offer at home collections but they come at a cost, incorporating a cost-effective government scheme to provide this same service or a subsidy for small business to use existing services could mitigate hardships and barriers to entry such as these.
* **Digital Mentorship**: Young entrepreneurs need access to digital skills training, ideally through local enterprise boards. Local enterprise offices provide these services but are known to be shorter on staff.
* **Cybersecurity Support**: Practical training on data protection and fraud prevention is critical. Entering the world of Entrepreneurship through an online median opens you to the entire world market, but also and entire new world of threats. This is compounded by Irish law requiring all Irish companies to have a publicly listed office address. Small start ups are essentially forced into doxxing their full legal name and home addresses on the internet to comply with the law. This creates a clear and obvious vector of attack for criminals and scams to take advantage of. Limiting the publics access to private company information and free training courses are required if our Irish companies are to remain safe and secure from all possible malicious threats.

# Online Gaming

Gaming during lockdown was often a social lifeline. But lag and disconnections often ruined the experience. Making it more of a frustration than entertainment or enjoyable.

* **Cloud Gaming Optimization**: Services like Xbox Cloud Gaming and GeForce NOW or at the time Google Stadia need local edge presence for improved latency. In my personal experience and without exaggeration every single one of these services were completely unusable in rural Ireland.
* **Gaming Hubs**: Community centres could offer supervised gaming areas with high-speed internet for teens and young adults. Youth clubs in Ireland have become a thing of the past with the advent of social media and other media entertainment devices becoming cheaper and more accessible. This is unfortunate as a big aspect of social interaction is being face to face or seeing the person you’re communing with. Many now turn to parasocial relationships with influencers online seeking that same social interaction, damaging the youth’s ability to socialise normally and leading to a more segregated and distant society. I believe the reintroduction of Youth clubs with new entertainment technology such as gaming consoles at its centre piece will sway teens and young adults to hang out in person again just like it has done in many Asian counties.
* **When it’s ready its ready**: The craze of companies jumping on the opportunity to provide gaming services completely in the cloud was incredibly optimistic but short sighted. Even densely populated urban areas in capital cities using such services experienced constant input lag. The technology to supply practically 0 latency cloud gaming experiences simply does not exist on a practical scale for this to work. However, when broadband technology has caught up and is fully rolled out. Owning nothing physical but a controller and being able to access the most powerful array of video game or workstation hardware from anywhere in the world is an exciting and innovative idea. Allowing anyone, with any need, to work from anywhere.

# Limitations and Challenges

From personal experience and community input, the following issues remain major hurdles:

* **Infrastructure Gaps**: Fibre rollout delays and lack of 4G/5G coverage remain pressing. In my case almost a decade of contacting service providers and members of the local government was required for fibre optic to be installed in our home. This is a free service that was meant to be implemented country wide half a decade ago, yet communities are still without it.
* **High Costs**: Other companies did offer to install this for use when contacted but the price was completely unreasonable. They are fully aware of the decade(s) long backlog for this service and are capitalizing on vulnerable communities that are out of options. A mass roll out of this service to all affected communities would drastically reduce the influence of these companies forcing them to once again compete and offer a better service at a cheaper price.
* **Digital Literacy**: A lack of experience in any field that people find confusing or frustrating makes them feel inadequate or unintelligent, encouraging them to stay away. Technology is the same but is getting more advanced at an exponential rate. The longer it avoided the worse the problem becomes. A wide variety of simple training courses need to be readily available and encouraged by local governments in order to prevent this epidemic.
* **Cultural Barriers**: In some communities, there is mistrust or scepticism toward digital tools and services. Growing up with farmers there was constant heckling about use or reliance on technology especially in the late 2000’s to the 2020’s. Now however the precedent has changed. There has been a complete 180 turn around as it becomes less and less possible to preform any task, duty or job without technical know-how and remain competitive. I now see young farmers leaning into technology and hopefully this trend continues. The matter of older farmers still in this mindset is still an issue, however. They require increasing amounts of support each year as technological innovation pushes forward. If this isn’t contained it could spell disaster not just for farmers jobs but the entire countries food and resource supply chain.

# Discussion

Solving rural Ireland’s digital divide requires action on multiple fronts:

* **Accelerated Rollout**: Full implementation of the National Broadband Plan, especially in the most remote areas.
* **Youth-Led Training**: Train students to assist community members in navigating digital tools.
* **Subsidy Programs**: Provide scalable support for households, students, and small business owners to access cloud services.
* **Public-Private Collaboration**: Tech companies should partner with local governments and communities to pilot cloud access solutions.
* **Green Cloud Transition**: Community cloud hubs powered by renewable energy could reduce costs and carbon emissions simultaneously.

# Conclusion

This report stems from personal frustration, but also from hope. Cloud computing has the power to radically improve rural life whether it's attending school remotely, launching a business from a farmhouse, or staying connected through gaming. But for this promise to become a reality, we need action: faster broadband, smarter infrastructure, digital education, and a cultural shift toward embracing technology.

Rural Ireland doesn't need a handout; it needs the tools to catch up and keep up.

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