

Infrastructure for a Connected World

An interface is best when it disappears and the user can focus the problem at hand. In the same way infrastructure, is best when it can simply be assumed and becomes invisible.

With an invisible infrastructure as with an invisible interface a user can concentrate on their tasks and not think about the computer. Dan Bricklin and I chose to implement VisiCalc on personal computers that people could just purchase. This made VisiCalc *free to use*.

The reason the Internet has been so transformative is that it gives us the ability to ignore the “between” and focus on the task at hand or problem we are trying to solve. To use a website all you need to do is open the browser and type the URL (or, often, use an app), and it “just works”. We take this for granted now. But when the web first burst onto the scene it seemed like magic. And, amazingly the web is effectively free-to-use because you pay for the connectivity totally apart from each website or connection.

If we are to extend this magic to connected things, aka the *Internet of Things*, we need to look behind the screen and understand the “why” of this magic.

In order to use the web, we just need connectivity. This worked well in local networks such as Ethernets where you can just plug in your computer and connect to any other such computer locally and thanks to interworking (AKA The Internet) this simplicity was extended to any other connected computer around the world.

Today I can connect to the web as I travel by having a cellular account and cadging connectivity here and there after manually signing up to websites (or lying by saying I read through an agree screen) and working past WiFi security perimeters. And we accept that oftentimes we’re blocked.

If we are to truly support an “Internet of Things” we need to assure free-to-use connectivity between any two end points. Achieving this is a matter of technology and economics.

To take a simple example: if I’m wearing a heart monitor it needs to be able to send a message to my doctor’s monitoring system without having to negotiate for passage. No agree screens or sign-up routines. For this to occur we need what I call Ambient Connectivity – the ability to just assume that we can get connected. This assumption is the same as assuming that we have access to sidewalks, drinkable water and other similar basics all around us.

The principle challenge to achieving Ambient Connectivity today is economic. At present we fund the infrastructure we use to communicate in much the same way we paid for railroad trips by paying the rail companies for rides just as we pay a phone company to carry our speech. For a railroad operator, owning tracks is a necessary expense it bears so that it can sell the rides. It wouldn’t make sense to offer rides to places that aren’t profitable to the railroad. It doesn’t allow you to explore beyond the business needs of the railroads’ business model.

In this same way the telecommunications company owns wires (or frequencies) so that it can sell (provide) services such as phone calls and “cable”. It can’t make money on value created outside the network. This is why there is so much emphasis on being in the middle of “M2M” or a machine-to-machine view of connected things and treating them like dumb end points like telephones.

With the Internet we create solutions in our computers and devices without depending on the provider to assure they reach the messages’ correct destination in order. In this sense they are more like automobiles than railroad cars and we need policies more suitable to the infrastructure of roads and sidewalks.

A road isn’t merely a trackless railroad. We can drive across open fields or walk along paths if we choose. But communities pay for roads and sidewalks as common infrastructure to facilitate transit.

We don’t have to collect a fee to pay for each step we take. More important, we don’t have to stop passersby to assure they paid their sidewalk fee.

The traditional telecommunications business model allowed innovation only to the extent that a path-provider made a profit. This is at odds with an Internet where value is created outside the network and is totally decoupled from the particular wire that might be used to exchange packets. This is much like the value of a particular stroll being associated with, but not charged by, a particular square of pavement.

We can solve this by having the local community join together to pay for the common infrastructure based on the value realized by the community as a whole. This is a market based approach based on aligning incentives and value creation. It’s what we do whenever we need to work together, be it sharing trash collection for an apartment house or paving the streets in a city.

The business of charging for “speech” (exchanging packets) limits innovation to what is profitable to a provider. It’s as if you can’t get a street paved because it isn’t sufficiently profitable to the owner. Instead of thinking about providers we should think about communities creating their own solution. You and your neighbors join together to pay for the streets because you need them, not because a provider profits from them.

If your broadband connection goes out there is likely to be abundant connectivity nearby via WiFi or cellular or over another provider’s broadband connection. But these may be unavailable because each one requires a separate billing relationship. It’s like having water everywhere but not a drop to drink. And to add further injury – if your kids need to do their homework on the weekend they might have to wait days to get that connection back.

The shift from railroads to automobiles happened once we had engines that were light enough to use existing roads. Automobiles and trucks then generated a demand for more road capacity. Today we would say that the ability to travel freely created a viral demand for more capacity. Municipalities paid for roads to interconnect their communities. In 1919 Major Dwight D Eisenhower (<http://goo.gl/foOZrw>) recognized the need for a national highway system. Later, when he was President in the 1950s he was able to implement it.

Today the seeds of change can be found in every home and corporation where we have common connectivity. Your devices may share common facilities. This wasn’t always the case. In 1995 the future of home networking was going to be the residential gateway and each time you added a computer you would get an additional recurring fee, just like adding another phone line or another set top box. I was at Microsoft at the time and wanted to put all my devices on a common network so I enabled windows to be “router ready” so that you only needed one connection to the rest of the world.

We take home networks for granted today but yet we still pay a separate monthly charge for each cell phone and other connected devices. We accept this model because few people understand the genius of the Internet and presume that we still need phone companies despite the success of Skype, WeChat, WhatsApp, and the many other offerings.

There is one Internet so why do we need multiple broadband infrastructures? Today’s policies are akin to having ConEd or PG&E build a separate electric grid to compete with Eversource. In practice we get competition by using a common grid and choosing which electric power company

we want to buy from. Unlike electricity we don’t really “consume” data.

The Internet does **not** act like water pipes. You don’t need twice the capacity for two computers. During the 100 seconds you are looking at a web page 100 other people download other pages without slowing you down. Carriers know this and benefit by reselling the same connections to 100 other people. Why can’t you get that same benefit by sharing with your friends and neighbors?

The good news is that we already have essentially unlimited capacity in place. It’s as if we were looking ahead to Moore’s law in 1970 and worried if we had enough silicon to meet our computing needs. Today’s limitations on capacity are the result of policy and not technology.

A single USB-C cable with very thin wires has 20 gigabits of capacity! With packets it doesn’t matter if the signal is helped along by a wire or if we use wireless for a given segment. This allows benefit from the synergy across all technologies. We get a hint of this in the vast abundance of Wi-Fi compared with the limits of the cellular approach.

We are not limited by cost or technology.

The seeds of change exist. Today’s home networks are DIY (Do It Yourself). Most companies and schools do their own networking. The Internet shows the power of DIO (Do It Ourselves). This is why I’m working to take home networking to the next level and turn apartment complexes and other spaces into connected communities. That provides the examples for larger communities such as campuses, office parks, and cities.

The Internet demonstrates the abundance and opportunity inherent in the existing infrastructure. Once we achieve recognition that the Internet is our new infrastructure we’re then ready to reap the benefits of trillions of dollars in direct innovation. We get the benefits of connected health care, better environment monitoring and so much more.

You can read more about these ideas at <http://rmf.vc/FurtherReadings>.