Interview with Ether 2's Jonathan Gael at the Launch of "The Q." at Fall Demo 2010

Hi Jonathan, you just launched "The Q.". What is "The Q."?
Jonathan Gael: "The Q." is a breakthrough networking technology that eliminates the need for routers, clearing the way for far more efficient data transmission. In technical terms, we're talking about a family of protocols that all stem from Distributed Queued Switch Architecture (DQSA) the bottleneck-eliminating technology that provides near-perfect queueing and Quality of Services (QoS) at layer 2, the protocol layer which provides access to physical and wireless media. We strive to offer a true broadcast architecture at the layer 2 Media Access Control (MAC). In practical terms, this means that additional users can be added to the network without additional overhead; just as a broadcast television station does not worry that additional televisions receiving its signal will slow down the broadcast network.

Let's back up for a moment -- what problem does this solve, and why eliminate routers?
Jonathan Gael: Were it not for a fundamental design flaw between the original voice networks, and the latter data networks, nobody would have needed to invent a modem or router. Our goal is not to eliminate routers; this is simply a byproduct of implementing a near-perfect MAC protocol that eliminates the need for routers to exist.
However, because the phone company gave us a synchronous network architecture when Ethernet requires an asynchronous one, our network communications path is fundamentally misaligned. Furthermore, things like QoS and broadcast/multicast work really well on synchronous networks, which is why Ethernet and the rest of the 802.x protocols like Wi-Fi and Wimax have never been a good choice for voice and video. (This is why cable and satellite operators don't worry about their Internet competitors.)
We're still in the adolescent phase of the Internet in which the only way to handle the explosion of users and media has been to increase bandwidth. This only delays the inevitable traffic and routing overload, much in the way urban freeways have failed to solve traffic congestion. We're proposing a new way of transporting data over existing networks that solves the problem in a fundamental way ... or, as I like to say, "All green lights."

If you eliminate routers, how does The Q. get data to its intended destination? Do you have to hard-wire unique addresses into the devices themselves?
Jonathan Gael: Internet Protocol version 6 (IPv6) is certainly an important step to getting data to where it needs to go without routing translations that stem from a shortage of IP addresses under IPv4. However, IPv6 only solves one piece of the puzzle in that it makes the end points of the network directly addressable. The beauty of distributed queueing is that there is technically only one hop between any two nodes on the network, and since all network traffic can be seen from

any node, it costs the same to deliver to one or to all. Of course, dynamic channels can be created to send data only to the intended receiver, but with distributed queuing you no longer need employ a massive server farm to setup 10,000 independent streams – you could simply virtually serve the content to as many users as needed. This shouldn't be such a foreign concept – it's just broadcasting, only for IP content.
I should add that we don't expect to tackle wide area applications right out of the gate, even though we envision a future "one machine" concept – a global distributed switch run by multiple cable and wireless operators. For now, we will stick to local area applications like Wi-Fi and sensor networks, and we will route traffic that needs to go outside the local network, thereby extending the functionality of today's Internet.

How does The Q. work?
Jonathan Gael: Once embedded into any type of physical or wireless network, The Q. will process data without retransmissions or back-off periods, over any distance to an unlimited number of network devices. With traditional networks, users compete for the channel with actual payload data – which is like a collision one might experience when several couples walk into a crowded restaurant to get a table. The only time one can experience a collision on The Q. is in the reservation request itself, and this small contention is always resolved quickly to get to the payload data in the broadcast queue. In fact, The Q. can support 110% network saturation before experiencing any throughput degradation, resulting in greater than 95% throughput efficiency, and wireless throughput at greater than 85%. Ultimately, this efficiency will enable carriers, both wireline and wireless, to provide unified networking for the price of a regular telephone line. "Unified" means that all of your services will be unified on one pipe – not just one bill.

Does The Q. work on existing networks? Does anything have to be changed?
Jonathan Gael: No and yes. Distributed queuing cannot work on existing networks, however, legacy MAC network nodes can work on The Q., which would require an Ether2 chip at the carrier's plant for wide area applications, or an Ether2 hub for the home and other local area applications. There are wireless technologies that could be used in the data center as well, which would be great for cross-connects and meet-me rooms between carriers. In these settings, we can greatly reduce complexity by eliminating layers of traditional networking middle hardware.

The Q. enables migration to future network architectures – which up to now has not been possible – by serving as a synchronous and asynchronous network at the same time. In short, we intend to invalidate Dr. Robert Atkinson's statement to the FCC that "there is no migration path" to future architectures.

Can you run a hybrid network with both legacy and Ether2-compatible devices?
Jonathan Gael: Yes, as outlined above, but we take a performance hit when we interleave the legacy format with DQSA. Still, this is the only practical migration path, as we don't believe that society is ready for the drastic technology overhaul most research suggests – we would leave TCP/IP alone, thank you very much.
Just as today's Internet is both the original Internet plus a massively parallel group of carrier Internets that combine to create the cloud, the future Internet will also be a multiple set of combined parallel networks from various network operators. Perhaps a really smart carrier will partner with Ether2 and run one strand of backbone fiber as a pure distributed queue, and another

as a hybrid network, so that more demanding customers and carrier applications could be served sooner rather than later. In hybrid mode, we'd have to wait for all the legacy machines to die off before maximizing The Q. to its full potential.

How does The Q.'s efficiency compare with that of legacy routing technologies?
Jonathan Gael: The National Broadband Plan recently cited that the average advertised fixed broadband speed is 8 megs, and the actual delivered speed was only 4.1 megs. While I'm certain that some carriers live up to their ads, on average, most of us are getting ripped off. In order to move forward, one must first understand that there are two kinds of networks: contentious and non-contentious. Ethernet is an example of the former, where you have to fight for a channel. Local Area Networks like FDDI and Token Ring are examples of the latter, where data gets passed in a daisy chain to where it needs to go. These networks failed from instability associated with every node always having to be on to pass the data along; and because of contention, Ethernet failed miserably when it was first implemented because it needed a traffic cop. That's when it became switched Ethernet. Nobody distinguishes between the two anymore, because pure Ethernet is dead (unless your network can run on a 4 port hub without connection to the world).
The Q. is non-contentious, which is why we don't need a switch in the middle of the network. Unlike previous attempts at non-contentious networks, The Q. will be the first to perfectly implement queuing theory to data traffic in a 100% distributed control fashion. By "distributed" I mean there is no traffic cop in the middle of the network; therefore, control of the network is performed at the edge. On a graph, The Q. adheres closely to the perfect theoretical M/D/1 curve, no matter what the traffic conditions or distance. At 10 Gigs total bandwidth, latency is reduced to just the propagation delay of the physical channel. Furthermore, you can share channel bandwidth evenly among the users. One 10 Gig fiber could deliver 9.5 Megs to 1000 homes at 110% network saturation. Likewise, 30 office desktops and wireless devices could evenly share their broadband pipe, so the each one gets nearly 1/30th of the channel bandwidth. Ethernet-based technologies can never deliver that kind of throughput efficiency. In terms of power, The Q. also translates directly into energy savings because the elimination of retransmissions will double battery life in simple devices like sensors. In fact, energy savings would be observed in any network application because our hub and network-attached device do not have to work as hard as a router and its attached device, so the energy savings is substantial and pervasive.
Bottom line, there's really no comparison in terms of efficiency. Wi-Fi, sensor networks, and clustering technologies included in protocols like WiMAX just fall off when the number of users gets too dense. Carrying forward the Ethernet kernel in the name of interoperability has really dumbed down network communications.

The Q. has the potential to solve the continuous rise of broadband demands. Is it the internet of the future?
Jonathan Gael: Yes, As Dr. Robert Atkinson reported to the FCC, "[…] the internet of the present will not become the Internet of the Future: there is no migration path." We, as a society, need to decide if we want take the first steps towards future architectures that can become the future Internet.
At first, Ether2 products will look like typical USB-connected wireless devices or "thumb drives" using an Ether2 wireless hub. Following initial market adaption, Ether2 technology will

be OEM so that it's already in the products you buy. Wired and optical hubs will be available for data centers. At the point of carrier integration, the impact will be societal. Ether2 broadcast networking will allow additional homes and businesses to join the network without additional overhead costs, which will ultimately allow the Ether2 consortium of network operators to close the digital divide.

The internet is not going to change overnight. What is your market opportunity? Where do you see the low hanging fruit?
Jonathan Gael: Our primary market will be sensor networks that can increase to an unlimited node count, while doubling battery life. We will specialize in applications in which sensors have different availability requirements. This is where native layer 2 QoS plays a big factor. We are targeting both Body Area Networks and Personal Area Networks, which need to know that a heart monitor is more important than a wet diaper detector, and that an airborne chemical weapons detector is more important than a soldier's body temperature.
Wireless sensor node (WSN) technology in healthcare and fitness is estimated to be a huge market. Sales of wireless sensor systems could reach $5-7 billion over the next 10 years – a projected annual growth rate of 40 or 50 percent. Forrester Research estimates that the US chronic disease device market will grow to US $26 billion by 2015.

Do you see early adoption in local, specialized networks rather than the Internet as a whole?
Jonathan Gael: On a global basis, all network traffic will converge and diverge, and nothing will ever change that except for infrastructureless networks – networks that are very specialized for war zones or catastrophes. While we have great simulation results for infrastructureless environments, it is not the low hanging fruit. Initially, we want to build networks that will extend the Internet. Early adoption will be in "feeder" networks. In sensors, each patient in the hospital or each soldier in battle might have five sensors on their body. Each sensor doesn't need the same radio strength as the one that's going to send data to the base station, and each sensor could take a turn at being the master node of the cluster. We will also excel in reliability because of our ability to support cooperative network nodes for hopping to nodes that are not within range of the base, and store-and-forward, which is the ability to replace a missing packet from one of your neighbors when requested. Of course, you also have to look at all the "head-ends" – the storage and web farms that are housed in data centers that are collocated with the carriers. Once the technology is in the home and in the data center, network operators in the middle will have no choice but to adopt The Q.

How about competition? The shortcomings of current networks are not new, who are you competing with?
Jonathan Gael: As an enabling technology, our competition to a large degree is the standard. So while many companies have been attempting to "extend the backplane" via optical Ethernet, there is no competitor attempting to eliminate routing and routing bottlenecks themselves, or bridge today's state-of the-art to a future architecture. The competition that we really have to look to is the competition between the players in their given markets. For instance, any sensor company that licensed our technology would have so many advantages that they would dominate the market. The question then becomes, "Does the end user really care about the standard, or do they just want a better product and features?"

You opened the simulation code for The Q. to the open source community. Why not keep the secret sauce to yourself and what do you expect to happen?
Jonathan Gael: We have an open source agreement available to the community of developers, academics and network operator researchers, or Econode, (Ether2 Consortium Network Operators & Developers). However, the agreement will specify the application-specific purpose so that we can have a unified overall effort to tackle specific application. Again, the first application is Wireless Sensor Networking, and we want to get a foothold in a market that can lead to broad adaption. So if you are a big server manufacturer, don't expect to put our chip inside the box for free. I expect our technology to be the first open source network that is not just a software solution. There are other examples of open source hardware, like Arduino, the extremely successful robotics controller card. Like Arduino is to robotics and Linux is to operating systems, Ether2 will always be at the center of the distributed queuing universe. Sharing the simulation code is essential to growing our developer community. Companies in many countries should emerge because of our designs, and these companies will help us to establish the open standard.

Will any associated chip technologies be open source as well – are you looking to establishing an open standard?
Jonathan Gael: Actually, we want to use the standards by and large as they exist. We just need to make a minor alteration at the MAC layer. If that creates a new universal open standard, then so be it. There are many layer 1 or PHY technologies that are below the MAC, including cross-layering for link status reporting, beam forming, load balancing with peers, and multi-frequency dual port connections for multi-hop mesh. The extent to which any of these "drivers" are open source will be up to the rights holders. Our chip core is also proprietary, and we don't own it even though we have the right to use it. Other companies that develop our MAC protocol may try to use a different FPGA or ASIC chip core for high speed network applications. Either way, the water level will rise so that all the boats will float higher.
As to other technologies, we plan to offer a "best of breed" security suite, which will leave about 50% of the chip available for user loaded SoC (Standard on a Chip) applications. This will give application developers lots of room to sell complimentary SoC solutions that will run in our chip. For example, if you want to activate Salare's VoIP security suite, it will be included in our gear. Salare is the first plank in our security platform.

Who is the driving force and inventor of The Q., and what is the Ether2 consortium?
Jonathan Gael: The Ether2 team consists of four co-founders including Dr. Graham Campbell, the visionary and inventor of Distributed Queue Switch Architecture (DQSA). He has been a Professor of 20 years at the Illinois Institute of Technology. On the business side, we have CEO & cofounder David Dietrich. As the former CEO of Pernova travel software, he's built massive transaction networks which were responsible for 25% of the nation's airline reservations. We also have Gary Bahadur on board, the former cofounder and CIO of Foundstone Inc. (acquired by McAfee for $86 million), and me, Jonathan Gael, as chief evangelist. I built the team and forged all IP relationships, with 15 years in telecommunications and technology under my belt.

How is The Q. going to address current flaws in internet security?

Jonathan Gael: Our goal is to get networks to the point where breaches are directly a result of human factors, like duping a customer service rep into renewing a password and sending it to a new email address. Network-borne malware, including hacking tools, should become a thing of the past. Ether2 could also embed privacy applications so that lawful search requests are granted only for court mandated search terms and nothing else. No longer would an employer, for instance, hand over an entire personnel jacket of information that should not be shared. But it is also important for law enforcement to not reveal the search terms to the employer or the network operator. This is a UC, Irvine application that is great for our privacy while letting law enforcement do their job. (I have to look up the name of the program.)

What other applications do you see for The Q. on the horizon?
Jonathan Gael: Satellite. It may be the highest infrastructure cost, but blanketing the country with service would be fast. Virtually every form of networking could apply including supercomputing, cell wireless, terrestrial wireless, naval wireless, Freespace optical, shipboard communications, aircraft onboard communications, wireless LANs, terrestrial WANs, storage area networks, cluster computing, local fiber, metro fiber, national fiber, backplane communications, inter-chip communications and intra-chip communications.

What is the potential impact of The Q. on wireless mesh networks – do you see major business opportunities there?
The potential impact is huge, and this is where most of the latest research simulations are happening. Our network responds very well to cooperation in the network and to multiple-input multiple-output topologies. Load balancing and storing and forwarding packets within clusters is also very exciting. It turns out that because of The Q.'s ability to rapidly reconfigure the cluster within a broadcast architecture, we can go from idle to completely saturated states – perfect for cooperative mesh and mobile hand-offs, and may even have anti-jamming applications for the military.

Given its ability to convert the internet into an equal opportunity fast lane, does The Q. bolster the case for Net Neutrality?
Just because we'd be distributing enough bandwidth to satisfy the broad range of business and consumer needs doesn't mean that the carriers will not want to create tiers in order to get more money for "premium" services, but that's just marketing. The Q. will take away the argument of scarcity in order to hike rates; and if the network operator is in Econode then they would automatically be agreeing to not discriminate for any reason. The only thing that should affect price is the size of the pipe, plain and simple. The underlying issue is the 4th Amendment right to privacy, which needs to characterize Internet usage as Customer Proprietary Network Information (CPNI)…and just as CPNI laws prohibit marketing to me based on my usage of plain old telephone service (POTS), the same should apply online. Imagine if GE wanted to charge you more for the same light bulb if you use it in a restaurant as opposed to your living room. How the light bulb gets used is none of their business. Let's just all agree that telecommunications is part of the commons, like water and power, and that every home and business should get 10 megs for the price of a POTS line.
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Questions asked by Xenia von Wedel, SocialRadius. For more info about The Q. and ether2, please follow the company on twitter @ether2theQ or sign up for the open source community project at http://www.ether2.com