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Last Mile Blues:

Taming the Most Unpredictable Frontier

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A few years back one of the authors stuck their neck out and predicted that networks would soon be a thousand times larger, and that growth would have a significant impact on features, services – and on the OSS infrastructure. The OSS community was urged to start planning OSS systems that could handle the growth. Well, as we now all know, the "bubble burst"; growth of new networks and new services slowed dramatically, and the author got some grief for that prediction. In this case, however being right or wrong just swings on your definition of "soon." Networks are being reconceived and soon they will be way more than a thousand times larger. And yes, OSS infrastructures need to be reconceived to support the new networks, services and features – soon!

Looking more closely at how OSS capabilities will be impacted requires us to look much more closely at these new networks. Just who will the dominant carriers be? Will we continue to see consolidation of big players to regenerate the giants of the past? Will broadband wireless access networks take off in the hands of residential and commercial communities? Or, will some other kind of service provider emerge and change the landscape yet again? We can seek some clues from the not-so-distant past…

Not long ago everyone in the US communications marketplace was talking about the glut of long-haul bandwidth from overbuilding in the late nineties. This overabundance was seen to be depressing the market for communications vendors (little need to buy new gear) and also depressing revenues for telecom suppliers (competitive over-supply driving prices down). The then 10 gigabit backbone trials were just showpieces as there was not enough traffic to fill them up. The Internet build out slowed when just about everyone was on the "highway" and the traffic flowed along just fine. The industry turned inward and fed off itself. And in the background dialup access gave way to ADSL and digital Cable – small broadband. All those connected businesses and homes were just adjusting to how sweet that connectivity is. They started to want more. Today more folks want to be connected to that big broadband network, and cannot seem to get enough of it. The situation has flipped from oversupply to throttled demand. And when supply is limited, consumers get concerned – and some become activist.

The players in this new debate about metropolitan networks are residential consumers, business developers, last mile communications suppliers, wireless broadband suppliers, and local governments. This emerging market ecosystem has reached sufficient mass to support its own trade journal (Last Mile Magazine: www.lastmileonline.com) and conference (Digital City Expo). Basically, the network owners and business drivers for expansion are well understood for long haul and regional distribution networks. No one doubts the long haul bandwidth will be there: big pipes drive efficiency in long haul; high density drives efficiency in regional distribution networks. Long haul networks are being built with plenty of future capacity – this year 40 Gigabit networks are being deployed. Regional distribution networks are being built in the US by the surviving carriers – at least 80,000 more fiber miles are planned before the end of the decade.

That last mile of connectivity is still where getting connected slows down. Contention exists about who builds, or will cough up the money to pay for, the last mile from the regional network to terminate at business and households. The new "undiscovered horizon" is the lower density rural suburban boundary. And in the city, it is the right-of-way in the tall shiny building.

Conflict: We are at a crossroads where two views of municipal communications supply and oversight are on the verge of strong conflict. Since communications is a utility, should communications systems in towns and cities be treated like:

- The electrical system, where incumbent carriers own right of way, have little competition, and effectively dictate their designs and terms without input from, and often over the top of, local interests?
- The water system which is owned and maintained by the municipality which buys water from a larger supplier, stores and distributes it to local residents and reaps local revenue?

Not long ago, we could have put forth the cable franchise as the model for municipal communications. Local municipalities licensed one or more cable carriers in their zone of control to deliver cable TV. However, deregulation brought about by intensive, successful lobbying by RBOCs, has eliminated the local municipality as a controller/participant in TV distribution. Also, in winning the right to supply voice and data over cable TV infrastructure, cable companies became "de facto" regulated like, and in the same pot as, communications companies.

The vast majority of local municipalities seem to have no public policy on this as yet. Mostly these fall into the fortunate category of having good (but not great) service from existing communications companies. Others view the issues as too complex and costly to justify studying the issues and taking a stand.

Yet in the growing number of communities where the question is being asked, debate runs hot. For municipalities, the key driver for soliciting communications infrastructure is the new discovery that connectivity, big broadband connectivity in particular, is an asset in competing for new business and development projects. Municipalities see that new development follows big broadband rollout. Studies show that lit communities attract 2-3 times the business development of unlit communities. The second municipal business driver is that local residents are impatient to get the biggest, fastest pipe they can – anyway they can; and since they can influence local government easier than big companies, they are banding together to get last mile connectivity. Lastly, municipal government services themselves will be greater consumers of bandwidth, particularly for wireless access to security cameras, police, fire and rescue. Homeland security is actively paying for these upgraded municipal services.

This debate looks a lot like the historical example of rural co-ops for electricity. Big cities got supplied by negotiating contracts with major electrical suppliers. But areas outside of the big financial and manufacturing cities had to band together in cooperatives which funded construction of power plants and distributions systems. These projects were guaranteed with local taxes and bonds, but expected to make a profit or return dividends to the consumer members. The federal government looked favorably upon rural power co-ops. In getting homes anywhere and everywhere electrified these projects were successful. Some failed economically in their early years. Yet when they succeeded economically, not only did they connect power, they made lots of money for towns and residents.

Today the big initiatives for FTTP in the USA are from two surviving RBOCs: AT&T's Lightspeed and Verizon's FiOS. Both are multi-service, big broadband plays delivering VOIP, Internet connectivity, HDTV, digital TV and content on demand. Both companies are investing heavily in capital, from a Wall Street perspective. But this capital only funds about 3 million homes for each this year – if they stick to schedules. Neither carrier will currently deploy services outside of their "traditional service zone" established when they were RBOCs.

So who gets these broadband connectivity services? From the point of view of the municipalities, it is a lottery and there are too few winners to meet demand. So municipalities are trying to accelerate roll out of big broadband by taking over build outs of the last mile in their economic domains. "Dilemma: how does the municipality partner with service providers to provide advanced services and capability when the population or household density per square mile may never be financially viable for the service providers?" was a question recently posed by a telecommunications executive and Member of the Telecommunication Board of a Texas municipality.

Some municipalities are setting up local metropolitan distribution networks. Organizationally these associations take many forms, but the goal is to get big broadband connectivity into areas that incumbent telecom companies are seen as too slow to serve. Early experiments were with wireless networks but these have proven very unsatisfying to everyone – user and business alike. Without WiFi that can easily pass through trees and big buildings, metro WiFi becomes a costly affair of setting up countless poles and other distribution hubs. The economics do not justify the lower bandwidth potential. Wireless today maxes at 2.5 megabits where FTTH comes in at 30 megabits.

In the end, partnerships are best. A great example of this today is the Utopia network [http://www.utopianet.org/]. Utopia is a regional communications utility charted by 14 member local governments in Utah. They provide the fiber pipe into the delivery box in the home. They partner with telecom companies by leasing bandwidth to the telecom providers to reach these homes and sell communications services to the businesses and residents. It is a win for everyone.

But the avowed business policy of the major telecom FTTP providers is to own the full facilities themselves. Only then can they insure customer lock-in. It is pretty much certain (at least when some early deployment bugs are out) that if you plant fiber to a home, the churn on that home gets close to zero. And lastly, putting in

and owning new fiber bypasses old cable franchise agreements some municipalities still hold to, since these arrangements once provided 5% of TV delivery revenue to these same towns. As building owners request similar gate-taxes to deploy services inside their properties, AT&T is also hedging its bets by deploying 3G wireless in 100 metro markets.

The future: Pervasive computing, QoS, and integrated services:

But what are we going to do with all that bandwidth? We are finally going to get Vint Cerf's "Internet Toaster." Everything in the home and in the business will be networked together and often directly gated into the wide area communications network. This is called *pervasive computing* and new businesses that support development of this technology are springing up. At the moment, there is no consensus on how to manage these end network devices.

In addition, soon homes will often exceed 1TB in local storage. And this data falls into three classes:

1. Data which is private and must be secured; and for which remote secure replication will be needed.
2. Data, generally video and music, which is "rights managed" and for which service content providers must provide active accountability.
3. Data which is shared within open and closed public user groups and for which network access (usually HTTP) is needed.

All of these represent market opportunities for service providers or internet companies, but management plans for these data models have not been discussed.

One of the pathways into the home will be through the gaming console. Gaming is now a bigger business than films. Few American homes do not have a gaming console. These connect to the net today to allow networked game competition. Microsoft and Sony both plan to evolve these consoles into home controller products. What is at stake?: communication, entertainment, gaming, pervasive computing (game controller becomes house controller), medical monitoring, and home security. At the moment, these devices are not smart and have no management capabilities, but it is unlikely that these will remain unmanaged devices. Will the manufacture/supplier develop and offer management services as these devices become critical, rather than opportunistic?

Gaming consoles also are demanding more and more bandwidth and connectivity to communicate actions, graphics, and voice. When it is available via IMS, QoS connections will be demanded by gamers - pushing telecom technology growth just as these gamers push PC technology forward today. Basically gaming will evolve to something that looks like the "closed user group" replacing the old private dial plans that drove Advances Intelligent Network (AIN) technology into the service provider market. However, these groups will be much more fluid, with gamers joining and leaving more rapidly than the AIN user group did. Also these groups will be international in scope connecting gaming consoles to distributed computing networks, to other consoles anywhere and everywhere in the world. Gaming manufactures have no notion on how to manage these services as they grow. Services providers understand this problem best, but not the qualitative difference the new quantitative scope jump imposes.

Municipalities will become gigantic consumers of communications services. The threats of terrorism and civil unrest dominate the news, but local crimes and quicker response to accidents drive the deployment of continuous, real-time, remote monitoring devices. Cameras will be at every intersection and covering every angle of every major building. Remote recording is necessary to prevent tampering. Also homeland security is paying for new technology which can recognize everyone in the field of vision of these cameras. Oversight, requirements for convictable evidence and insurance liability will drive the real time visual monitoring of every responder – police, fire, ambulance, even the town engineers. In addition, chemical sensor networks and micro weather station networks will be deployed.

None of these services can ever be allowed to fail. All require five nines of reliability from the network, as lives will depend on these services. And they are coming fast. Homeland security provides monetary help to both large and small municipalities to deploy monitoring devices. If service providers cannot guarantee QoS for all

these devices and services, than the municipalities will need to contract for or build their own networks, freezing out service providers, or at least eliminating a great deal of potential revenue.

Most of these services will require wireless broadband. This means hundreds of thousands of new "poles" on which to put the wireless network transmitters/receivers – all of which must be managed. Connectivity of these poles to the larger network will be line-of-sight radio or data over electric transmission lines. The world of isolated wireless "hot spots" is supplanted by the community as one large hot spot. Provision of these municipal wireless networks is driven from the bottom up by the towns and cities. Service providers should be providing many more strategic resources to join these municipalities in partnerships. Otherwise, private municipal networks will become islands where service providers are shut out. An example of this is the Oklahoma Municipal League (OML) and its business extension, the Oklahoma Municipal Services Corporation (OMSC) along with its selected business partners. Completely independent from traditional telecom, Comport Network Services & Solutions, the Cherokee Connex, and the Community Communication Authority (CCA) have teamed up to bring Wireless Broadband (utility-grade broadband) to rural America. This model of starting with municipal security services and expanding to become local "last mile" connectivity networks for homes and businesses is starting to catch hold. Many small companies and cities are actively watching these initial business trials and seeking to duplicate positive results.

Management models

Will these devices be managed locally or remotely? Local management makes sense if management services can become automatic, robust and simple enough to be deployed into home and small businesses environments. Management services today are not developed with this degree of autonomy and simplicity. Architecturally, the closest local management model today is the remotely deployed management agents used in large IT software distribution networks such as IBM's Tivoli. This model can meet scaling needs if agents can become autonomic, remotely deployed and simple.

Alternatively, the management model could be remote management like the device managers for mobile phones from service providers. A model like remote management agents implies a local management network in the home or small business with agents communicating back to the larger network when necessary. On the other hand, Service Providers today can monitor phones via presence on the cell network pushing down configuration information and can update phone software as new services become available.

We believe that current phone management models offer the most promise going forward. However it is not yet clear what is needed so this approach can handle a hundred to a thousand times more devices.

While the communication networks are evolving so to is software. Service Oriented Architecture (SOA) will allow everything (including software, devices, connections, etc.) to have functional and management services it connects with. These services need not be local, and can be global in distance and in scope. With adequate bandwidth, network resident, remote virtual services will become one of the largest consumers of QoS connectivity as they are used to record lives, provide intelligent personal assistants, manage all financial transactions, and oversee all the things in ones life – rather important things like kids, homes and cars.

IMS is the service providers' bet for providing and managing QoS bandwidth. But less well understood is that IMS likely will become the network side of the SOA software for service connectivity. By providing guaranteed, managed QoS connections, people will feel comfortable enough to offload the support services and management to network resident services, which releases some stress for remote management systems, but requires management of the connectivity of linking with these remote network services.

Also IMS enabled presence and location information will allow people to form temporary data service connections with all the business and people they pass. With presence and location, from the perspective of service connections, the last mile drops to 100 feet. As people walk past businesses, their IMS phones (if we can still call this advanced device a phone) will query stores and restaurants for the service preferences of the phone's owner establishing transactions and setting phone owner schedules to optimize consumer preference realizations and increase efficiency of consumers and businesses. Some of these transactions may be quite small, and there is a cost to performing the query and getting a response – so micro transactions (those of pennies or less) will become commonplace. Traffic and transactions from these IMS devices will greatly exceed the scope of existing credit card networks.

It is unclear that IMS software vendors are planning for this degree of acceptance. Both the IMS software services and the management of those services will need to handle enormous transactions. And the security of these transactional services must be absolute.

Given all these near future IMS and SOA enables services, and all those home and business devices connected to the net, even more backbone bandwidth is actually needed. Major suppliers will be moving to full 40 Gigabit build outs. With IMS and SOA services, we will be talking of "billions and billions" of connection streams riding over these trunks at any time. These services will connect with vast network resident computing grids.

Get with the grid

Today service providers see grids only as opportunities to sell managed services to big businesses using the service provider product models based on frame relay management service products. This narrow viewpoint may mean service providers get left behind – subsumed by grid savvy companies like Sun and IBM. Service providers should immediately advance their models of how to manage grids and begin to put grids into the top of their strategic thinking. Transaction networks for micro transactions will need massive grids. Management applications will require the power only supplied by distributed grid to process and control these loads. IMS itself needs to become a distributed grid service.

Management services

So far there is no management scaling problem because FTTP and IMS service is rolling out so slowly, a few hundred thousand homes or SMBs at a time. But what happens when 30 million homes are connected and each home is managing 5 services and 30 devices? And when it is 90 million homes with 200 services in each? Or when 300 million USA residents will have connectivity to a constantly changing environment of networked things and services? And certainly twenty years from now when Indo-China passes the USA in communications demands; and later if Africa and South America need these as well?

So how do you manage QoS on several billion connections that make up your part of this global network? How do we get 100 billion connections to inter work reliably, at the same time? Again it is clear that today's approaches to management cannot support a communications infrastructure of this scale, scope, and complexity. It is unlikely that any centralized management architecture can. But the good news is that this time, "soon" gives us perhaps a decade to mature new OSS systems. In this time, if the infrastructure and OSS communities accept this vision and accept this precipitous horizon of need, new systems will arise.

The seeds are here today in experiments with distributed grid software and autonomic agent systems. Better to get behind growing these technologies into mature markets, than to expect another bubble bursting to bring these trends to a standstill.