FROM Cable Advisory Committee

TO: Truro BOS and Town Administration

January 2011

Municipal Area Network and Open Cape in Truro:

Background information,

Definitions,

Questions

Introduction:

　　This document was prepared by Mike Forgione of the Cable Committee to provide background to town officials and to begin to frame the issues as we prepare for Open Cape's bringing additional high-speed Internet connections to Truro.

Executive Summary

During the past year we have heard about the technical terms of Municipal Area Network, I-nets, the Internet and World Wide Web. Along the way, we heard Comcast Broadband service and Open Cape. To make things worse, we heard about Dial-up Service, Digital Subscriber Lines (DSL), Cable Modem Internet, Satellite Internet, Broadband over Power Line, Wireless Networks and 3G/4G wireless. What are these things? Why and when do I need them? What do they do? Below is our attempt to address this very complex and technical topic. Our goal in this document is NOT to make a decision on what Truro needs. Our goals are:

1. To provide an understanding of Networks and the Internet. This understanding will assist us in our decision of a Municipal Area Network for Truro.

2. To begin the discussion of how we can effectively utilize Open Cape to lower the operation cost of Truro's Information needs. Based on current

plans, Open Cape will be fully deployed within the next 3 to 5 years. How will it change Truro?

To help simplify these concepts, we will use the example of road system. The US road system, with its local roads, Intrastate highway and Interstate highway offer a good "real-life" example of networks. We have intersections and exit ramps that allow a person to move from one type of road to another. We have different rate of speed depending on the road that we are on.

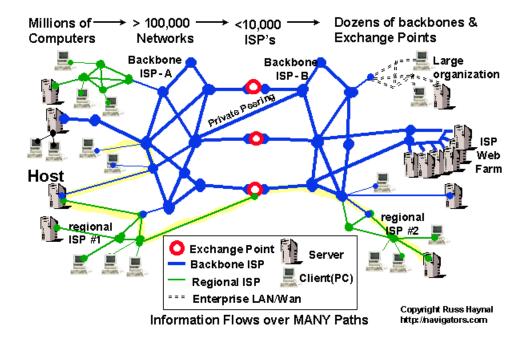In our closing remarks, we do address the following questions and our opinion on them.

1. Should we have Comcast build the Video Return Line from the COA facility to Town Hall?

2. What do we do with Open Cape?

3. What happens to the "unserved" Internet population of Truro?

4. What will happen to Comcast Cable TV membership in the future?

5. What are the key things that Open Cape will change in the Town?

6. Will Open Cape bring new Internet Service Providers to the Truro Homes?

What is the Internet?

The internet is a global network connecting millions of computers. Each internet computer, called a host, is independent. It can communicate with any other computer as long as they are both connected to the Internet.

The technology that the Internet or network uses to interconnect the individual computers can be wired (Twisted pair, Coaxial Cable, Fiber Optic), wireless (Microwave -WIMAX, Satellite, Radio Communication, High Frequency Radio Technology, Infrared Communication) or a mixture of both wired and wireless technologies.

So, the Internet is millions of computers interconnected by wires or wireless. There are a variety of ways to access the Internet. Online services, such as America Online, offer access to some Internet services. It is also possible to gain access through a commercial Internet Service Provider (ISP).

Millions of → >100,000 → <10,000 → Dozens of backbones &
Computers   Networks   ISP's   Exchange Points

Information Flows over MANY Paths

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Our road systems are a good analogy for the Internet. In a town we have local roads. These roads connect the town and allow movement of goods and services within the town. Local roads connect to Intrastate roads and they in-turn connect Inter-state highways.   Similarly, you connect to the Internet through a local ISP, such as Comcast or Verizon (the local road), who in turn connects to the Internet backbone (the inter-state highway.)

What is the World Wide Web?

The World Wide Web, or simply Web, is a way of accessing information via the medium of the Internet. It is an information-sharing model that is built on top of the Internet. The Web uses the HTTP protocol (and its encrypted cousin, the HTTPS protocol), only one of the languages spoken over the Internet, to transmit data. Web services, which use HTTP to allow applications to communicate in order to exchange business logic, use the Web to share information. Browsers, such as Internet Explorer, Safari or Firefox, are used to access and respond to Web documents called Web pages that are linked to each other via hyperlinks. Web documents can also contain graphics, sounds, text and video.

The Web is just one of the ways that information can be disseminated over the Internet. The Internet, not the Web, is also used for other services including e-mail, Usenet news groups, Internet telephony (VoIP), instant messaging, file sharing (FTP), streaming media (Webcast, Podcast), and webcams (chat rooms, video conferencing). So the Web is just a portion of the Internet, albeit a large portion, but the two terms are not synonymous and should not be confused.

Going back to our example, the road system is the Internet Network. The movement of Goods and Service on these roads is the World Wide Web. We use the road to travel to the stores to purchase goods, travel to the library to read the news paper and travel to our neighbors to exchange ideas. That is the essence of the Web, a tool that enables the sharing of information.

What is Open Cape?

Open Cape is a Network, it is part of the Internet, and it will serve the Cape Cod area as a Network Service Provider (NSP).

Open cape is a robust Fiber Optic Network:

> "The Open Cape proposal consists of a core fiber backbone on Cape Cod with extensions to two major regional network connection centers in Providence and Brockton, numerous fiber optic laterals extending off of the backbone, a high capacity optical transport system, a microwave radio overlay, and a regional collocation center. All of these elements combine to provide a robust, high capacity communications infrastructure. Fiber optic based services will range from traditional bandwidth based offerings to dedicated wavelengths of light to dark fiber leases. The OpenCape collocation center will serve as the focal point of network operations and provide leased collocation space for public and private organizations in the region. "

Open Cape will connect anchor institutes to the network to provide cheaper, faster and more dependable service. The NTIA has described "Community Anchor Institutions" as consisting of schools, libraries, medical and healthcare providers, public safety entities, community colleges and other institutions of higher education, and other community support organizations and entities.

> "OpenCape will connect over 70 anchor institutions to the network using laterals as part of its initial build-out. Highlights of these include twelve emergency shelters (schools), thirty libraries, five colleges, six academic research facilities, and eighteen town or public safety buildings. The OpenCape path also permits many additional anchor institutions the ability to rapidly obtain service from the network including seven hospitals, two additional higher education institutions, eight additional libraries, ten county, state or federal institutions, five commercial/industrial centers, and potentially over 270 public safety and educational facilities.
>
> The cost of commercial middle mile service will be significantly lower than is currently offered in the region, and in addition, non-profits and government entities will receive a deep discount for all network services"

An NSP is a company that provides backbone services to an Internet service provider (ISP), the company that most Web users use for access to the Internet. Typically, an ISP connects at a point called an Internet Exchange (IX) to a regional ISP that in turn connects to an NSP backbone. In the U.S., major NSPs include MCI, Sprint, UUNET, AGIS, and BBN.

According to the Open Cape website, Open Cape will provide at no cost the following connections in Truro:

1. Truro Library

2. Truro Central School

3. Truro Town Hall

Large bandwidth will exist at these sites. But, can they access the World Wide Web? Could these sites have Telephony (VoIP telephone service)? Could they have Email? We don't believe that this capability will be provided by Open Cape. Keep in mind that Open Cape is NOT an ISP provider. It will be the responsibility of the Town to purchase these services. This needs to be validated.

Open Cape will link public safety officials within a wide area network and support a 700Mhz wireless mobility network for vehicles in basic functions such as communicating with Cape Cod Hospital during a patient run from Provincetown. Open Cape will also support much broader community needs for more robust

public safety communications during frequent storms and potential hurricanes. But, does this mean that Truro's emergency dispatch system will be improved by Open Cape? We don't know. This should be verified.

Returning to our example, if the town never wanted to move outside the boundary of the local roads, we would not have a need for intrastate highways. We could slowly move from one local road to another until we get to our desired location. It would be slow but we would get there. Route 6 was built to speed-up the high volume of traffic that occurs within the region. It allows for faster speeds and more goods/services can be moved around. These intrastate highways are the backbone of the Internet. The local roads have exit ramps that allow people to switch road systems. Anchor facilities (users that have need for high bandwidth) will by-pass the local roads and enter the Intrastate highway as soon as possible.

Up to now, in our example we have been assuming that these roads are open to all traffic. In the Internet world, that is not true. The roads are owned by someone. In some cases it is for-profit entities and in other cases they are owned by non-profit entities. The exit ramps on these roads cost money; switches, routers and servers need to be purchased and supported. The lines need to be supported. These are all costs that need to pass to the end user. In our road example, toll boots are set up. In the Internet world, these charges are assessed to the end-user by the ISP. Open Cape will have costs and it will need to generate revenue.

What is Comcast?

Comcast is a publicly traded company that owns the fiber optic cable and coaxial cable on the Cape. Comcast uses this "wire" to provide Internet service, telephony (VoIP digital phone service) and Television service to its paying members. We will not look at the television or phone services. We will concentrate on the Internet service.

For Internet service, Comcast is 2 things:

1. It is a Network Service Provider (NSP). Utilizing its cable (Fiber Optic and coaxial) and a cable modem, it creates a Network for its customers.

2. It is an Internet Service Provider (ISP). It purchases a wholesale connectivity from Internet Exchange (IX) for their customers. The ISP is responsible for its own portion of the network, sales and marketing, and customer service. An ISP can also purchase other services from an NSP

that they in turn provide to their customers such as e-mail service, Web-based e-mail service, personal Web Hosting, Telephony (VoIP telephone service), chat, discussion groups, and other end-user applications. All these services are provided under the ISP's brand name rather than that of the NSP.

So, Comcast Internet service is a backbone provider and an ISP.

Using our example, Comcast realized that their investment in the cable for TV could be used for Internet service. As such, using the existing cable and cable-modems, they created a private fully owned road. The on-ramp to this road system is at the point of the cable hook-up in your home. Their toll-booth is the monthly charge for the service. In this charge, they bundled the cost of the lines and the toll for entry into the Inter-state highway system.

Along the way, Comcast realized that they could make extra money by using the extra capacity of their private road system to offer other services like Telephone.

Unlike Open Cape, Comcast realizes that its' competitive advantage is the road system. As such, it is a closed system. A company could not come in and buy a level of traffic on it. They can pay to use; but they cannot re-sell. Comcast wants to manage the road. Open Cape on the other hand is Open and seeks other companies to share the road. Open Cape maintains ownership; but the companies can manage their business.

What is a Municipal Area Network?

A Municipal Area Network (MAN) is a Network; a MAN is a bunch of dedicated wires and maybe some wireless towers connected to computers and devices with the goal to deliver a service to a municipality. It is a highly reliable network service that provides high-speed, high-bandwidth, direct-fiber connections for users within Truro. The MAN could be established solely for municipal government purpose Or, it could be set up for a geographical area (a town square, a city street, the entire town). Or, it can be a combination. The key is that a "Group" of users is identified.

A MAN is built around a level of service it wants to provide to this group of people. The MAN can provide access to documents, data or information residing on computers or devices within the MAN network. If a user within a MAN network needs to access anything outside the MAN network, then the MAN has to provide ISP service. Like all ISP's, a MAN needs to purchase wholesale connectivity from Internet Exchange (IX) for their customers.

Using our road example, the MAN is our locally town owned roads. They are part of the overall world wide road system, but they were primary built to facilitate the movement within the town.

What could a Municipal Area Network be used for?

A Municipal Area Network is designed and deployed for municipal use. It supports all communications needs of the municipality and generally exclusively used only for municipal applications. For the municipality, it can provide:

- Data applications : MUNIS and other financial systems, tax systems, student management systems, water and sewer systems, surveillance systems, email systems, domain systems, VLANS of any type, data storage systems, access layer security systems, other data applications, and high speed access to the internet

- Voice applications: IP Telephony or VoIP of any type (centralized or distributed), legacy digital and analog PBX systems, stand alone phone systems, and multi megabit (10Mbs, 40 Mbs, 100Mbs and up) voice access to carriers.

- Cable TV: Connects all production and distribution sites for the municipal cable TV studio, and remote sites. Provides access to cable companies such as Comcast, Verizon, Time Warner, Charter and others for distribution to the public

- Security and other Video applications: Provides high bandwidth transport of all video applications for security cameras, traffic control cameras, and other secured video requirements.

- SCADA applications : Monitoring of reservoirs, water supplies, and other secured access to municipal owned sites

- Smart Grid applications: The network supports all manner of smart grid applications that are often provided by the independent utility for the city or town. Optimization of electrical power needs for the community, meter reading and controls, and centralized management of the utility systems for diagnostics and repairs to the system.

- Wireless applications: High speed network backbone that supports radio dispatch and radio traffic for police and fire departments. Broadband delivery of video, and surveillance traffic to emergency response vehicles

- Provides network backbone and infrastructure for other wireless applications like traffic cameras, wireless coverage for public WI-Fi, and other wireless edge applications.

A MAN could be used to provide Internet access to the public. The Town would establish a number of Internet hotspots or in the extreme provide Internet connectivity for the entire town.

What are our next steps?

As in any Information Technology project, a ROI (Return on Investment) is key to our success. There is no doubt that the technology to make this happen is available and mature. They key questions are:
1. What Services do we need?
2. What is the ROI to switch from current to future?

Towards the goal of identifying what services are needed, we recommend that you breakdown the analysis along the following lines:

1. What don't we have today but may want to in the future? I would include: Monitoring of Municipal sites and Cable TV. We do not believe that the Town is ready for video monitoring system in the town.
2. What do we do today but may want to do different? For these municipal activities, I would break down the analysis by the characteristics/needs of the site. This would give us:
   a. Low need sites: Sites that need only Internet access and a phone. I would include the following sites as low need: DPW, COA, Library, Beach Office, Pamet Harbor Office, Transfer Station, and Highland Golf Course.
   b. High need sites: Sites that need Data Access needs, Internet Access and phone services. I would include the following sites as high need: Town Hall, Police Department, Fire Department and Truro Central School (assuming they have a Server)

3. Internet Service: Provide Internet Service for the entireTown. This would require Wireless WIMAX.

It is our recommendation that the IT Director for the Town needs to drive this ROI. He/she needs to inventory what exist and map out how Open Cape will be utilized.

Conclusion & Thoughts

We made a conscious attempt to simplify this very difficult topic. The Internet with its protocol, switching, routers and serves is extremely complex. At the same time, we felt that giving the reader a basic understanding will allow the individual to ask better questions and make decisions. We are not the Experts!!! We need to ask questions, learn and adopt our vision as more information is brought to our attention. With that said, we do have some opinions around the key decisions that currently face us and a potential for the future.

1. Should we have Comcast build the Video Return Line from the COA facility to Town Hall? We do not recommend that Comcast build this line. We believe that there are two other options that are cheaper and more in line with our vision. We believe that this line could be built either during our MAN build-out or built using Open Cape or existing Comcast lines. The technology of Video over the Internet is a reality. We do not see the need for a dedicated fiber optic line to do this.

2. What do we do with Open Cape? Open Cape is a "Game Changer". The future on the Cape is so much brighter because it is occurring. We need to offer the project time to clarify their service offerings. Will they offer ISP service? Will they offer us an opportunity to improve our Emergency Dispatch system? How to we leverage this extra bandwidth to attract new business opportunities and improve our current business community?

3. What happens to the "unserved" Internet population of Truro? We don't believe that anything will change in this area. The ROI concerns that

prevent Comcast to extend their network to these homes will continue with Open Cape and any other service provider who ventures in this area. The population to support this is not there. Future wireless improvements like 4G and Satellite will have success in this area. WIMAX, new microwave technology, could help. Again, we do not believe that Comcast or Open Cape will significantly change this. If this is something that the Town feels a need to address, then it will need to pay for it.

4. <u>What will happen to Comcast Cable TV membership in the future</u>? We believe that in the future TV will change from a model where stations broadcast and schedule programs to an on-demand model. Technologies like ROKU and HULU will alter how we watch TV and the transmission media. Using the internet, we will download our programs and watch them when we want. We see higher and higher Internet usage. We will shift from Cable TV broadcast (we currently receive royalty from Cable TV receipts) to broadband/Internet (we do not get a royalty for Internet). Comcast has started to capture Internet usage patterns and we envision that it will soon offer new price structure to increase revenue in this area. We expect the Town's Comcast TV royalty to decrease. As such, any use of this royalty should be closely managed.

5.   <u>What are the key things that Open Cape will change in the Town?</u> At this time, Open Cape is on record to provide a hook-up at the Central School, the Library and Town Hall. We believe that these connection points could be used to reduce IT and telecommunication costs. We believe that Telephony (VoIP) and centralization of servers will become a reality. There is no longer the need to keep this hardware locally. A similar shift towards "centralization' occurred in the private sector. We envision that the pressures of regionalization will drive centralization of hardware and IT staff. The town will simply buy a "level of service" rather than own hardware and hire dedicated IT staff.

6. <u>Will Open Cape bring new Internet Service Providers to the Truro Homes?</u> We are not sure about this. The problem that we have in Truro is the size of the population versus the cost to build a network that could serve the population. We don't see how a for-profit company could afford to build a fiber-optic network to each individual house in the town. The best hope rests with wireless technology. Neither Open Cape nor Comcast have this on their radar screen at this time.

Appendix
Definitions

Term	Definition
3G	The 3G (3rd Generation) network is the colloquial term for the mobile communications (cell phones) network standard IMT-2000, defined by the International Telecommunications Union (ITU) and used by mobile devices to transmit voice and data.
4G	4G is the short name for fourth-generation wireless, the stage of broadband mobile communications that will supercede the third generation
Bandwidth	In computer networking and computer science, bandwidth is a bit rate measure of available or consumed data communication resources expressed in bits/second or multiples of it (kilobits/s, megabits/s etc.).
Browser	A web browser or Internet browser is a software application for retrieving, presenting, and traversing information resources on the World Wide Web
coaxial cable	A cable that has a metal wire core.
DSL	Digital Subscriber Lines
fiber optic cable	Cable lines are strands of optically pure glass as thin as a human hair that carry digital information over long distances. Can carry data longer that coaxial cable and faster.
FTP	File Transfer Protocol (FTP) is a standard network protocol used to copy a file from one host to another over a TCP-based network, such as the Internet.
HTTP	Short for HyperText Transfer Protocol, the underlying protocol used by the World Wide Web. HTTP defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands
HTTPS	HTTPS (HTTP over SSL or HTTP Secure) is the use of Secure Socket Layer (SSL) or Transport Layer Security (TLS) as a sublayer under regular HTTP application layering. HTTPS encrypts and decrypts user page requests as well as the pages that are returned by the Web server. The use of HTTPS protects against eavesdropping and man-in-the-middle attacks. HTTPS was developed by Netscape
HULU	Hulu.com is an online video service that offers hit TV shows, movies and documentaries for free.
I-NET	is any network that uses the Internet Protocol (IP).

ISP	An Internet service provider (ISP) is a company that offers its customers access to the Internet. The ISP connects to its customers using a data transmission technology appropriate for delivering Internet Protocol packets or frames, such as dial-up, DSL, cable modem, wireless or dedicated high-speed interconnects. ISPs may provide Internet e-mail accounts to users which allow them to communicate with one another by sending and receiving electronic messages through their ISP's servers. ISPs may provide services such as remotely storing data files on behalf of their customers, as well as other services unique to each particular ISP.
IX	Internet Exchange. An Internet exchange point (IX or IXP) is a physical infrastructure through which Internet service providers (ISPs) exchange Internet traffic between their networks (autonomous systems
MAN	Municipal Area Network see page 7
MUNI	Municipal Wi-Fi. Often abbreviated as muni Wi-Fi, municipal Wi-Fi is a city-wide (municipal) wireless network, based mainly on 802.11 networking standards that provide high-speed Internet access within the municipality for free or low cost access when compared to standard broadband access fees
NSP	Network Service Provider. A network service provider (NSP) is a business or organization that sells bandwidth or network access by providing direct backbone access to the Internet and usually access to its network access points (NAPs
PBX	(Private Branch eXchange) An inhouse telephone switching system that interconnects telephone extensions to each other as well as to the outside telephone network (PSTN).
Podcast	A podcast is a pre-recorded audio program that's posted to a website and is made available for download so people can listen to them on personal computers or mobile devices.
ROI	Return on Investment
ROKU	is a privately held Saratoga, California consumer electronics company that sells home digital media products.
SCADA	SCADA stands for supervisory control and data acquisition. It generally refers to computer systems that monitor and control infrastructure or facility based processes
SMTP	Simple Mail Transfer Protocol (SMTP) is an Internet standard for electronic mail (e-mail) transmission across Internet Protocol (IP) networks

Telephony	A term used to refer to telephone lines, trunks, circuits, related equipment, and the information (voice, fax, and data) that is transmitted over them
VLANS	A network architecture which allows geographically distributed users to communicate as if they were on a single physical LAN by sharing a single broadcast and multicast domain. ATM forum LAN emulation supports VLANs
VoIP	Voice over Internet Protocol (VoIP) is a general term for a family of transmission technologies for delivery of voice communications over IP networks such as the Internet or other packet-switched networks
VRL	Video Return Lines.
Webcast	A webcast is a media file distributed over the Internet using streaming media technology to distribute a single content source to many simultaneous listeners/viewers. A webcast may either be distributed live or on demand. Essentially, webcasting is "broadcasting" over the Internet
WIMAX	Worldwide Interoperability for Microwave Access (WiMAX) is a telecommunications technology that uses radio spectrum to transmit bandwidth between digital devices. Similar to WiFi, WiMAX brings with it the ability to transmit over far greater distances and to handle much more data
WWW	World Wide Web

Does Truro Need it?

Public Access

Internet Access for Citizens	Nice to have
Internet Access for local business to spur economic development	Nice to have
Internet access for public schools	Must have
Wireless broadband service	Nice to have

Public Works

Data applications	Must have if IT Regionalization is in the future. Also we should look at the applications that are housed on Town-hall servers. Is there an opportunity to run them on remote servers.
Mobile employee applications	Not needed – Town is too small
Fleet and maintenance crew dispatch	Not needed – Town is too small
Mobile employee instant messaging, email and voice	Not needed – Town is too small
Employee telecommuting	?
Smart parking meter and enforcement	Not needed – Town is too small
Automated utility metering and control	Not needed – Town is too small
Mobile asset tracking	Not needed – Town is too small
Traffic light control	Not needed – Town is too small
Security	Must have if Town wants to install security cameras at some facilities or in the Town
Video Return from other Municipal	Must have from Library, School and

facility	Council on Aging.
Internet Access at all Municipal facilities	Must have.

- Town Hall (Network Hub) – High need
- Police Department – High need
- Fire Department – High need
- DPW – Minimal need
- COA – Minimal need
- Library – High need
- Beach Office – Minimal need
- Pamet Harbor – Minimal need
- Transfer Station – Minimal need
- Highland Golf Course – Minimal need
- Truro Central School – High need

Phone service at all Municipal facilities	Must have.

- Town Hall (Network Hub) – High need
- Police Department – High need
- Fire Department – High need
- DPW – Minimal need
- COA – Minimal need
- Library – Minimal need
- Beach Office – Minimal need
- Pamet Harbor – Minimal need
- Transfer Station – Minimal need

	• Highland Golf Course – Minimal need
	• Truro Central School – High need
Cable TV at Municipal facilities	Not needed in most facilities. With the exception of: • Truro Central School

Public safety — Wireless

• High speed network backbone that supports radio dispatch and radio traffic for police and fire departments	Must have
• Broadband delivery of video and surveillance traffic to emergency response vehicles.	Not needed – town is too small.