Abstract

The Community Connection Aggregation Project (CCAP) is in essence connection teaming via a logical Community Area Network (CAN) topology intended for multiplying internet connection speeds among communities by a factor of *n* at little or no additional cost. The essential center point of this concept is a Connection Aggregation Device or CAP that, in conjunction with a redistribution method, be it wired or wireless, would allow all parties involved access to bandwidth significantly beyond that which would be available to them via their connection alone.

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Community Connection Aggregation Project

The purpose of this project is to provide an internet connection with a theoretical speed limited only by the number of participants for little or no additional cost to the end user by utilizing a central device to aggregate internet connections from homogeneous or heterogeneous consumer-level connections into a much faster internet connection to be redistributed among all participating parties.

Since common internet traffic is rarely a high-speed sustained stream, this would easily facilitate a 36mbit connection for the same monthly price as a 6mb connection using only inexpensive common consumer level networking hardware and a spare computer.

Purpose

The inspiration for this project was based on the fact that as of July, 2007 the average home internet connection speed in the United States is less than two megabits. The Communication Workers of America (2007) in their Speed Matters report stated:

“The median download speed for the 50 states and the District of Columbia was 1.9 megabits.” (p.4).

In Figure 1. you can get a very basic understanding of how CCAP works.

Figure 1. Overview of functionality of Connection Aggregation Device.

By aggregating the connections, it is possible for 3 users with 5mb/1mb sustained to achieve 15mb/3mb sustained, one user at a time. In a practical example, if house A is streaming a video using 2mb/.5mb, there is still 13mb/2.5mb of bandwidth for other participants to use. If user B tries to load a web page at this time, it will still be over twice as fast as it would not utilizing a CCAP installation.

Theory

Since internet traffic is rarely a sustained high-speed stream (with exceptions such as large P2P file transfers, gaming, streaming movies, etc), we can combine multiple users’ bandwidth “headroom” (free bandwidth above and beyond what they are using) and allow everyone involved to utilize it. Even if the traffic from one client is high-speed sustained traffic, there are measures that can be implemented such as bandwidth limiting wherein no one point (house A, for example) can usurp the

entirety of the bandwidth. A viable solution could be to limit any single point to 85% of available bandwidth to facilitate the continued usage of the connection for other points. In practice this would let any of the 3 participants with 5mb/1mb connections use a maximum of 12.75mb/2.55mb, while still retaining an additional 2.25mb/450kb for other users. In this example, concerns of scalability become evident, as 100 points contributing 5mb/1mb would allow any single point to utilize 425mb/85mb, while leaving the remaining 99 points with 75mb/15mb. Under heavy usage this situation could become disastrous, thus practical configuration of bandwidth limiting is largely dependent on the size of the installation.

Incidentally, this also creates a somewhat fault-tolerant network, assuming in the rare likelihood that each node would be on a different physical network segment and/or subnet. Nevertheless, it does provide a certain level of fault tolerance against hardware and “last mile” cable failure, as this would result merely in a decrease of available bandwidth proportionate to the number of connections still remaining which could be expressed as $n - n1$.

Hardware

Ideally, one would already posses all the required hardware as it is fairly commonplace nowadays to have a quite powerful

unused computer, at time of publication an unused 800mhz Pentium III based system with 512mb of ram and a small, solid state disk (compact flash with an IDE adapter) would serve this purpose nicely. The network cards do not have to be homogeneous although such a situation may facilitate slightly easier configuration and compatibility. For example, in a theoretical system with 4 NIC cards, all PCI type and all the same model, for the sake of this example, let us say they happen to be 3com chipset based. This allows the use of enumerated XL*[n]* interface names, all utilizing a single kernel module.

Table 1. illustrates an example of a typical network interface configuration under FreeBSD.

Table 1. Example FreeBSD Network Interface Configuration

Since we only need one outgoing connection to a connectivity device, only one card is used as output. If this were a faster setup (say, 5xFIoS 40mb/40mb connections), we would use 100baseTX cards for input and a 1000BaseTX card for output, as theoretical maximum speed would be 200mb/200mb - overhead.

Wireless Option

There also exists in theory the option to use wireless to facilitate easier linking of all required hardware. The most obvious advantage to this lies in the possibility to omit point-to-point outdoor wiring. Wireless access points could be configured to broadcast the signal to wireless NICs in the

connection aggregation device (a typical example of this would be a wireless access point operating in standard access point mode and having it's own LAN subnet), which could then output via wired NIC feeding a wireless access point to which all users would then have access. An illustration of the above concept can be seen in Figure 2.

References

Communication Workers of America. (July, 2007). Speed matters. *A Project of Communications Workers of America*, 4. Retrieved December 1, from http://www.speedmatters.org/document-library/sourcematerials/sm_report.pd

Table 1.

Interface Name (FreeBSD)	Destination
xl0	House A modem
xl1	House B modem
xl2	House C modem
xl3	To switch, back to users at

	houses A, B, and C

Figure 1. Example of a setup of a community connection aggregation installation utilizing a central aggregation device.

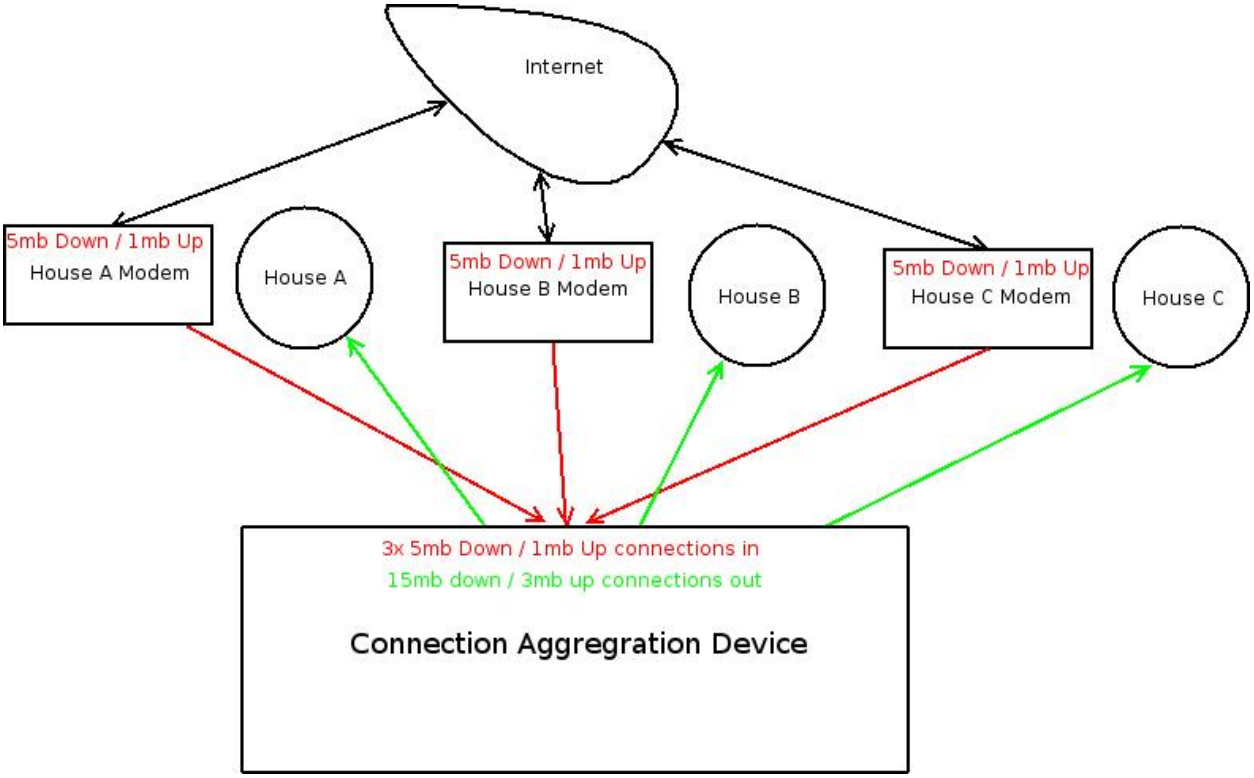
Internet
5mb Down / 1mb Up
House A Modem
House A
5mb Down / 1mb Up
House B Modem
House B
5mb Down / 1mb Up
House C Modem
House C
3x 5mb Down / 1mb Up connections in
15mb down / 3mb up connections out
Connection Aggregration Device

Figure 2. Overview of possible wireless configuration utilizing connection aggregation device.