cbg communications, inc.
Philadelphia Office: 5 Great Valley Pkwy., Suite 282, Malvern, PA 19355 P/ (610) **648-3819** F/ (610) 648-3815
St. Paul Office: 444 Cedar Street, Suite 950, St. Paul, MN 55101 P/ (651) **379-0800** F/ (952) 379-0999
www.cbgcommunications.com

Review of the Comcast

Fort Collins Cable System

Technical Characteristics

Prepared by:

Dick Nielsen
Senior Engineer
CBG Communications, Inc.

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Introduction and Background

CBG Communications, Inc. (CBG) has been working in conjunction with River Oaks Communications Corporation (River Oaks) at the request of the City of Fort Collins, Colorado (City) to perform a technical review of the Comcast cable system serving the City. The scope of our review involved an analysis of a number of documents related to the system, including system testing and certification information and other documentation. We were not requested to make an on-site audit of the system. Consequently, it should be noted that the findings and recommendations described below are based solely on the review of the documents and written materials, as well as the information sought and obtained in discussions with Comcast personnel.

On or about October 22, 2003, we made the following requests for information from Comcast:

1. A general description of the cable system, including:
    a. Number of plant miles, broken down by aerial and underground
    b. Age and condition of system
    c. Number of homes passed
    d. Number of subscribers
    e. Average and maximum homes per node
2. A description of system operating parameters, including:
    a. Full system bandwidth and top frequency in both the forward and the reverse directions
    b. Typical optical transmitter and receiver signal levels at the headend, hubs and nodes
    c. Typical trunk and line extender amplifier input and output levels, including tilt
    d. Subscriber system tap drop specifications (tap output levels)
    e. Typical signal levels at houses
    f. Typical signal levels at the input to the subscriber terminal device (TV or set-top unit)
3. Node tree and amplifier schematic including:
    a. Headend and hub locations
    b. Node locations and fiber routing
    c. Amplifier cascades
    d. System boundaries
4. A description of current interconnections with neighboring or other regional systems, the purposes of the interconnections and the method used for interconnection.

5. System design end of line performance specifications indicating the worst case values for:
    a. Carrier to noise
    b. Carrier to composite triple beat
    c. Carrier to second order
    d. Cross modulation
6. The last two FCC Proof-of Performance tests.
7. The latest FCC Cumulative Leakage Index (CLI) test results.
8. Line materials and equipment list and specifications including:
    a. Fiber node optronics
    b. Trunk amplifiers
    c. Line extender amplifiers
    d. Feeder line taps and passives
    e. Trunk cable
    f. Feeder cable
9. A description of the current interactive capabilities of the subscriber network including operating specifications for the return amplifiers.
10. A description of any existing network monitoring systems.
11. A description of any current backup powering systems for the headend, hubs and the distribution system.
12. A description of construction practices including whether, and what size of conduit has been utilized for underground system installation.
13. A headend equipment diagram showing signal flow from the input sources (satellite dishes, off-air receive antenna, etc.) to the combining network and headend output.
14. A frequency allocation chart for all services on the subscriber system that indicates current total system capacity, channels in use, and services provided.
15. Equipment list and specifications for all subscriber set-tops units.
16. Description of digital compression, high definition television, cable telephone, and cable modem technologies currently deployed over the subscriber network and the associated services provided to subscribers via these technologies.
17. A complete description of any in-process upgrades to the subscriber network, including but not limited to, elements such as future capacity expansion, the timetable for completion, infrastructure upgrades and additional interconnections.
18. A current Institutional Network (I-Net), if any, and any planned I-Net upgrades. Also provide the same information as indicated above but related to the operation of the I-Net. The I-Net schematic should also show the location of all facilities connected to the I-Net.

In correspondence dated December 15, 2003, Comcast provided much of the requested information. We received the FCC Proof of Performance test results, most of the requested system specifications and design criteria, service lineups and descriptions, and the CLI Flyover results. In some cases Comcast simply indicated the system was "within the required levels set by the FCC rules and regulations Part 76." Assuming they are indeed meeting those "specifications," then that would be acceptable. However, it would also seem that Comcast would indeed have these numbers spelled out specifically for the Fort Collins system. Comcast also stated that some of the requested information is "available for viewing at our offices located at 8000 E Iliff Ave Denver, CO 80231. If you would like to schedule a time to review, please contact Glenn Walker at 303-603-5012 to arrange a date and time." This was not practical for CBG within the scope of this project from both a timing as well as a financial perspective.

Findings

CBG's review of the data provided through correspondence, supporting materials, discussions, maps and other documentation focused on three major areas to determine the viability of the system to meet both current and future requirements of the Fort Collins community. The three major areas are: system architecture; system capacity; and system performance.

System Architecture

Today's state-of-the-art cable systems exhibit several key elements. First, the cabling format is typically Hybrid Fiber Coax (HFC). This type of system provides fiber optic cable to optronic nodes serving neighborhood areas, with short amplifier cascades (typically in the 4-5 amplifier range) emanating out from the node to provide signals to the homes within the node service area. The nodes are typically capable of serving a relatively small number of homes passed, usually 500 homes or below. Additionally, the system is usually designed with adequate back-up power to support highly reliable delivery of advanced services.

Comcast states in its Request for Information Response, "The system design is based on an average of 900 homes per node, maximum of 2400 homes per node." The System Parameters sheets also included in Comcast's response indicated a designed homes per node of 1200. Either of these homes passed numbers would appear to be high. Comcast's System Parameters sheet shows 6 fibers per node. This would indicate that all nodes are further migratable to smaller node sizes. These characteristics are consistent with an architecture that is capable of providing cable modem services, cable telephony and future targeted services, such as video on demand, if the appropriate electronics are also placed at the headend and in the home.

Regarding other characteristics, the amplifier cascades could not be determined through a review of maps as Comcast did not include detailed maps with their response; however, the information supplied states "A typical cascade off any node is a 5 to 7 amplifier". The system design in place appears to have cascades above other state of the art cable systems. Longer cascades can contribute to lower performance in both the forward and return spectrum. The supplied information also indicates that 95% of all system power supplies have back up capability.

System Capacity

The current state-of-the-art for cable television systems provides for system capacity of 50-860 MHz in the forward direction and an activated system in the return direction for 2-way operation. Typically, analog video channels are provided up to 550 MHz, with the remaining forward spectrum used for a variety of digital signals, including compressed digital video satellite, premium and pay-per-view channels, digital music services, cable modem service and cable telephony. Additional space is reserved and available for future video-on-demand and other services.

In the upstream direction, state-of-the-art systems provide for an activated path that can carry polled and impulse upstream data from subscriber terminals (converters), system status monitoring data, upstream data communications from businesses and homes and upstream telephony communications.

The documentation provided by Comcast indicates the Fort Collins bandwidths, although they may meet current needs, are not consistent with state of the art systems as mentioned above. Additionally, while no return system performance data was provided, Comcast does indicate a return spectrum of 5-40 MHz and that it is currently providing cable modem service and that the system allows for impulse pay per view to Fort Collins customers.

System Performance

As pointed out above in the background section, obtaining the type and amount of data needed in order to fairly evaluate the performance of the cable system took a period of time from the point in October 2003, at which a variety of needed documentation was initially requested, to the point at which we received the final set of data in mid December, 2003. After discussions with Comcast, CBG sent an e-mail requesting that Comcast provide test methodology documentation in order that CBG could verify test result validity based on Comcast's testing procedures. CBG received this information on January 21 after a number of follow-up calls and e-mails to Comcast. All of the requested information should either be in Comcast's Public File or at least readily available to the Engineering or Technical Departments within Comcast. The delays would seem to be unwarranted.

Our review of this final set of data indicated that, with the exceptions listed on the attached sheet, the cable system is performing at a high level that meets or is better than FCC requirements for all parameters tested, including visual signal levels, system frequency response, noise and distortion parameters, and other requirements. The information provided indicated that the cable system should be performing, from a baseline technical perspective, more than satisfactorily to provide good picture quality for video services and successful delivery of cable modem and other advanced services.

Recommendations

Overall, based on a review of the documentation provided, it appears that Comcast is operating a cable system in Fort Collins that will allow continued expansion of services over time. Consistent with the issues raised and addressed during our review, we do recommend, though, that the City pursue the following with Comcast:

1. In order to ensure that the City can have reasonable assurances that the system continues to perform at a high level, the City should periodically inspect the Public Files regarding the FCC Proof of Performance testing as well as the annual results of the CLI testing.
2. To ensure that the system continues to perform adequately throughout any renewed franchise, we recommend that certain basic technical requirements be included in the new franchise. At a minimum, this should include initial HFC architecture, required bandwidth in the upstream and downstream direction, maximum allowable node size, 2-way activation, compliance with all FCC system performance requirements, sufficient back-up power and a mid-term technology review.

It is important to again note that CBG was not requested to perform a field audit to review Comcast's Fort Collins system on-site. At any point that substandard performance is indicated to the City, it would be prudent for the City or its designee to perform at least a representative sample audit in the field to: verify all the written information and documentation provided; visually inspect equipment and picture quality at several test points; and observe objective performance tests in real time in order to ensure that the cable system continues to perform at the high levels indicated by Comcast.