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Report on Transitioning Local Origination (LO) and Public, Educational and Government (PEG) Access Channels to High Definition, On Demand and Other Media Platforms for the Northwest Suburbs Cable Communications Commission

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1. EXECUTIVE SUMMARY

At the request of the Northwest Suburbs Cable Communications Commission (NWSCCC), CBG Communications, Inc. (CBG) has conducted a study related to transitioning the Public, Education and Government (PEG) and Local Origination (LO) Channels under its purview to High Definition (HD), on-demand (VOD) and other Media Platforms. The PEG Channels under the purview of the NWSCCC are:

- Northwest Community Television (NWCT) Public Access Channel 19
- NWCT Public Access Channel 20
- NWCT TV Guide Channel 18
- Government Access Channel 16 (programming provided from individual NWSCCC member jurisdictions, as well as centrally from NWCT)
- Local Origination Channel 12
- Educational Access provided on multiple channels

HD, VOD and related platform transition is critically necessary for a variety of reasons, including:

- HDTV provides a much higher quality video and audio signal.
- Manufacturers, distributors and service support organizations for video and television equipment, including everything from production equipment such as cameras and switchers, to post production editing equipment, signal transport equipment and consumer electronic equipment such as televisions and video monitors, are now fully engaged in the production of high definition digital equipment and are reducing or halting their production, distribution and support for their standard definition digital counterparts in many cases.
- Consumers, who increasingly have high definition televisions and set top devices, have come to expect the quality that HD video can provide.
- Program viewers and content recipients are accessing media increasingly in a non-real-time manner, through on-demand access over both cable and internet-based platforms.
- Access to content is increasingly occurring on a wide range of devices: everything from large screen televisions to IPads and other tablet computers and smart phones.

Our first project task was to get a comprehensive understanding of the NWSCCC-area LO and PEG Channels current status related to high definition digital transition, on demand provision and use of various media platforms, and the pathways that PEG providers were already on related to such transition in all phases of their operations. Consistent with this, a number of content production and distribution components, elements and characteristics were analyzed, including:

- Facility functional areas (studio, editing, field, etc.)
- Findings from the recent Community Needs Assessment

- Overall facility/equipment user profiles
- Centralized and remote access origination transport methodologies – current and projected
- Facilities layout
- Signal flows from production through post production to the master control/playback storage/distribution point
- Equipment inventories
- Operating rules and procedures
- Operating and capital budgets
- Staffing levels and description
- Website usage
- Programming schedule (daily/weekly/monthly) for each channel programmed
- Programming samples accessed via websites
- Any other documentation that was useful related to the project requirements

Tours of NWCT, government and educational facilities were made, observing each functional area (studio production, editing and post production, multi-camera field production including the production truck and ENG Van, master control, etc.) and paying specific attention to standard versus high definition digital components, the types of components, the status of the transition and the transition plans already identified. After the initial site visits, two "visioning" sessions (one for professional production and public access and one for government and educational access) were held to discuss CBG's initial findings and recommendations, related to the various types of PEG and LO entities and the associated functional areas.

Along with this, a number of transitional concepts and components were discussed, as well as priorities for phased implementation. The transitional concepts and components included:

- High definition vs. standard definition
- Digital vs. analog audio
- The use of virtual set and imaging technology
- Delivery of programming through cable-based and internet-based video-on-demand, and the capacity needed for such
- Access to PEG programming, both real-time and on-demand, through user friendly menuing systems
- The potential integration of interactive television (iTV) components into PEG content delivery
- A variety of different video transport technologies, including:
    - IP
    - HD/SDI
    - Fiber Optics
    - Cellular Wireless
    - Microwave Wireless

All of the information gathered from these activities was analyzed and built into a set of findings and recommendations, along with associated equipment projection and phased implementation spreadsheets.

The key findings and recommendations for each transitional area are:

High Definition

- All the NWSCCC-area PEG Access and LO operations should move to a fully high definition (preferably 1080p) digital production environment within the specific transition timeframe proposed (most within the next 4 years).

- It will be important for the NWSCCC to push for HD capacity for all PEG channels during franchise renewal negotiations.

Digital Audio

- All NWCT, LO, and other NWSCCC-area PEG Access entities should move to a digital audio environment during the first half of their overall high definition and other digital transition. Analog audio is sufficient until that time.

Flat Screens/Multiviewers

- All NWSCCC-area PEG and LO entities should move to 16 x 9 HD monitoring, and consider individual, multiviewer or monitor wall technology, depending upon the type that is most efficient for their operation.

Green Screen/Virtual Set and Imaging Technology

- PEG and LO entities in the NWSCCC area should continue to look for ways to increase utilization of virtual set technology to maximize use of available space and enhance opportunities for creative and innovative programming.

Content Storage Systems

- Significant additional storage needs to be acquired to accommodate current and future needs of the NWCT facility.

Interactive Television (iTV)

- The NWCT, other NWSCCC-area PEG channels, and LO will need to increasingly incorporate iTV content into their programming.

- The NWSCCC, especially it's LO Channel 12, will need to work with Comcast to deploy iTV applications and customize them.

- Implementation of iTV content is labor intensive and will require resources over and above what is available today within each of the NWSCCC-area PEG and LO entities' operations.

Video on Demand

- Availability of LO and PEG Access programming through cable based video-on-demand services will increase the reach of LO and PEG content. Accordingly, VOD distribution of PEG programming should be a priority item during franchise renewal negotiations. Based on supporting on-demand distribution for all of the LO and PEG channels, it would be beneficial to negotiate a substantial number of hours of VOD capacity for the NWSCCC-area LO and PEG entities combined.

Internet Protocol (IP)/HD-SDI Transport Options

- The NWSCCC should develop use of IPTV or HD/SDI over fiber for transportation of video between NWCT and government facilities (and perhaps also educational facilities), and between its master control and Comcast.

- The NWSCCC-area LO and PEG channels should pursue the utilization of IPTV for transportation of archived footage and other program material to develop greater collaborative content sharing in the future.

- LO Channel 12 should continue to use microwave transport for the near future but will need to upgrade it to HD digital technology, with the addition of repeaters. Alternatives, such as cellular network transport, should be pursued to determine if they can ultimately augment or replace the microwave.

Three Dimensional Television (3DTV)

- Once HD digital transition is complete, NWSCCC-area LO and PEG entities should consider future transition to 3DTV.

- The NWSCCC will need to ensure that enough PEG Channel capacity is negotiated in franchise renewals to facilitate PEG 3DTV content distribution.

Customer Reception Technology

- NWSCCC-area LO and PEG channels should continue growth in cross platform development to reach different demographics and households. These channels will need to evolve their content delivery methods over time as new methods of viewing evolve. Additionally, the NWSCCC will want to have applications developed to further ease the access and viewing of programs via smartphones and tablet type devices.

- The NWSCCC must ensure sufficient access to PEG Access and LO programming, including detailed program title and descriptive information by both real-time and on-demand cable system viewers. This should be a focus of franchise renewal negotiations.

Closed Captioning

- Closed Captioning is an important assistive technology that could expand the reach and impact of LO and PEG channel programming. It will take significant additional funding, and policies to be developed by the NWSCCC, its member jurisdictions, and allied entities (such as school districts), but when feasible, it will be important to consider adding closed captioning.

Mobile/Remote Production

- The Remote/Field Production equipment, Mobile Production Truck and ENG Van should all be upgraded to full HD capability and integrated into the rest of the production facility.

A key determination of the study was that each NWSCCC-area LO and PEG entity is at various stages in their transition to high definition digital technology and the use of on-demand and other media platforms. In order to address these various stages of migration, CBG created a transition baseline for each type of facility in the equipment projection spreadsheets that are attached to the main report. It is important to note that the baseline correspondingly includes a range of equipment (such as different types of hard-media based digital field cameras) in order to cover the differing approaches, characteristics and status of the different PEG facilities. Accordingly, the equipment needed for high definition digital transition and the associated cost will vary for each entity depending on where they fall in the range for each functional area component. This specific cost then is reflected in the individual spreadsheets developed for each entity and facility.

The specific cost for educational access transition activities is not forecast in the attached spreadsheets, although, educational entities can use similar unit costs to those shown in order to project their transition costs, based on their priorities and available funding.

When reviewing the budgetary impact of the forecasts made in the study in order to transition the PEG Access and LO channels to HD digital production, post production and signal transport, as well as to increase on-demand program provision and use of other media platforms, the onetime transition cost is projected to be $4,808,840. Most of the transition would occur in Years 1 through 4 of the transition period. This breaks down into the following:

- Public Access - $544,100
- Infrastructure throughout the entire NWCT facility, as well as archival/storage costs, headend/playback costs and on-demand/video streaming costs for all related equipment in the NWCT facility - $575,500
- Government Access, including transitioning all council chamber production areas, council chamber control rooms and creation of a “Channel 16” headend at the NWCT facility that incorporates the transport electronics to the facility - $1,171,500
- Truck and Van-based Mobile Production, including the microwave transmission technology needed for remote signal origination purposes - $985,000

- Local Origination and professional staff production and post-production equipment - $875,500
- Ancillary Support equipment - $30,000

All of these onetime equipment transition costs ($4,181,600) are escalated by 15% to account for initial capitalized installation/maintenance/warranty costs. This cost equates to $627,240, and together with the associated equipment costs, results in a total onetime transition cost of $4,808,840.

Most of this equipment is replaced once during a ten year period, depending upon the projected equipment life cycle (most equipment varying from 5 to 7 years before replacement, with some as much as 9 years [infrastructure-related components] or more [microwave equipment and vehicles]).

Overall, over ten years, $9,010,480 is forecast to be needed to support public access, government access and local origination transition activities and continued replacement in all functional areas. This breaks down into $7,835,200 in total equipment cost, plus the 15% escalator for installation, training and warranty equaling $1,175,280.

Overall, the findings, recommendations and cost projections incorporated in the study provide an efficient and effective path for the NWSCCC-area LO and PEG channels, individually and collectively, to continue their migration from standard definition to full high definition digital production, postproduction, content storage and delivery technology, as well as greater use of on-demand and other media platforms. The study can be used to support continued transition efforts in the current fiscal year and beyond and have been projected in function area phases in consideration of: critical programmatic requirements; the age and type of equipment currently in service; shifts in technology on the part of both PEG Channel providers and the delivery systems (such as cable television and the internet) that they use; and the current and projected funding levels available to support transition activities.

It is important to note that the recommendations herein for any individual PEG entity and functional area are meant as planning and development tools that may require adjustment depending upon the circumstances encountered over time. Specifically, as time goes on and each fiscal year approaches, there are likely to be additional shifts in technology, changes in funding availability and programmatic shifts based on changes in the characteristics of an individual channel's mission in order to meet new and evolving requirements, that will affect the specific recommendations made in any given year and the timing of the actual procurement of recommended equipment.

All this taken together, means that it will be important for the NWSCCC, the NWCT Channels, government facilities and educational access providers to react dynamically to technology shifts and available funding and continue to evolve in the way that they use technology and promote the use of technology by their clients, constituents and target audiences.

2. INTRODUCTION

At the request of the Northwest Suburbs Cable Communications Commission (NWSCCC), CBG Communications, Inc. (CBG) has conducted a study related to transitioning the Public, Education and Government (PEG) and Local Origination (LO) Channels under its purview to High Definition (HD), on-demand (VOD) and other Media Platforms. This type of transition has been occurring over the last few years for every type of video program producer, distributor and provider, including broadcast television, cable television, satellite television, LO and PEG Channels. HD, VOD and related platform transition is critically necessary for a variety of reasons, including: HDTV provides a much higher quality video and audio signal; manufacturers, distributors and service support organizations for video and television equipment, including everything from production equipment such as cameras and switchers, to post production editing equipment, signal transport equipment and consumer electronic equipment such as televisions and video monitors, are now fully engaged in the production of high definition digital equipment and are reducing or halting their production, distribution and support for their standard definition digital counterparts in many cases; and consumers, who increasingly have high definition televisions and set top devices, have come to expect the quality that HD video can provide. Accordingly, this review incorporates recommendations to provide guidance and critical pathways for full transition from standard definition (SD) digital to high definition (HD) digital, for all the PEG and LO channels within the NWSCCC-area.

Additionally, program viewers and content recipients are accessing media increasingly in a non-real-time manner, through on-demand access over both cable and internet-based platforms. Also, access to content is increasingly occurring on a wide range of devices: everything from large screen televisions to IPads and other tablet computers and smart phones. During the transitional activities recommended herein, it will be important for the PEG and LO channels within the NWSCCC-area to develop content that can be repurposed for the diversity of these different platforms.

The PEG Channels under the purview of the NWSCCC are:

- Northwest Community Television (NWCT) Public Access Channel 19
- NWCT Public Access Channel 20
- NWCT TV Guide Channel 18
- Government Access Channel 16 (programming provided from individual NWSCCC member jurisdictions, as well as centrally from NWCT)
- Local Origination Channel 12

Additionally, Educational Access is provided on multiple channels.

Tom Robinson, President of CBG, has served as project manager for this study. Dick Nielsen, CBG's Senior Engineer, has worked on a variety of issues related to channel and content transport and delivery, while Carson Hamlin, Media Integration Specialist, has been integrally involved in the review, analysis, findings and recommendations development concerning a host of production, post production and facility master control HD, VOD and other media platform

transition issues. The information gleaned in the analysis and our subsequent findings and recommendations have resulted in the phased equipment and facility transition recommendations included herein.

The findings and recommendations incorporated herein provide an efficient and effective path for the NWSCCC-area LO and PEG channels, individually and collectively, to continue their migration from standard definition to full high definition digital production, postproduction, content storage and delivery technology. They can be used to support continued transition efforts in the current fiscal year and beyond and have been projected in function area phases in consideration of: critical programmatic requirements; the age and type of equipment currently in service; shifts in technology on the part of both PEG Channel providers and the delivery systems (such as cable television and the internet) that they use; and the current and projected funding levels available to support transition activities.

It is important to note that the recommendations herein for any individual PEG entity and functional area are meant as planning and development tools that may require adjustment depending upon the circumstances encountered over time. Specifically, as time goes on and each fiscal year approaches, there are likely to be additional shifts in technology, changes in funding availability and programmatic shifts based on changes in the characteristics of an individual channel's mission in order to meet new and evolving requirements, that will affect the specific recommendations made in any given year and the timing of the actual procurement of recommended equipment. This is explained in greater detail in Section 7. Budgetary Impact.

We recognize and appreciate that multimedia content development and dissemination technology continues to evolve at a very rapid pace. Also, the availability of technology is changing, over time, the way that consumers access and use multimedia content that is developed and delivered by such technology. All this taken together, means that it will be important for the NWSCCC, the NWCT Channels, government facilities and educational access providers to react dynamically to technology shifts and available funding and continue to evolve in the way that they use technology and promote the use of technology by their clients, constituents and target audiences.

3. STUDY METHODOLOGY

Our first task was to get a comprehensive understanding of the NWSCCC-area LO and PEG Channels current status related to high definition digital transition, on demand provision and use of various media platforms, and the pathways that PEG providers were already on related to such transition in all phases of their operations. In order to begin this process, a detailed work plan was developed, background information was gathered and initial site visits to NWCT and government and educational production facilities were set up. Content production and distribution components, elements and characteristics analyzed, included:

- Facility functional areas (studio, editing, field, etc.)
- Findings from the recent Community Needs Assessment
- Overall facility/equipment user profiles
- Centralized and remote access origination transport methodologies – current and projected
- Facilities layout
- Signal flows from production through post production to the master control/playback storage/distribution point
- Equipment inventories
- Operating rules and procedures
- Operating and capital budgets
- Staffing levels and description
- Website usage
- Programming schedule (daily/weekly/monthly) for each channel programmed
- Programming samples accessed via websites
- Any other documentation that was useful related to the project requirements

Information was reviewed and a number of follow-up questions were developed that were then discussed during the initial on-site visits, or by follow-up phone conversations or e-mail.

During the initial site visits, tours of the facilities were made, observing each functional area (studio production, editing and post production, multi-camera field production including the production truck and ENG Van, master control, etc.) and paying specific attention to standard versus high definition digital components, the types of components, the status of the transition and the transition plans already identified. After the initial site visits, two "visioning" sessions (one for professional production and public access and one for government and educational access) were held to discuss CBG's initial findings and recommendations, related to the various types of PEG and LO entities and the associated functional areas. Along with this, a number of transitional concepts and components were discussed, as well as priorities for phased implementation. The transitional concepts and components included:

- High definition vs. standard definition
- Digital vs. analog audio
- The use of virtual set and imaging technology

- Delivery of programming through cable-based and internet-based video-on-demand, and the capacity needed for such
- Access to PEG programming, both real-time and on-demand, through user friendly menuing systems
- The potential integration of interactive television (iTV) components into PEG content delivery
- A variety of different video transport technologies, including:
    - IP
    - HD/SDI
    - Fiber Optics
    - Cellular Wireless
    - Microwave Wireless

Participants in the meeting were encouraged to think about both their current needs as well as their needs far into the future (consistent with the potential length of a new cable franchise) and their ideas, suggestions, comments, and concerns were incorporated into our analysis.

All of this information was analyzed and built into an initial set of findings and recommendations, along with associated equipment projection and phased implementation spreadsheets. The initial sets of spreadsheets were provided to NWSCCC staff for their review. After review, a number of suggestions were made for modifications and provision of additional information. The CBG team engaged in a number of follow-up discussions concerning these suggestions, including line-by-line review of the digital transition equipment projection spreadsheets that were prepared for each PEG entity and function area. Based on the follow-up discussions and information provided to us, a new set of projection spreadsheets and the initial draft report was prepared and provided. Further information was then received and discussed, resulting in the final set of high definition digital transition spreadsheets incorporated herein and corresponding changes in the report narrative.

The entire set of information gathered, reviewed and analyzed has resulted in the final set of findings and recommendations that follow.

4. PEG AND LO CHANNEL TRANSITION OVERVIEW

At the outset, it is important for the reader to understand who provides the various forms of PEG Access and LO, the organizations that they are affiliated with and represent and the mission of their channel(s). These factors significantly affect how each entity is approaching high definition digital transition, the use of on demand and pursuit of utilization of various media platforms, including the differing emphasis and prioritization that each entity has concerning transition in various functional areas, the current status of their transition and their needs for the future to complete the transition.

Provided below is a brief overview of each type of PEG Access and LO and a high-level examination of the current status of their transition. Significant additional detail concerning specifics of transition for various production, post production, and signal delivery functional areas, characteristics and elements, for each of the PEG and LO entities and their needs going forward can be found in Sections 5 and 6 and the attached spreadsheets.

4. A. Northwest Community Television (NWCT) – Public Access Channels 19 and 20

NWCT Channels 19 and 20 Overview

Northwest Community Television (NWCT) provides public access to video production services for residents and organizations in the nine member cities of the NWSCCC, through the equipment and facilities at the NWCT Public Access Center in Brooklyn Park. The programming produced at the NWCT facility and that brought in by outside program producers is cablecast over Channels 19 and 20 (Channel 18 serves as a TV guide for these two channels as well as programming on Channels 12 and 16).

The programming on Channels 19 and 20 reflects the diversity of those that produce at the access center and focuses on a wide range of subject areas, including: politics, entertainment, religion, sports and news.

NWCT offers a variety of resources to Public Access producers, including: training and use of two studios, editing equipment and single-camera and multi-camera production equipment.

Overview of Public Access Transition

Over time, NWCT has continued to upgrade the equipment available to Public Access producers, such that there is a large amount of digital equipment. However, a significant portion of this digital equipment is SD, not HD.

For example, regarding field acquisition, there are nine (9) HMC 150's that acquire to secure digital memory cards (and NWCT is in the process of phasing out all tape-based cameras in the future), but the playout is SD.

Regarding editing, there are four (4) non-linear edit suites, which is adequate for the public to use, and the editing software is HD based. However, studio control will need full replacement in order to move to High Definition.

NWCT's Channels 19 and 20 are also not currently available on-line in either a streaming or on-demand format (NWCT does have a YouTube Channel though).

Accordingly, as discussed in more detail in Section 6 and the attached spreadsheets, significant enhancements are needed to transition the Public Access channels to High Definition, on-demand and other media platforms. Also, based on priority transition needed for: infrastructure and routing throughout the entire facility; the professional studio; and the production truck and van, needed enhancements for public access are forecast to occur later in the planning window.

4. B. Channel 12 (Local Origination)

Channel 12 Overview

Channel 12 is produced at the NWCT facility on the professional side, and provides both a daily NWSCCC-area news show (Monday through Friday) as well as news features (such as Health Check, In the Garden, Business Matters, Money Savers and Local Living) and sports programming, such as Sports Jam. Channel 12 also provides a program that focuses on the NWSCCC area cities called Community Corner, as well as Northwest Cities, Mayor's Minutes and Community Calendar. Channel 12 also focuses on full coverage of local parades, concerts and special events within the community.

Channel 12 is produced by the professional staff at NWCT and is considered a Local Origination (LO) Channel (as opposed to a PEG Access channel), which enables it to be supported by commercial advertising and other types of sponsorships.

Overview of Chanel 12's Transition

Channel 12 has made significant strides in transitioning to HD and provision of on-demand services, but there are still many areas that need upgrades and enhancements. Specifically, field acquisition and editing suites are now all HD or HD capable. In studio control, Channel 12 has HD/SDI cabling as well as an HD/SDI multi-viewer and HD monitors. The ENG cameras are also HD compatible.

However, almost everything else is SD (cameras, switcher, etc.) and playout is currently in SD (since no HD capacity is currently available from Comcast).

Regarding on-demand, there is significant on-demand access via the internet to a variety of news features, sports, archived newscasts and other programming. Additionally, viewers can watch a live stream of Channel 12. On-demand access through the cable system is not yet available because Comcast has not provided such access to Channel 12.

4. C. Government Access Channel 16

Government Access Channel 16 Overview

Government Access programming provided over Channel 16 is primarily produced at, and distributed from, Council Chamber production areas, field production equipment and playout servers located at the City Halls of the nine (9) member jurisdictions. This programming is currently sent directly to Comcast and then provided on a discrete Channel 16 only to the jurisdiction providing the programming.

The amount of production ranges greatly depending upon the capabilities of the individual member city. For example, some only provide coverage of council meetings and some commission meetings, while others do some field production and other types of production in their Council Chambers (Brooklyn Park for example, currently produces a half hour show about the City). NWCT does some common shows for all of the Cities (such as a "Meet the Mayor"-type show).

Overview of Channel 16 Transition

There is a wide range of transition issues related to current government systems, with some equipment still being analog (which would require a full digital migration) and other equipment being SD (which would require migration to HD). In other cases, some equipment is already HD (Brooklyn Center for example, already has HD field production equipment); while other equipment is HD ready or HD compatible (some of the cities, for example, have HD compatible Tightrope servers for playout).

To address these issues in a holistic manner, CBG has developed a template that can be utilized by each government, to address the needs of their particular current equipment complement. While we have forecast complete new upgrades for every government facility in the attached spreadsheets, some will need less than the full complement based on their current capabilities.

Additionally, those that have field equipment will be able to look at the specific field equipment recommended for Public Access and Channel 12 and determine items that may fit their particular needs in the future.

Regarding on-demand, all of the Cities currently use Granicus for on-line distribution, which provides them with both streaming as well as archival on-demand capabilities. These units would need to be upgraded to HD in order to complete their internet-based distribution transition in the future.

4. D. Educational Access

Educational Access Overview

Educational Access is provided in the NWSCCC-area over multiple channels. An example of educational programming is that provided by the Wayzata School District (Wayzata). It brands its Educational Access programming as "ED's TV".

Wayzata is the big provider of programming for ED's TV. Programming is also provided by the Robbinsdale and Minnetonka School Districts.

Wayzata has production capabilities in nine (9) of their High Schools, as well as production capabilities in the auditorium, gymnasium and TV studio of their main facility (Old High School). Programming is routed within the Wayzata school system through a fiber network that interconnects all of their schools. Their headend is at the Old High School. This is where programming is aggregated and sent to Comcast.

Robbinsdale School District covers their Board meetings as well as concerts and other District-related programming.

Robbinsdale carries their programming on tape and DVD to Wayzata for aggregating into the Channel 22 feed.

Channel 22 would like to provide programming that reflects a greater diversity of school districts within the NWSCCC area, including Anoka/Hennepin, Brooklyn Center, Hopkins and Osseo (in addition to the current Robbinsdale and Wayzata).

Overview of Educational Access Transition

Information obtained from the School Districts indicates that while there is a focus on video production within districts such as Wayzata and Robbinsdale, their current equipment is largely SD and would need significant upgrading to HD. For example, Robbinsdale School District has field cameras and a multi-camera mobile system, but they are SD. Similarly, their Avid edit system is also SD.

Wayzata has significant production capabilities but these are currently primarily SD as well.

Accordingly, as the School Districts desire to transition to HD production, post production and distribution, they would need significant upgrades from their current SD environment. While we have not listed specific School District requirements in the attached spreadsheets, School Districts could look at the types of equipment that have been projected (along with associated costs and capabilities) that match their specific needs in the future. For example, HD equipment needed for Board of Education meeting rooms would be very similar to the HD equipment forecast in the spreadsheets for Council Chamber productions.

Channel 22 is currently not streamed over the internet (Vimeo is used for on-demand access for some programming), but the Wayzata School District desires to do that in the future.

Robbinsdale School District does stream its School Board meetings using Granicus. They also upload the programming they put on Channel 22 to the Granicus system and they have a YouTube Channel for access to archived programming.

5. DIGITAL TRANSITION ELEMENTS AND COMPONENTS

After review and analysis of the digital transition status and issues related to those that provide PEG Access in the NWSCCC area, including review of common digital transition themes among all the PEG Access providers, as discussed above we've determined that all providers are well into the process of digital transition and are working towards full HD digital transition. Key elements and components of HD and other digital transition are discussed below.

These various elements and components were reviewed, evaluated and utilized to develop a digital transition baseline for each functional area of the Northwest Community Television facility's operation and government council chamber production areas, which is described in Section 6. The facilities' digital transition status was then analyzed versus the baseline, which resulted in the equipment projections and phasing, as well as the budgetary impact, described at the end of this document and incorporated in the attached spreadsheets.

5. A. Standard Definition (SD) and High-Definition (HD) Digital

At this point in the evolution of digital television, the most basic issue to review is making the transition from SD to HD, and whether to implement an SD/HD hybrid environment or move to full HD components (and then what version of HD to choose). The main characteristics of Standard Definition (SD) television are the 4x3 aspect ratio, the interlaced television signal, and the 486 (visible) lines of resolution in NTSC. In SD Digital, this equates to 704 x 480 pixels of resolution. It was built on small bandwidth capacities because of legacy technologies. In contrast, the current High Definition (HD) technology uses a 16x9 aspect ratio, can be interlaced or progressive, and can go up to 1920 x 1080 pixels of resolution.

Specifically, we recommend that both the NWCT facilities and government council chambers' operations within the transition timeframe proposed, move to a fully high-definition digital environment. Essentially, just like the television production world has moved over time from black and white to color, VHS to DVD (and now Blu-ray) and from analog to standard definition digital, it is now moving to a more fully high-definition digital environment. This means that eventually little or no standard definition digital production and post-production equipment will be left to procure (this is already happening with consumer electronic devices), nor will replacement parts to repair existing SD equipment or support from manufacturers, vendors and distributors for such equipment, be available. Additionally, the cost for high-definition equipment continues to fall, meaning that it is now and will continue to be achievable at a reasonable cost during the transition timeframe proposed.

The reason the broadcast, cable and satellite industries have moved to HDTV is because of the obviously better picture quality and sound quality, which consumers have also recognized. As of January 2012, over 69% of US households have at least 1 HD television set, up from 17% in 2006, according to recent published research. Over the past 5 years, 52% of US households adopted HDTV. According to the research, the percentage of HDTV homes continues to grow rapidly.

While there currently remains a small gap between the number of consumers that have HD televisions and the number that actually receive HD programming, this gap is decreasing. For example, 75.5 % of television households have HD capable sets while 72.9% are receiving HD programming[1]. This gap is steadily decreasing and we expect it to continue to decrease as cable systems and other providers continue to heavily promote HD programming and potentially migrate to all HD content over the next few years

HD technology has evolved substantially over the past two decades and now encompasses everything from home consumer equipment to high-end video production and distribution systems. There are differences, however, in HD types and how various equipment processes and handles HD signals. There are HD types, which are highly compressed, such as HDV, and others, which offer very high quality uncompressed HD signals. The evolution of HD has consisted of three major plateaus, the first being 720p, or 720 lines of resolution with a progressive scan.

The 720p format displays approximately 1 million pixels per frame. There are a variety of resolutions available, ranging from 1024 x 768 to 1280 x 720 to 1366 x 768. Larger television manufacturers are offering fewer 720p products larger than 42", although the format will not phase out completely for a number of years to come.

The next evolution was 1080i, which features 1920 x 1080 pixels of resolution. It is interlaced, meaning that the image is projected on the television screen in a multipass fashion. 1080 is also provided in a progressive scan format 1080p (discussed below), which projects the entire image on the television screen by scanning each line in a sequential pass. Current HD broadcasts are typically in the 1080i or 720p format.

The highest current, commercially available picture resolution is being obtained with the 1080p format. At a resolution of 1920 x 1080, it displays more than 2 million pixels. It can display every pixel that HD can produce. There is a growing amount of content being produced in 1080p currently, and this is expected to increase substantially in future years. Some external input devices, such as Blu-ray disc players and some gaming devices are outputting 1080p and as a result, gaming and movie enthusiasts are among those purchasing 1080p television sets.

After reviewing equipment lists and conducting walkthroughs, it is evident that there are significant equipment upgrades and replacements needed to move all NWCT operations to HD (High Definition) from the current SD (Standard Definition) production. Some functional areas have significant HD capabilities, while others are just beginning down that path. We recommend that the goal of all the NWCT operations for the next four years is to move beyond standard definition to full high-definition within that timeframe. As more thoroughly detailed in Section 6 and the attached spreadsheets, this could be accomplished through various migration paths in different functional areas for public access, government access and local origination, based on their current technologies.

This type of transition schedule will allow the NWSCCC to budget replacement schedules accordingly, in consideration of anticipated funding. This transition schedule will also allow

[1]Source: http://www.tvb.org/media/file/TV_Basics.pdf

time for the cable operator to commit to cablecast PEG channels in HD. Although the provider, Comcast, has not yet committed to it in the NWSCCC area, the need for such has been demonstrated, Comcast has begun to provide HD capacity for PEG channels in other of its systems and these factors should be points of discussion by the NWSCCC in renewal negotiations.

Specifically, there should be both HD and SD channel capacity, for each of the following services:

- LO Channel 12
- NWCT Public Access Channel 19
- NWCT Public Access Channel 20
- Government Access Channel 16 (Discrete HD provision in each member city, as well as overarching HD provision of NWSCCC-area system-wide programs provided by the NWSCCC)
- Educational Access channels

The analog access channels are currently also being simulcast in SD for Comcast's digital tier subscribers. The HD capacity should be provided within the new franchise as soon as the PEG Access or LO entity can provide HD programming throughout the production chain and transport to Comcast. This will vary for different entities, but all should be capable by the end of the fourth year of the projected transition period.

Currently Comcast is primarily providing 720p and 1080i HDTV signals to its subscribers. It has indicated that it does not change the format of HD signals it receives but merely passes them through in their native format.

There also can be internal needs to produce content in high-definition (such as for training or high resolution documentation purposes). This should be addressed by each form of PEG Access as needed.

Another consideration for planning a complete HD migration within the four year transition period is that issues revolving around 720p, 1080i and 1080p are more likely to be resolved sufficiently. As the 1080p technology becomes more prevalent in the marketplace, more broadcasters are likely to seek a means to provide over-the-air broadcast of 1080p. Currently the majority of broadcasters broadcast in 1080i as the highest resolution format to ensure that their FCC–assigned spectrum can be maximally used for a combination of SD and HD content. In five to ten years, advances in spectrum efficiencies should allow for the adoption of 1080p if the broadcast industry is able to afford the costs of field equipment and studio upgrades to 1080p[2].

Accordingly, regarding HD formats, we recommend that NWSCCC PEG entities standardize on 1080p at this time. If cost becomes an issue during the forecast transition timeframe, any affordable HD steps NWCT wants to take, whether it is a migration to 720p, 1080i, or 1080p, is

[2] Source: www.hdtvsolutions.com/hdtv_reference_guide.htm.
Also, ww.cedmagazine.com/here-comes-1080p-maybe.aspx. Krauss, Jeffrey. "Here comes 1080p—Maybe."

suitable because all are now prevalent in the marketplace. Then, all NWCT operations should re-evaluate their HD technology during each procurement cycle and work together for standardized migration paths to 1080p, or the highest format that is practical at that time. This includes not only equipment, but infrastructure, such as cabling, routing and test and measurement equipment.

It should be noted that each of these formats can be achieved with many types of products. However, manufacturers can use different underlying compression schemes for the same display format. For example, HDV, P2, Flash Memory Cards, and optical disc-based systems can all be used to achieve these formats, but each uses different compression schemes, which can affect the overall quality of the end product, depending on what is being produced. If an Access entity is using a larger amount of virtual set technology, for example, they may want to use a product with very little or no compression so that image quality is not compromised. The bottom line is that each one of the operations needs to look at their own individual work flow and the types of programs they are producing to determine the best formats to achieve their desired HD resolution level.

Key Recommendations

- **All the NWSCCC-area PEG Access and LO operations should move to a fully high definition (preferably 1080p) digital production environment within the specific transition timeframe proposed (most within the next 4 years);**

- **It will be important for the NWSCCC to push for HD capacity for all PEG channels during franchise renewal negotiations.**

5. B. Analog vs. Digital Audio

As video has evolved from analog to digital, so has audio. Audio can now be recorded, transmitted, and played back in both analog and digital formats. The main broadcast standard for digital audio is called AES/EBU, after the Audio Engineering Society and the European Broadcasting Union, who developed it.

There are both technical advantages and challenges regarding the use of digital audio. Some of the advantages include the ability to carry several channels of digital audio on one SDI cable. Other advantages include the ability to keep audio in a pristine state through multiple production points. Some of the challenges include possible interface issues with converting digital audio back to analog when needed, and issues with syncing up audio and video sources so lip sync errors do not occur. These challenges can be resolved with correct equipment and engineering know-how.

Digital audio can be both embedded in a serial digital signal and carried as standalone audio on a separate audio cable. There are three types of digital audio cables: Type one is balanced audio, meaning three conductor wires are used. Type two is unbalanced audio, meaning two conductor wires are used. Type three is optical audio, meaning optical fiber is used.

Most of the PEG entities in the NWSCCC area have chosen to stay with analog audio, while a few have chosen to use digital audio, specifically by embedding audio into the SDI video stream.

Analog audio is still greatly entrenched in many production facilities and still supported by many manufacturers, but it should be noted that many new monitors and routers require embedded digital audio to be used. If analog audio is to be continued, digital audio embedders and de-embedders will need to be used. Analog audio is less expensive than comparable digital audio equipment and it is relatively easy to operate and to train users on analog audio equipment and concepts. Analog audio is sufficient in the beginning of the projected high definition and related digital transition timeframe but we recommend that a move to digital audio take place during years 2 to 4 of the planning window depending on the entity. At that time, audio equipment should be purchased with digital audio as a preference, either embedded or standalone.

Key Recommendation

- **All NWCT, LO, and other NWSCCC-area PEG Access entities should move to a digital audio environment during the first half of their overall high definition and other digital transition. Analog audio is sufficient until that time.**

5. C. CRTs vs. Flat Screens/Multiviewers

As the use of standard CRT monitors continues to decline in the video production world, increasingly facilities are moving to flat screen technology using individual monitors, or multiviewers to view numerous sources on one monitor, as appropriate for the particular facility. For many facilities, there are specific advantages in using multiviewers. They include being able to pick the images desired on the monitor from multiple sources, resolving space limitations, and the ability to enhance the viewing, all the way up to HD. Multiviewer technology is also very flexible in its display of content. One can add the ability to also view data information such as audio levels, timing and clock information, etc. All of this can be adjusted for individual user preferences.

One of the things to be cautious of with multiviewer technology is ensuring access to an alternative if the multiviewer fails. Traditional CRTs can be used as a backup in case of multiviewer failure.

Additionally, to avoid the multiviewer from becoming a single point of failure, some manufacturers have based them on a distributed architecture design, so that video will still pass through even in the event of a complete failure. Multiviewers also have redundant outputs to be used in case of monitor failures.

A monitor wall is a combined series of multiviewers working in conjunction to create a large multiview experience of many (or all) video sources. The system design of a monitor wall can include a mixture of computer, audio, digital and analog video signals. This is intended to replace aging traditional monitors throughout a single location. It gives one the ability to view sources throughout the facility when the facility is configured to be more centralized. For example, it can be configured in many ways to include video and audio feeds from studios,

playback/headend areas, and edit rooms. Advantages of multiviewer technology in general include auto-detection of input sources, where one would be notified if anything were to interrupt the video source. If the multiviewer is centralized in a monitor wall, then engineers would see any interrupt messages from throughout the facility. If a solution with multiple modules is used for multiviewers, then redundancy is built in with the addition of distributed modules so there is no single point of failure in the monitor wall.

Picture 1 - Multiple monitors are tied together on a monitor wall to create a very large viewing experience.

The NWCT master control, especially if a government access headend is created, would have the size and type of facility where a monitor wall can be an effective solution for multi-channel monitoring and troubleshooting.

Organizations are also adopting green initiatives related to video monitors being used. Among new monitor technologies, LCDs are more likely than plasma monitors to receive the EnergyStar efficiency rating. This rating reflects monitors that use at least 30% less energy than their retail counterparts and the EPA reports that if all television sets and monitors used in the United States were EnergyStar, more than $1 billion in energy costs savings would be realized. In the past few years, with the advent of increasingly sophisticated LED backlighting, LED based monitors have become the best flat panel HDTV technology on the market. LED monitors offer unmatched energy efficiency.

It should be noted that, as the PEG entities in the NWSCCC area procure new equipment, they may want to consider moving towards common or standardized technologies when feasible. If this occurs, then shared resources, training, troubleshooting and cost efficiencies can be applied. For example, shared backup multiviewers, field cameras, studio cameras, and other resources could be made available if standardized technologies are established between entities.

Key Recommendation

- **All NWSCCC-area PEG and LO entities should move to 16 x 9 HD monitoring, and consider individual, multiviewer or monitor wall technology, depending upon the type that is most efficient for their operation.**

5. D. Green Screen/Virtual Set and Imaging Technology

Virtual set technology (also known as chromakey or green screen technology) enables a studio set or background to be created electronically and be superimposed with the talent in the television picture. Regarding NWCT and other NWSCCC PEG entities, virtual set technology can be utilized in many creative ways such as giving the impression of depth and pseudo-3D visualization. It also enables smaller studio spaces to look very large. Other benefits include customization such as branding a look and giving a sense of place. The virtual set equipment recommended is detailed in the accompanying digital transition equipment projection spreadsheets.

There are both hardware and software solutions for chromakey technology. Hardware solutions are usually used when chromakeying is done live or live to record. These hardware solutions can be standalone, feeding into switchers, or they can be part of the switcher itself. Software solutions are often used for post production purposes. Like hardware solutions, they can be separate, specialized software packages, or they can be included in editing packages. Adobe Premier, AVID and Final Cut Pro have chromakey software included in their standard installations. Therefore, the kind of chromakeying solution each entity chooses will need to be determined depending on their goals and main purpose. One solution could be to have a mixture of both hardware chromakeying in a studio environment, and individualized post production software as needed. This mixed hardware and software approach has been utilized by broadcasters, video production houses and the film industry currently, and should continue to be pursued.

One advantage to the software approach is that it is a less costly solution. Disadvantages include the requirement for post production editing to apply the effect. This can be seen as an advantage, however, if the editor desires the flexibility to change backgrounds after a shoot is complete or if there is a need to apply additional effects after those that were applied real-time. A good example of post production chromakey software editing is the CGI effects in most major motion pictures and music videos. Hardware chromakey solutions are more expensive but can produce live real-time chromakey effects. An example is the weather person standing in front of the weather maps on the nightly news.

As virtual set technology advances, the NWSCCC area PEG and LO entities should keep developing ways to utilize it. For example, there are some entities that have very limited production space, in which case virtual sets could be used effectively to enhance their programming. Because of their limitations on space, they do not have room to store sets and change them out, so green screen technology is a viable option. For larger facilities, virtual set capabilities could be increased to include more elaborate effects such as multi-camera, multi-

angle options. This technology should be considered when purchasing new equipment such as cameras and switchers to make sure it has the ability to interact and process chromakey signals.

For smaller studios, or those studios without extensive chromakey needs, only a chromakey curtain/wall/screen fixed set, virtual set software to create the background, hardware chromakeying engine, and proper lighting are required. For larger or higher-end virtual set studios, the basic equipment will need to be upgraded so that both hardware and software support multi-camera shoots, movement and tracking. Also, a chromakey cyclorama wall or similar size color background will need to be developed because a smaller curtain or screen will not be adequate. If there is room, it is recommended that one of the public access studios have a cyclorama wall installed. This will give access producers the flexibility to use this technology in at least one of the studios.

Key Recommendation

- **PEG and LO entities in the NWSCCC area should continue to look for ways to increase utilization of virtual set technology to maximize use of available space and enhance opportunities for creative and innovative programming.**

5. E. Content Storage Systems

With the increased use of high-definition production, there is also a need for increased storage capacity throughout the facility. The recommended storage reflected in the accompanying spreadsheet reflects a level of at least 150 TB with the initial purchase, as well as the replacement. It should be sufficient to handle NWCT's needs over the length of the projected 10 year period.

Specifically, as producers and staff continue to migrate from tape-based work flows to tapeless workflows, the need to have adequate storage will be a significant factor. Video files, especially HD video files, require a large amount of storage space as well as high performance servers. Furthermore, the need to access files will require a very robust server or video archival system where multiple users can calibrate and work in a similar or parallel environment. In addition, an archival system can also be used for graphics, and audio files, enabling users to store, and share graphic elements and production music for various projects.

Along with storage demands, the need for back up and disaster recovery must addressed by any archival system implemented. Steps must be taken to prevent data loss when events such as hardware failure or accidental deletion of files occur. This should be considered and taken into account when purchasing storage.

It will also be important to have a good robust software tool to manage and organize all of the video files used throughout the facility. This tool should be capable of simultaneous use by multiple users for capturing, logging, sharing, backing up and archiving data. The software should also be capable of cataloging all media assets, not just video files but also still images, audio files, Flash files, PDFs, etc. The software should incorporate extensive metadata

capabilities (both extracted automatically and entered by the user) that can be used for searching and filtering.

Key Recommendation

- **Acquire additional storage reflected in the spreadsheets to accommodate current and future needs of the facility.**

5. F. Interactive Television (iTV)

Interactive Television (iTV) takes the viewer from a strictly passive (content recipient) role to an active (content affective) role. iTV is an evolving technology with existing applications such as real-time voting in which the viewers influence the direction of the program. Younger viewers are increasingly more demanding of their news, information and entertainment media in the sense they do not want to just passively take in information. They seek out exactly what they are looking for and expect a more two-way or interactive experience. These members of the audience will expect and require being able to shape their viewing experience in ways that have not traditionally been done.

The basic concept of iTV has been around for some time, initially using separate upstream and downstream systems (television and telephone for example). Such examples include polling during sporting events. Viewers are asked to text in there answer on questions such as: "Who is the most valuable player of today's game?"; "Who should be the starting quarterback?"; etc. This application does not affect the outcome of the program but does allow the audience to share their opinions and see rolled up results in a matter of minutes. Other such examples include viewer surveys during a political program such as a presidential debate. Again viewers are asked to provide a vote on which candidate they believe has addressed a given issue with the best response or what issue is the most important during the election. Yet another example is a news program asking viewers to go to their website and provide feedback on issues being reported. These polls are not scientific but rather simply allow the viewer to feel a sense of involvement with the program.

These examples continue to include the utilization of technology outside of the television medium for viewer response, such as through cell phones for texting and computers for e-mailing or lengthier responses. For a truly 100%, television-based interactive experience the viewer will utilize the two way network they are receiving their television signal from to provide feedback to the studio or to request information. The viewer will make elections on such things as the camera angle they wish to view an event or show from. They will also be able to help decide the path or plot direction on shows they are watching. An example of a commercial application would be to allow viewers through the use of their television remote control to ask for more detailed information than is supplied by a commercial. If this information is requested and provided subsequently to the program, it is called a "Request for Information". If this information is accessed through the on-demand platform, it is called "VOD Telescoping". For instance, if a viewer is interested in a car they see advertised, they can ask for the car's specifications in order to further explore the viability of the car to meet their needs. The operator of the program network and/or transport system (cable, broadcast etc.) would make additional

revenues for every viewer asking for this more detailed information. Additional examples of iTV applications include Polling and Trivia, where additional information can be provided in an interactive manner. For example, during a sporting event, player statistics and historical data could be accessed by a viewer by simply clicking on an icon on the television screen.

PEG programming will also need to evolve to incorporate some of these applications as well as applications not yet available or even envisioned. Like many newer technologies and applications, iTV may today be seen as a novelty. However, over time, it will evolve into the typical viewing experience required by the targeted audience.

NWSCCC-area PEG and LO entities should keep apprised of new iTV applications as they are developed and deployed. Indeed, PEG access providers may, in the future, need to customize existing iTV applications as well as develop and deploy their own specific iTV applications.

For instance, development of an application that allows viewers to see the main topics of discussion at a city council or school board meeting, and the ability to hone in on the topics that most appeal to them, will likely become the conventional method of watching these meetings over the cable television platform. As another example, 12 News could ask viewers to vote on an issue or topic of great local interest, such as if a local government was debating expansion or improvement to a local park, viewers could vote on whether they believe the project should move forward or be abandoned. Another example of iTV applications, in addition to the numerous polling type applications that may appeal to audiences of the channels operated by ED's TV and the participating school districts, includes interactive education or distance learning. This would allow for feedback from students to the instructor on a real time basis such as queuing up questions or comments while instruction is occurring in order to help the instructor tailor the class instruction on the fly and answer questions in a timely manner. Quizzes can also enhance the perception of involvement by the audience. A program can offer a multiple choice quiz for viewers to answer. The creation of competition can also increase the attention to the subject matter being shared by the programmers.

The NWSCCC and the PEG and LO channels it oversees will need to work with Comcast to deploy these applications and customize them to meet their specific needs and the needs of their audience. LO Channel 12, since they already work with Comcast Spotlight, which is Comcast's group spearheading its iTV efforts, should have significant opportunities to explore the use of iTV. This in turn, could lead to applications for the NWSCCC-area PEG channels.

Use of iTV will require staff properly trained in developing or customizing applications on a Java platform, as well as the required software to manage the applications. Industry experts are becoming more readily available for NWSCCC-area providers to reach out to for start-up and development expertise. The most limiting factor to application creation will be the imagination of designers. Take for instance, the applications available for the iPhone. About 2 ½ years since the first iPhone was sold, Apple announced in a press release dated November 4, 2009 that over 100,000 applications were then available for its iPhone. Since that time, the number has grown to over 500,000. People have taken prior applications and changed them slightly to fill their needs and perhaps the needs of others. iTV will likely see similar application development as viewers

and programmers develop new and enhanced applications to better include their viewers in the television experience.

It should be noted that beyond the staff that is needed to help develop or customize iTV applications, there also need to be resources focused on: determining the applications that best fit the target audience's needs (through surveys and other outreach and feedback mechanisms); monitoring the use of the iTV applications implemented; and continuing to tailor the applications as audience preferences become better understood. In short, implementation of effective iTV applications is a labor intensive process, separate and apart from the development of traditional downstream, or one-way, program content.

Key Recommendations

- **The NWCT, other NWSCCC-area PEG channels, and LO will need to increasingly incorporate iTV content into their programming.**

- **The NWSCCC, especially it's LO Channel 12, will need to work with Comcast to deploy iTV applications and customize them.**

- **Implementation of iTV content is labor intensive and will require resources over and above what is available today within each of the NWSCCC-area PEG and LO entities' operations.**

5. G. Video-On-Demand

Video-On-Demand (VOD) has been characterized as a form of iTV. This format allows viewers to watch what they want when they have the time. VOD allows for stopping a program, fast forwarding and reversing to a portion of the program that the viewer wants to see again. VOD's popularity has grown over the past few years from a variation on pay-per-view, where a viewer pays an additional fee to watch a movie or event, to a method of watching programs without the requirement of paying an additional fee. Many programs that are shown on networks at a slotted time every day or week are now also available on the VOD platform.

Viewers have the ability to watch a show on their terms regarding the time of day. In addition, the viewer can fast forward through portions of the program that do not interest them and focus solely on the portion of the program that applies to them.

In the PEG world, viewers can watch an event and choose what they want or need to see. For instance, if a City Council has a meeting that lasts for 3 hours and covers many different topics, the viewer can skip over topics that do not interest them or have less importance to them. As an example, if the Council is voting on an important land use issue, a viewer can fast forward to that portion of the meeting. They can rewind if they missed something or did not fully understand it and review what they have already seen. Similar circumstances apply to school board meetings and other events that are shown on Educational Access.

VOD should be explored for all of the entities to provide a more individually tailored viewing experience for the various audiences. Research indicates that VOD is increasingly becoming the preferred method of program viewing for non-event driven programming.

Cable companies have historically been reluctant to provide VOD capabilities to PEG Access due in part to the high server costs associated with storing necessary content. However this is changing rapidly and VOD has become more mainstream as the cost of storage space has dramatically declined. This reluctance has given way to PEG entities being allowed to offer VOD, as part of recent franchise renewals, agreements to relinquish channel capacity, or as a portion of compensation from the operator to cure an unfulfilled obligation. In most of these cases, the operator has provided approximately 20 – 30 hours of space on their servers to be shared among all of the interested PEG entities. In this case, the entities must slot time limits for each participating member of the group.

Comcast has embarked on a PEG VOD pilot project called Project Open Voice. Comcast indicates that this project is designed to enable PEG entities to explore which types of VOD programming would most benefit residents and also help develop navigation, menuing, management and VOD content submission requirements, both technical and administrative, to effectively utilize Comcast's "Get Local" VOD structure.

Deployment of VOD on the cable system would enhance the end users' ability to watch what appeals to them instantaneously when they have the time available. This is similar to the way residents can obtain information using internet-based VOD technology. Using current encoding technology, staff will not only be able to encode programs in different formats and bit rates but support traditional PC's as well as MAC's and mobile technology such as I-phones and I-pads.

These services could also be made available via VOD on the cable television system, which will increase the value of the system to Comcast customers and enhance the ability of the PEG facilities to educate and inform the community.

Deployment of VOD will require some resources for the entities deploying this service and will likely require collaboration between these entities to determine such parameters as the available time for each and how long programs should remain available on the VOD platform. In addition, transportation to Comcast will need to be discussed and negotiated. The NWSCCC will want to ensure that the programming delivered to Comcast is in a format Comcast can use while ensuring that the integrity and quality of the programming are not compromised. For instance, Comcast may provide a FTP site for NWSCCC to upload programming onto, allowing Comcast to then load it onto their servers. This transport may be accomplished using the internet or existing fiber optic cables running between Comcast's Brooklyn Park headend facility and the NWSCCC facility. Comcast may instead prefer the programming to be delivered via IP encoding equipment whereby the programming is inserted onto its CRAN, or local fiber optic ring connecting all headends and hubs within the Twin Cities area. Then, Comcast can take the programming off of the CRAN wherever its VOD servers are located. In addition to working with Comcast to determine the delivery techniques to be used, the amount of storage capacity or space (hours of programming) that Comcast will make available will need to be determined with set minimums and perhaps increases in available storage space over time. The NWSCCC should

make VOD distribution of PEG programming a priority item during its upcoming franchise renewal negotiations.

Review of the types of programming that would well fit a VOD platform (the most recent government meetings, recent Channel 12 newscasts, sporting events, concerts, rotating public access programs, School Board meetings, flagship ED's TV programs and others) would require a substantial number of hours of necessary VOD capacity. This type of capacity should be one of the focal points of negotiations with Comcast, ensuring that PEG programming will be available to those that desire to increasingly access their viewing choices on-demand.

Key Recommendation

- Availability of LO and PEG Access programming through cable based video-on-demand services will increase the reach of LO and PEG content. Accordingly, VOD distribution of PEG programming should be a priority item during franchise renewal negotiations. As indicated above, it would be beneficial to negotiate a substantial number of hours of VOD capacity for the NWSCCC-area LO and PEG entities combined.

5. H. Internet Protocol (IP)/ HD-SDI Transport Options

Internet Protocol Television (IPTV) is a digital transportation method whereby transmission on the network generally only occurs when specific channels are requested by a set top box or other IP-enabled device in a VOD manner. Although multiple devices can reside at a single location, each requesting a different channel or program, IPTV transmission utilizes a fraction of the bandwidth needed to broadcast all channels throughout the network.

Specifically, in an IPTV delivery platform, video and audio signals are transformed into data packets of information in order to allow transmission over an IP network. The delivery of these packets is no different than the delivery of any other data packets with one exception; Quality of Service (QoS). QoS is the prioritization of delivery of data packets over other data packets whose uninterrupted delivery is less critical. QoS must exist to allow for seamless transmission and reception of the "video packets" and packets related to other real-time services, such as voice or telephone calls. Whereas a large data file can withstand delays during transportation that simply slows the delivery down (often still not noticeable to the end user), real-time services are adversely affected by very small delays or interruptions in the delivery of some or all of the packets. Therefore, QoS must be assured for these real-time packets that give them priority over all other traffic on the network.

Although IPTV is Internet Protocol-based, the signal does not necessarily traverse the public Internet as the name may imply but rather utilizes the same technical methodology and standards. For instance, some cable operators utilize IPTV technology to deliver their VOD product to their customers, but the signals from such operators to their customers never touch the public Internet. Instead, it travels on the operator's closed network. Therefore it should be noted that there is a difference between IPTV and Internet television.

IPTV was designed, in part, to allow video and audio signals to travel down infrastructures with far smaller bandwidths than Hybrid Fiber Coaxial (HFC) or fiber to the home (FTTH) networks, such as telephone network DSL systems. IPTV allows telephone companies such as CenturyLink to operate what is in essence a completely VOD-based network where the infrastructure only needs to have the capacity to transmit one "channel" at a time to each set-top box (up to 4 channels per address, based on available bandwidth to the address) rather than hundreds of channels as is done in traditional cable television systems.

In the past, cable television systems historically broadcast analog channels utilizing 6 MHz of bandwidth for each channel. With the advent of digitally based-channel transmission, using QAM (Quadrature Amplitude Modulation) rather than IPTV, significantly more channels can be broadcast within this same network bandwidth. A 6 MHz bandwidth is divided into as few as 1 or two HD channels. Two HD channels per 6 MHz is the most common with as many as 3 HD channels per 6 MHz of system bandwidth deployed today. CableLabs is continually conducting research, working to provide as many as 6 HD channels within a 6 MHz bandwidth and as many as 12 or more SD channels. Therefore, QAM digital technology, by nature, allows significantly more channels to be transmitted on a traditional HFC cable television network. A strictly digitally based cable television network is therefore capable of having several hundred HD and SD channels being broadcast simultaneously.

Essentially then, cable television systems with their relatively high bandwidth have not gone away from the simultaneous multichannel broadcast platform they have used since the advent of cable television (albeit, the technologies utilized to broadcast these channels has changed dramatically from a strictly analog platform). However, cable systems have deployed narrowcast services such as VOD which allow users to watch what they want when they want to watch it. In addition, some cable companies now utilize Switched Digital Video (SDV). SDV operates in much the same way as VOD whereby channels with a small audience, niche services, are only transmitted to one or more nodes when a customer elects to watch by tuning their converter to the channel. The channel appears to be broadcast from a functionality standpoint but is indeed only transmitted when requested. Because the program is real-time, though, there is no rewind, pause and fast forward functionality like there is with VOD.

PEG Access entities in the NWSCCC-area are currently utilizing forms of IPTV and are forecast to increase utilization over time. Notwithstanding this, there is no need within the high definition digital transition planning window to have such entities convert their entire systems to wholly IP platforms. Rather the various digital formats that are utilized will be converted to IP video as needed, primarily for transportation, storage and on-line distribution purposes at this time. A few cases in point follow:

5. H. 1. PEG Channel Transportation and Content Sharing

Traditional cable television systems such as those operated by Comcast may not migrate to an all IPTV format in the near future due in large part to the existing commitment to and investment in other transmission formats such a QAM-based signal transport. In addition, a large amount of the receiving equipment, i.e. converters or set-top boxes utilized in these systems today is not capable of receiving IPTV format signals.

However, IPTV is being utilized by Comcast to transport its signals between its headends and hubs, as detailed further below. Regarding transportation of PEG channel programming from government facilities, the NWCT to Comcast, and educational facilities, the following is occurring today.

Currently each of the Member Cities provides all programming and management of their specific Government Access Channel 16. These channels are transported via coaxial cable, in an analog format, from the city halls to their respective Comcast hubs where they are then transformed to an IPTV format, inserted onto Comcast's Converged Regional Area Network (CRAN) and transported back to Comcast's Roseville headend for insertion onto the subscriber network.

If an IPTV architecture was further developed between PEG facilities, one significant advantage would be ease of sharing information and programs between the various PEG entities in the NWSCCC-area. Because the information is IP based, any network capable of transmitting data can be utilized to move these programs from one location to another in an efficient and seamless fashion. This includes the networks within facilities as well as the ones between facilities. For instance, the LOGIS fiber optic network being utilized today for government data transport from each of the City Hall locations could be leveraged for transport of PEG Channel 16 programming, therefore eliminating the existing analog coaxial transmission network.

5. H. 1. a. Recommendation for a Government Channel Headend

One scenario for creating a government channel headend, centralized at the NWCT facility, would replace the existing analog coaxial network with an IP based transport utilizing the LOGIS network or other fiber optic connections. This would allow all programming originating at the city halls to be routed to the NWSCCC master control. These signals can then be inserted onto the router located in Master Control providing override and management capabilities for each of the Cities' Channel 16s.

For this to work, all of the Cities' channel 16 programming would leave the city hall locations in an IP format over the LOGIS Network. The programming would be routed to the NWSCCC facility where it would be converted back to an SDI format and inserted onto a router. If a particular City prefers to do all of their programming and management of their channel, the router would simply act as a pass through for the City's programming. If, however, cities would like to have the NWSCCC manage their schedule or provide additional programs on its channel 16, this will be performed by the router.

A second scenario would create the same type of centralized headend over similar fiber pathways, but would require a full fiber connection between each City Hall and the NWCT facility. This would allow the video content to be sent in full uncompressed HD/SDI, such that it would not need to be converted to IP until it

was sent by the NWSCCC to Comcast. This would be useful, where the NWSCCC jurisdictions wanted to share content and wanted such content to be routed between facilities without any degradation in signal quality.

In either scenario, NWSCCC could further support the cities by providing overall management of the channels but, perhaps more importantly, provide programming options on a regional or city by city basis. This configuration will allow the cities all the programming and management capabilities they have today with additional programming options in the future.

5. H. 2. Cable Network Transportation

Cable television operators utilize IPTV today for transportation of programming between their headends and hubsites in a highly efficient manner. For instance, Comcast has two master headends and numerous hubs regionally dispersed throughout the Twin Cities service area that utilize IPTV to transport services between the headends and hubs. The master headends provide all programming for the entire Twin Cities area by feeding the hubs with all cable TV channels, for further distribution to neighborhood nodes, including regionally specific services such as PEG programming, as well as internet data, phone and network management traffic. The hubs act as distribution centers for services being delivered to subscribers and also as collection centers for PEG programming which is then sent back to the headends via IPTV transport for insertion onto the subscriber network. This provides for efficient gathering and distribution of programming region wide from each location with multiple headend locations providing redundancy and backup.

Specific to the NWSCCC's channels, if a centralized government access headend were established, each of the Channel 16s would leave the router located at NWSCCC's master Control in an SDI format. This would then be converted back to an IP format at NWSCCC's facility and then routed to Comcast. In other areas within the Twin Cities, these IP signals are then inserted directly onto Comcast's CRAN for transport back to the Roseville headend. With cooperation from Comcast, this design can be implemented for the NWSCCC's city channel 16s as well. This design minimizes the equipment needed to transport the channels from the Master Control to Comcast's headend and ultimately onto the subscriber network.

5. H. 3. Cable Services

The majority of cable television services transmitted to consumers' homes today have limited utilization of IPTV technology. Today cable television companies utilize IPTV for transportation of signals between headends and hubs but have limited or no IPTV on their cable subscriber systems (unlike the high speed internet services offered by cable television systems which are capable of and are indeed transmitting IPTV requested by end users). Many operators' utilization of IPTV for directly delivered service at this point, for example, is limited to their VOD offerings. Otherwise, they like other cable television operators, use QAM-based digital transmission for the majority of

programming. This will likely change over time but neither Comcast nor other cable operators have given a timeline for this transition.

One exception to the limited utilization of IPTV on cable television systems is that of CenturyLink's Prism Service. Prism is a DSL-based service where the network's bandwidth is limited compared to traditional HFC and FTTH networks. Therefore, the Prism systems operate on what in essence is a Switched Digital Video platform. Channels with a high viewership are multicast while channels with lower viewership and VOD services are narrowcast or transmitted only when requested by one or more customers.

As noted in report Section 5.K on closed captioning, this type of delivery has created problems for PEG channel providers and should be monitored closely by the NWSCCC, should Comcast ever indicate a move to an all IPTV Network solution.

5. H. 4. Internet Video Streaming and IPTV

To many people, the acronym IPTV first brings to mind streaming video over the Internet. Streaming video by definition is the transmission of video, and the corresponding audio, over a network(s) to the end user. As mentioned above, IPTV, due to its efficient use of bandwidth, enabled video transportation, or streaming, via the internet back when bandwidth availability was far less than it is today. IPTV is the standard for streaming of video and has provided the platform for television services such as Hulu. When used in this manner, IPTV delivered, not via a closed system but over the public internet, is often referred to as Internet television. Hulu is a website offering commercial supported programming to the public (only within the US). It is a joint venture between NBC Universal, Fox, ABC, and numerous equity partners. Hulu distributes video for its own website as well as for many other websites such as CNN, Comedy Central, Bravo and Facebook just to name a few.

5. H. 5. Remote Video Origination

NWSCCC's LO 12 News relies on a microwave truck to provide live video feeds from remote locations throughout the NWSCCC's area. This truck takes the video and audio from the Mobile Production Truck, further described below, and utilizes a microwave transport technology using frequencies licensed by the FCC. The microwave truck has provided a reliable transport system where "line of site" capabilities exist. In other words, the antenna that is mounted on the microwave truck sends a signal to the antenna mounted on Comcast's Brooklyn Park headend tower location and then the signal is transported across the street to the NWSCCC facility for insertion into the news program or for other non-12 News programming. The transmit and receive antennas must have a clear, unobstructed path between them. Buildings, hills, trees, etc. can impair the signal that is received, at the receive antenna, or may be completely attenuated to a point of non-usability. Indeed there are locations within the NWSCCC area where signals cannot be transmitted back to the receive antenna due to obstructions between the location and the receive antenna. These areas are referred to as deadzones.

Furthermore, the system utilized by the microwave truck is based on analog technology. In order to continue these remote live feeds in the future, during the HD transition, the microwave system would need to be upgraded or replaced by another technology or technologies.

5. H. 6. Continued Microwave Transport

As explained above, the microwave truck will need to be upgraded to a system that is designed to transport HDTV signals. This upgrade would include all of the equipment in the truck that is used to monitor the video and audio as well as the equipment used to transmit the signal back to the receive antenna, and all equipment at the receive antenna location.

In addition, to overcome some of the deadzones present in the NWSCCC area, additional receive site locations would need to be added. These locations would require a tower or other tall structure such as a water tower where a receive antenna would be mounted. Then the signal would need to be retransmitted wirelessly to the existing receive antenna location, or a fiber optic backhaul system could be implemented. The total number of these additional receive locations would need to be determined by having propagation studies done to determine where obstacles exist that need to be overcome. Then a determination would need to be made as to whether a fiber optic backhaul or wireless retransmission of the signal to the existing antenna location would be more practical.

5. H. 7. Cellular Network Transport

As an alternative, or in addition, to the microwave transmission system described above, other means of signal transportation may also prove to be effective. For instance, a relatively new technology is being deployed for HDTV quality video from remote locations back to a studio or master control facility. This technology can be referred to as cellular based live video uplink technology. These systems utilize multiple cellular networks (multiple carriers like AT&T, Verizon, Sprint, T-Mobile, etc.) and multiple modems to transport digital video from the source, through the cellular networks via the Internet and ultimately to the studio or master control facility.

Although these cellular based systems have been around for a few years now, the NWSCCC would need to obtain a system from one or more vendors and perform tests from various locations throughout the NWSCCC area to determine if the operation of the system is of a high enough quality and reliability to be used by the 12 News staff to provide live programming for insertion into the nightly news program. During this testing, such parameters as signal availability throughout the area and latency would need to be evaluated prior to the purchase of the equipment. Because this technology utilizes the cellular providers' Internet service, the cellular based live video uplink technology would be in competition with all smartphones and other devices utilizing the network for Internet access. Therefore, this testing should occur at all times of the day to include times when "regular" cellular Internet service utilization is at its peak (such as rush hour

along the main corridors and freeways [while passengers are likely utilizing cellular Internet services] within the NWSCCC area).

Key Recommendations

- **The NWSCCC should develop use of IPTV or HD/SDI over fiber for transportation of video between NWCT and government facilities (and perhaps also educational facilities), and between its master control and Comcast.**

- **The NWSCCC-area LO and PEG channels should pursue the utilization of IPTV for transportation of archived footage and other program material to develop greater collaborative content sharing in the future.**

- **LO Channel 12 should continue to use microwave transport for the near future but will need to upgrade it to HD digital technology, with the addition of repeaters. Alternatives should be pursued to determine if they can ultimately augment or replace the microwave.**

5. I. Three Dimensional Television (3DTV)

As digital television continues to evolve through Standard Definition and HDTV, another technology has entered the video and television arena in the past few years. This emerging new technology is Three Dimensional Television (3DTV). With this technology, three dimensional (3D) images can be brought directly to television viewers much like people view 3D in movie theaters today. Three Dimensional has been utilized in still photography since the 1800's and has been used in movies since the early 1900's, but the deployment via television is a far newer phenomenon. 3DTV adoption and utilization has been slow to become mainstream in the US market. There have been increasing programs on television in a 3D format, but at least one significant issue will likely continue to impact deployment. Viewers are currently required to wear glasses that give the viewer the perception of a three dimensional image. As an example, one type of these glasses has two different color lenses giving the human brain the perception of depth or 3D. If a viewer is not wearing the glasses, the image appears blurry and may well cause the viewer to get a headache if watched for extended periods of time.

It is believed in order for 3DTV to become mainstream, the viewer must be able to perceive the image without the use of glasses. This is called Autostereoscopy which produces depth perception on a flat screen television.

There are also many concerns from the US cable industry on how this technology will impact their systems and infrastructure in the future. These concerns include the ability to still deliver two dimensional (2D) products in conjunction with 3D without impact on current bandwidth and without impacting the current infrastructure**.**

As with any new technology there will be a deployment curve. The first step on this curve will be to develop standards whereby all 3DTVs will utilize the same technology and thereby make broadcast and cablecast to large audiences possible. Then, significantly greater adoption of

3DTVs by the public will need to occur as content is developed over time and costs for 3DTVs become acceptable. As with the advent of standard definition digital and HDTV, this process will begin relatively slowly at first and gain momentum as more content becomes available and equipment price points drop, in turn driving a desire by the public to purchase 3D capable televisions which will then also drive an increase in production of 3D programming.

3DTV is more bandwidth intensive than current HDTV programming. For instance, manufacturers are developing 3D HDTVs with a resolution of 2160p or 3840 x 2160 pixels. This translates into approximately twice the bandwidth of a 1080p (1920 x 1080) HDTV signal.

It will take time for 3D to become mainstream and then most likely longer still before PEG Access programming providers deploy it. Accordingly, at this point, the NWCT, 12 News, and other PEG program providers should monitor 3D advancements and at a point in the future potentially develop plans for deployment. Specifically, it is our recommendation that once the initially recommended full HD digital transition is complete, NWSCCC-area PEG channel entities should revisit this technology and determine whether HD should be replaced with 3D in the future. Consistent with this, depending on the length of the franchise renewal term contemplated, the NWSCCC will want to ensure that enough PEG channel capacity is negotiated to facilitate 3DTV distribution of PEG content.

Key Recommendations

- **Once HD digital transition is complete, NWSCCC-area LO and PEG entities should consider future transition to 3DTV.**

- **The NWSCCC will need to ensure that enough PEG Channel capacity is negotiated in franchise renewals to facilitate PEG 3DTV content distribution.**

5. J. Customer Reception Technology

5 .J. 1. Equipment and Services

According to the Nielsen Company, referring to use of televisions, computers and cell phones, the average American now watches more than 151 hours of TV a month. That's about 5 hours a day and an all time high, up 3.6% from the 145 or so hours Americans reportedly watched in the same period the previous year. Also contributing to the increase is the steady growth in TV programming and the number of TV's in households. The average US household now contains more televisions than people which means that family members or roommates can watch their favorite television shows alone. More Americans are also watching time-shifted television via TiVO and other digital video recorders. About 29% of households have DVR's.[3]

[3] http://articles.latimes.com/2009/feb/24/business/fi-tvwatching24

Where traditional television sets are still the dominant means of accessing of video content, other technologies are growing rapidly. One of the fastest growing is the form of IPTV which includes internet programming from various websites; Netflex, iTunes, Hulu and many others that are emerging. As of February 2012, 10.4% of homes had an IPTV compared to just 4.7% that same month a year prior according to a recent Nielsen study.[4]

As indicated above, TV viewing is increasingly occurring over portable devices such as smart phones and I-Pads. Where a television program, as watched on a television set in the home, may last 30, 60 or more minutes, mobile device users often prefer to watch programs in much smaller durations. It can be difficult to watch a program that lasts 30 minutes or more on a mobile device in part because of the battery limitations of the device. In addition, as these viewers tend to trend younger, the audience often prefers it's video programming in smaller, perhaps 5 minute, increments. For instance, many YouTube videos are only a few minutes long or less.

As these technologies continue to emerge, it will be important for PEG programmers such as NWCT to continue to develop programming on multiple platforms to enable viewer flexibility.

5 .J. 2. Menuing and Navigation

Research indicates that television viewers do not channel surf the way they used to, in part because it is more time consuming with several hundred channels and in part because digital set top technology no longer provides a seamless surfing experience (i.e., channels take longer to "pop in" as you surf the system).

The majority of viewers are migrating to the use of the on-screen program guide as well as channel and program menus, theme blocked menu access (such as an all sports section of the channel line-up), on-demand menus, including both main menus and variety of sub menus, and similar components of the overall navigation system. Viewers are also increasingly using the information function to determine more detail about the program than just its title, allowing them to make more informed choices about viewing.

What this means for PEG Access and LO, is that for both real-time and on-demand viewing, these channels must have the same types of program title and descriptive information appearance on the menus and navigation screens that other channels have. This will ensure that viewers can also make informed decisions about viewing PEG Access and LO programming, as well as make such programming more easily accessible to them.

Key Recommendations

- **NWSCCC-area LO and PEG channels should continue growth in cross platform development to reach different demographics and households.** TV and other video

[4] http://blog.nielsen.com/nielsenwire/media_entertainment/i-want-my-iptv

programming viewing is changing rapidly. Where television in the home, or other fixed location, was the only means of watching video just a few short years ago, many new methods are available today. These include over the Internet on laptops in stationary positions as well as through mobile devices over cellular networks. **The channels will need to evolve their content delivery methods over time as these methods of viewing evolve.** For instance, although showing an entire City Council meeting on channel 16 still meets an important need of the community, slicing the program into 5 minute segments for Internet distribution, with a table of contents to help viewers find the portion of the meeting that most interests them, will further meet the needs of many people in the community. **Furthermore, the NWSCCC will want to have applications developed to further ease the access and viewing of programs via smartphones and tablet type devices.**

- **The NWSCCC must ensure sufficient access to PEG Access and LO programming, including detailed program title and descriptive information by both real-time and on-demand cable system viewers. This should be a focus of franchise renewal negotiations.**

5. K. Closed Captioning

Closed captioning allows the deaf, hard of hearing, adults and children learning to read, and people learning English as a second language to more fully understand the content of programming. No NWSCCC-area LO or PEG entities currently utilize closed captioning. There has been some desire expressed though, to explore closed captioning. In that respect, some considerations include both real-time and post production captioning schemes.

5. K. 1. Real-Time Live Closed Captioning

Real time live closed captioning has advantages over the other technologies because it can be viewed instantaneously by the audience with no delay. It is especially convenient for events that are very timely in nature, such as live meetings or special events. However, sufficient pre-planning is needed so that stenographers or other captioners are scheduled and available, and have an opportunity to familiarize themselves with specific terminology and names used in the program.

The two largest areas to consider with real-time live closed captioning are equipment and the cost of captioning services. Entities have the option of hiring independent or on-staff stenographers who are certified in closed captioning, paying for an outside service or utilizing automated voice recognition software. Live closed captioners have to be well-versed in stenography and certified as live closed captioners. A professional real-time stenographer, either independent or with a service, can type more than 200 to 225 words per minute with over 99% accuracy using a steno machine. Prices for live closed captioners vary by location. Some live contract closed captioners currently charge $150 - $200 per hour. As explained further below, some PEG entities have found it less expensive to hire an in-house closed captioner.

Live closed captioning can be done in two different ways, one being locally on-site, the other being done remotely off-site, using either independent or hired captioners or a closed caption service. There are advantages to using a live captioner, either independent, hired or through a service. One of the advantages of hiring an independent stenographer is that he/she could be less expensive than a service and more familiar with an individual entity's needs. In other words, they might be more familiar with the content they are captioning if an entity uses them on a regular basis, such as topics and individual's names involved in the programming.

Based on the experience of some other PEG entities that close caption, the least expensive option may actually be hiring a certified closed captioner on staff. Hillsborough County, Florida, which had been known for their early commitment to closed captioning of PEG programming and is home to a large deaf and hard of hearing population, at one time determined that they had enough work to hire both a real-time closed captioner and a trainee/assistant. Hillsborough currently focuses on captioning its public meetings.

The disadvantage of this option would be that there would have to be an initial investment in equipment (as described further herein) as well as some management and administrative time due to having an additional person on staff. Additionally, based on the number of hours that may need to be captioned for multiple channels, it may require more hours than one person could caption. This means at least one additional captioner may be needed (although this person could also be shared with individual members of the NWSCCC that may want to close caption).

One of the main advantages of an outside service is flexibility. An outside service can cover more programs at various times in the day or evening, but they can be more expensive. As an example, Montgomery County Maryland's County Cable Montgomery Government Access channel (CCM Channel 6), currently captions nearly all programming through a contract with NCI (National Captioning Institute) at a cost of over $300,000 a year plus phone line costs. The entities that are interested in closed captioning could negotiate as a group though, with outside services to attain the greatest cost savings and consistency.

Whether the closed captioner is on-site or not, a closed caption encoder is needed in the signal chain to enable content to be inserted into the video signal. This encoder should be compatible with the latest stenography equipment and software. Also, the stenographer needs to provide or have access to standard equipment and software that has the ability to output to broadcast encoders. If the captioning is to be provided by a service or a stenographer that is off-site, then additional equipment will be needed. A modem will need to be added to the encoder and a phone line and an audio interface device will need to be added from the audio feed. This will enable the stenographer to listen to program audio and transmit closed caption data back to the encoder. If a video signal is also available to off-site closed captioners, that would enhance their ability to follow the action, but most times is unnecessary.

It should be noted that another alternative for both live and post production closed captioning is voice recognition software. Automated speech recognition software can caption both live content for cablecast or live text streaming for the web. This is an emerging technology that is a lower cost option, but because it is less comprehensive, and still significantly less accurate, this may not be a viable alternative for NWSCCC-area LO or PEG channel providers at this time. For example, this software needs to be trained to recognize a specific person's voice patterns, which is very difficult to use in a meeting situation where many voices are interspersed. Additionally, automated timing and placement of caption data may not be as accurate as when done personally by a stenographer, and additional non-spoken data such as music symbols, sound effects, and identification of speakers will be lost.

5. K. 2. Post Production Closed Captioning

Post production closed captioning is done by using a combination of software and hardware and is sometimes done with clerical staff using a typical keyboard and working at their own pace. The advantages of this are that costs may be lower depending on the fully loaded hourly rate of the staff person utilized and captions can be placed specifically where they are needed in programs. The disadvantage is that this type of post production closed captioning can be time-consuming and could delay turn-around time.

The NWSCCC-area LO and PEG Access entities would have to provide both installed software and hardware to enable post production closed captioning in-house that would be synced to the video signal. This is similar to making a copy, but inserting closed captioning onto the copy. The closed captioning can be transcribed to the copy in most formats, including MAC and PC. A production staffer would have to sync the video to the script. Also, if programs have written scripts to them, the scripts can be inserted and turned into closed captioning in an automated process.

Post production captioning can also be performed by outside vendors. Costs to create post-produced closed captioned content through outside vendors, though, are typically expensive and can range from $6 to $10 per minute, or $360 - $600 per hour, depending on format and complexity, as opposed to approximately $4,000 - $6,000 for equipment to be used in house. If this option is used, captioning in languages other than English may also be offered.

Perhaps the most cost-effective and timely option is to caption post-produced programming again using real-time live captioning, either through the contract service or through a hired on-staff certified closed captioner.

5. K. 3. Streaming for the Web

Closed captioning for web-streams appears only when it is turned on in the user's browser, such as Windows Media Player. Most major web-based media formats support closed captioning. Some of these products, though, may support captions in their stand-alone client versions but not in browser-embedded or handheld versions of their products.

Since video streaming requires a lot of bandwidth, while text streaming requires almost no bandwidth, captions are transmitted much faster than video. This can result in a lack of synchronization between the video and captioning streams. There are emerging software and hardware solutions available, such as CaptionMaker WebPlus from CPC Software that address this problem, and could be considered by the NWSCCC-area PEG channel entities encoding and streaming in-house. Other emerging web captioning technology vendors such as CPC Software, Virage and, Adobe target automated voice recognition in volume. Additionally, some outside streaming vendors combine the captioning ability, the synchronization software, and the streaming servers with large bandwidth to accommodate hundreds to thousands of web viewers. As indicated previously, NWSCCC-area Government access channels are outsourcing their streaming and VOD to a company called Granicus. Granicus' system will perform closed captioning. It requires a special module which they indicate can be seamlessly and smoothly integrated with the base system.

5. K. 4. Closed Captioning Best Practices

Closed captioning is becoming more important in our society. However, even as the number of people that are deaf increases, determining the exact number of people who are deaf or hard of hearing in the United States is difficult. For instance, the US Census categorizes deaf and blind persons in a single group. Furthermore, there are varying degrees of "hard of hearing" in addition to those people that are at or near 100% deaf. It is, however, estimated by the Gallaudet Research Institute that as many as 140 out of 1,000 people in the United States have some level of hearing impairment with .9% to 2.2% of all citizens of the US having a severe hearing impairment, including those that are deaf[5].

The importance of closed captioning for the deaf and hard of hearing on public, education and government channels has been the topic of Congressional testimony. Several directors of PEG channels testified in January 2008[6] that AT&T's U-verse approach to PEG delivery, which strips second audio programming and closed captioning, significantly disadvantaged the hard of hearing and deaf communities. Congress was sympathetic and the topic was part of an FCC call for comments in March 2009.[7]

Because of all the above, we believe that closed captioning is important and, depending on available funding, should be considered by the LO and PEG channels in the NWSCCC-area in one form or another. The quantity of programs captioned may differ between the entities, but if captioning is to be done, we recommend as a priority that any

[5] Gallaudet Research Institute: http://research.gallaudet.edu/Demographics/deaf-US.php
[6] January 29, 2008. Folger, Annie. Executive Director, Midpeninsula Community Media Center Public, Educational and Government Access (PEG) In the Digital Age U.S. House Committee on Commerce and Energy Subcommittee on Telecommunications and the Internet.
[7] http://www.broadcastingcable.com/article/print/190051-FCC_Gives_More_Time_To_Weigh_In_On_PEG_Channels.php.

meetings involving governmental entities or decision-making bodies should be captioned in order to not disenfranchise residents.

As stated above, there are many options involving closed captioning to consider. For both live events and meetings, as well as other types of programming, such as non-live and less timely programming, we recommend utilizing either hired on-staff captioner(s), or a closed captioning service and negotiating pricing on a group basis, depending on available budgets and priorities.

One point to also be aware of concerning closed captioning is that, if a program becomes re-edited, then the captioning will also have to be redone for the entire program.

Key Recommendation

- **Closed Captioning is an important assistive technology that could expand the reach and impact of LO and PEG channel programming. It will take significant additional funding, and policies to be developed by the NWSCCC, its member jurisdictions, and allied entities (such as school districts), but when feasible, it will be important to consider adding closed captioning.**

5. L. Mobile/ Remote Production

5. L. 1. Remote/ Field Production

As stated more specifically in Section 6, the Remote/Field Production equipment should all be HD capable and encompass any features needed for use in today's production environment. Features such as tapeless acquisition, high powered lenses, and sophisticated setup options are all recommended for NWSCCC production facilities.

5. L. 2. Mobile Production Truck

The Mobile Production Truck should be equipped with state of the art equipment capable of full HD production. This includes cameras and production equipment housed inside the production truck. Complete details can be found in Section 6.

5. L. 3. ENG Van

As described in Section 6, the ENG van should be replaced with a new recommended concept. An optional flypack has also been proposed for future consideration by the NWSCCC that could be housed in the van, thus enabling greater flexibility and cost savings in the future.

Key Recommendations

- **The Remote/Field Production equipment, Mobile Production Truck and ENG Van should all be upgraded to full HD capability and integrated into the rest of the production facility.**

6. Transition Recommendations for Key Functional Areas in Each Portion of the NWCT and Associated Facilities

6. A. Introduction

As discussed in detail in various sections of the Report, each NWSCCC-area LO and PEG entity is at various stages in their transition to high definition digital technology and the use of on-demand and other media platforms. In order to address these various stages of migration, we have created a transition baseline for each type of facility in the accompanying equipment projection spreadsheets. It is important to note that the baseline correspondingly includes a range of equipment (such as different types of hard-media based digital field cameras) in order to cover the differing approaches, characteristics and status of the different PEG facilities. Accordingly, the equipment needed for high definition digital transition and the associated cost will vary for each entity depending on where they fall in the range for each functional area component. This specific cost then is reflected in the individual spreadsheets developed for each entity and facility.

All costs in the attached spreadsheets are 2012 list prices. These are utilized, because it is not known what discount from list will be available at the time of procurement (although a 10% reduction on average would be a conservative estimate).

Additionally, a 15% cost escalation was factored in each year related to the cost of initial implementation of the equipment and bringing it to a functional operation. This 15% figure equates to an average of cost for installation, training and initial warranty coverage.

6. B. PEG Access Equipment Projection Baseline Definition

The goal of the PEG Access Equipment Projection Baseline Definition is to help the NWSCCC-area PEG and LO entities transition from their current environment to high-definition digital technology, as well as facilitate greater use of on-demand and other media platforms. The Equipment Upgrade and Replacement spreadsheets in Section 9 include a description of the type and range of equipment needed in order to function adequately at the HD digital level. Some equipment that is not related to HD digital and other transition, but is still critical, is also included in the spreadsheet.

It is important to understand the difference between standard definition digital (SD) and high definition digital (HD) equipment. SD equipment can either be a 4x3 or 16x9 aspect ratio, but is in a digital format, not analog. SD could be anything from consumer grade to broadcast quality, whereas HD would always have a 16x9 aspect ratio and usually produces a much higher quality than SD video.

We are recommending new equipment purchases be HD, but in some cases still SD-compatible based on integration with existing equipment. Keep in mind this is a baseline only. NWSCCC may choose to integrate additional options or equipment above and beyond the minimum baseline for their particular needs.

The HD digital baseline transition for the major equipment in each functional area is as follows:

6. B. 1. Public Access

6. B. 1. a. Field Acquisition-Public Access

Field Acquisition is the easiest to transition to HD digital because it is an independent process that does not rely on the other functional areas. After touring the facility and meeting with Public Access staff, it was determined that many Public Access Producers are already shooting in HD using current available cameras. We are recommending they continue on this path with future upgrades along with their continued support of tapeless technology which will save on costs and help with the entire digital workflow of the facility. Current HD cameras offer many professional capabilities and are lightweight, easy to use, and can create spectacular images.

Flypacks enable NWSCCC to produce a complete multi-camera production in the field. This includes the ability to switch live camera feeds and mix live audio feeds. The price range varies greatly on flypacks depending on the flexibility needed. Northwest Community Television (NWCT) currently uses two Sony Anycast systems capable of multi-camera production. These Anycast systems are lightweight and portable and capable of switching multi-camera inputs. The current Anycast systems used are SD only and will need to be upgraded or replaced with HD models. We are recommending that they continue with this technology. We are also recommending an option for the NWSCCC to consider in the future that would provide a higher end flypack system capable of more sophisticated graphics, audio mixing, and chromakeying, thereby giving them both low-end and high-end options for remote multi-camera productions. This unit could also be used for studio control for their second studio (this option has not been costed in the attached spreadsheets. Its cost should be reviewed at the time that it may be considered for procurement).

Generally, flypacks are used for indoor purposes, such as sporting events, meetings, and special events. When outdoor events are covered, it is generally better to use the mobile production vehicle for the protection of the equipment, the temperature around the equipment can be better regulated and it would be more ergonomic for the production crew.

Like the field cameras, we are recommending NWSCCC transition to or initially purchase HD technology due to price and functionality factors.

6. B. 1. b. Studio Acquisition-Public Access

Studio Acquisition, along with Studio Control, is considered the main nerve center of many production entities. This is why there are large amounts of resources and funds committed to these two areas. NWCT currently produces over 100 new shows per month necessitating the need for 2 functional studios and studio control rooms. This will enable them to produce simultaneous programs from both studios.

Specifically, NWCT has two studios and one studio control and one set of studio cameras dedicated to Public Access. Currently they are only SD. We are recommending they be upgraded to HD to integrate with the rest of the facility as it transitions to HD. We are also recommending as an option, as stated above in the flypack area, that the NWSCCC consider in the future adding a high-end flypack system for their second studio control, enabling NWCT to have the flexibility for both studio control and high-end remote multi-camera productions. Along with the flypack, it would give NWCT the option to have two sets of cameras available for both studios.

Studio Acquisition includes many pieces of equipment used in a traditional studio environment, including cameras, virtual sets, and confidence monitors within the studio. These will all need to be upgraded to handle HD signals as the facilities transition to digital technology. Again, we are recommending that NWCT move directly to HD studio cameras to better integrate with the rest of the facility as they move to HD.

There is variability in the type and cost of virtual sets, and NWCT has a wide variety of virtual set needs as well. The competitive broadcast environment is fueled by the expansion of television channels and increasing pressure to lower costs and increase production. Content providers, including NWCT should continue to seek better, faster and more economical ways to deliver a greater range of program offerings using fewer resources.

Virtual set technology well fits the demand to produce and deliver more with less. As facilities move towards maximizing their operations, virtual set technology is used to maximize workflows and become a mainstream application in daily media production. An example of the different uses of virtual set technology is the ability to add special effects behind the talent such as virtual monitors or other video sources that can be layered with the talent.

Other uses include giving the viewer a larger sense of space, essentially creating the illusion of increased depth, and adding many visual elements into productions. There are also cost saving benefits to not redesigning and building conventional sets while having the ability to change set designs virtually, thus creating visual interest for the viewer. NWCT will have many options including built-in virtual set technology in production switchers or standalone options. We've projected

funding amounts for NWSCCC to upgrade existing and acquire new virtual set technology for public access.

The current lighting infrastructure used in Public Access is tungsten-based. We are recommending as an option that the NWSCCC consider upgrading these in the future to LED technology because of ease of use and to save on energy and replacement requirements (this option has not been costed in the attached spreadsheets. Its cost should be reviewed at the time such technology may be considered for procurement). This option would include replacement of lighting in both Public Access studios. Currently the Public Access studios have 23 and 32 lighting fixtures respectively. Moving to LED technology would require an increase in the number of fixtures depending on the type needed. This could be approximately 30 and 39 respectively.

6. B. 1. c. Studio Control-Public Access

Studio Control is also a very important functional area. The HD digital baseline includes all of the crucial components that must be transitioned to HD, with technical comments for each. The major components include production switchers, graphic units (character generators), monitoring (engineering monitors and multiviewers), and digital audio components. In order to stay current with technology and to be competitive with other channels on the cable system, investing in studio control upgrades will be essential. For example, analog switchers are not only out of production for the most part, but also difficult to find parts and support for, and cannot produce 16x9 aspect ratio pictures.

We are recommending the use of multiviewer technology to replace traditional monitoring within the facility. This will include one or more multiviewer control devices attached to monitors. Although the multiviewer controller is listed as a separate line item in the baseline, it is often included as a built-in component in many switchers. Therefore, NWCT may not require a separate, stand-alone multiviewer control unit.

Currently all NWCT is using analog audio mixing. We are recommending a transition from analog to digital throughout the life of the franchise. This will enable better workflow and increased capabilities for the users.

6. B. 1. d. Post Production-Public Access

Post Production is another functional area that lends itself to ease in transitioning to HD due to the fact that it can be done independently. Many producers are producing programming in HD and down converting to play back their programs over the cable system. Therefore, we are just recommending the replacement of edit systems as needed and continuing with HD technology. The major types of equipment involved in the baseline transition are ingestion, monitoring, edit equipment, and digital audio mixing.

Ingestion is the ability to move video and audio into the computer environment from various sources for editing. As mentioned in the baseline spreadsheets, various sources such as field cameras are already card-based. Moving forward, the editing ingestion process should continue to match the camera recording technology used.

As with field monitoring, edit monitors need to be replaced over time and be compatible with the edit technology utilized.

6. B. 2. Whole Facility

6. B. 2. a. Infrastructure

Infrastructure includes all equipment such as, Ethernet Encoder/Decoders, Transmitters/Receivers, Signal Converters, wiring and cabling needed throughout the facility to produce high-quality HD signals. Since the infrastructure is the backbone for all new equipment to communicate throughout the facility, it is essential that this functional area be upgraded with the ability to handle the new and existing equipment.

It is important to have the right infrastructure in place to support the conversion of SD to HD. Key pieces have been detailed in the Equipment Upgrade and Replacement spreadsheets.

6. B. 2. b. Archival/Storage

As NWSCCC-area PEG and LO entities grow, the need for more archival/storage will increase as well. This enables producers and staff to save and share their work.

Archival and other storage is also used to house finished programs that can be accessed by citizens for on-demand viewing of programs. Not only can programs be archived, but they can be categorized by subject, producer, event type, or date, and could be stored in various file types, so that citizens can view them on different platforms, such as web-based PC and Apple, cable on-demand or potentially mobile devices.

Even though NWSCCC already has much of this technology in place, we have included costs for significant upgrades and growth throughout the life of the franchise. Discussions indicate that especially Public Access is in need of more storage space, which is also reflected in the Equipment Upgrade and Replacement spreadsheets.

6. B. 2. c. Headend/Playback

The production servers need to have the capability of both standard and HD playback, moving to all HD in the future, and should have the ability to have programs transferred to them over the network (real-time ingestion) and have a robust scheduling capability to enable a well-rounded playback resource. NWSCCC is currently using an SD-capable playback server because the cable provider is still cablecasting in SD-Analog. As the cable provider migrates to all digital technology for PEG access channels, NWSCCC should be ready and equipped to cablecast with HD playback capabilities.

In the walk-through of the facility, it was identified that NWSCCC uses different systems for playing back their Channel 12 programming from the other Access channels. Staff expressed the need for a more broadcast-level playback system for this channel. Staff is currently pursuing replacement of this system. We are recommending that it should be fully HD capable.

We are currently estimating costs for one system to be used for standard playback of the Public Access channels. A second system for high-end playback, capable of commercial insertion, for Channel 12 is already slated to be procured by the NWSCCC in the near future and is not included in the spreadsheets.

6. B. 2. d. On Demand/Streaming

Both Internet streaming and Video on Demand (VOD) streaming have become an integral part of many production facilities' outreach to the public, especially consumers without cable television services. With this in mind, video streaming equipment needs to be capable of handling signals within the facility, be HD compatible and in most cases, be capable of running 24/7. We have forecast equipment in the attached spreadsheets to now stream the Public Access channels, as well as provide replacement of Channel 12's streaming equipment in the future.

6. B. 3. Staff Production

6. B. 3. a. Mobile Production Truck (MPT)

The Mobile Production Truck (MPT) is a resource that is an important component of NWSCCC's operation. Because of this, it is important that the equipment be state of the art and its capabilities match the capabilities used throughout the facility. Consistent with this, we are recommending that the MPT be upgraded to HD capabilities. We are providing for 4 high-end cameras similar to the News Studio and 1 lower end camera similar to the Public Access Studio. Also included is the cost for a high-powered 36x telephoto sports lens.

Channel 12 also has a Microwave Transmission Truck which is used for a live microwave feed in the News operation and other special events. NWSCCC has expressed an interest in migrating away from microwave technology and incorporating newer forms of transmission methods including cellular technology. We have addressed this as an option in the Equipment Upgrade and Replacement spreadsheets. We are also recommending that the microwave truck be replaced with a sprinter-type van. Such a can would be capable of housing one of the optional high-end flypacks, if such a flypack is developed in the future.

6. B. 3. b. City Facilities

The NWSCCC facility supports 9 cities within their jurisdiction. These cities, which all televise their meetings, are all at different levels of capabilities and therefore we are recommending a standardization of equipment in each facility that can be switched out and replaced easily. Based on our projections, each city would have HD capabilities for 4 robotic cameras, digital video switching, digital audio mixing, multiviewer monitoring as well as an Engineering/Confidence monitoring. Miscellaneous equipment such as DVD recorders are also included.

Each city currently has its own playback system included. However, we have also included funding projections for development of a government access channel headend that would enable routing of each city's signal back to the NWCT facility. This system can utilize either HD/SDI or IP transport over fiber from each Government location.

We have split equipment between Council Chambers and Council Control in the Equipment Upgrade and Replacement spreadsheets for ease of identification. The spreadsheet also indicates replacement of all equipment in Year 4 and Year 10, showing a 6-year replacement schedule. This can be pushed to a 7-year replacement schedule if cost is of concern. This would mean, though, that there would not be a replacement of this equipment within the 10-year schedule.

In the Council Chambers, we have identified these key pieces of equipment for transition:

- Cameras
- Document Camera
- Audio Microphones
- TV Monitor

In the Council Chambers Control Room, we have identified these key pieces of equipment for transition:

- Switcher
- Robotic Camera Control

- Character Generator
- Digital Audio Mixing Consoles
- Multi-view Monitoring
- DVD Recorder
- Engineering/Confidence Monitor
- Playback System

6. B. 3. c. News Studio

The main TV studio at NWSCCC is capable of several types of productions including small interview style, but its main function is to produce daily news. It is equipped with a permanent HD news set. The set incorporates various LED monitors and a rear screen projection system. Most of the monitors can receive SDI signals but the rear screen projector is component only and will need to be upgraded. Even though the current monitors can receive an SDI signal, they are only capable of handling SD because of the limitation of the cards in the monitors. These cards will need to be upgraded to HD cards.

The lighting in the studio is a new fluorescent system and will not need to be replaced immediately. When ready for replacement, we recommend pursuing LED lighting technology (similar to the option recommended for Public Access to consider in the future).

The three cameras in the studio will need to be replaced with the switcher upgrade to full HD.

6. B. 3. d. News Control Room

As mentioned in the News Studio section, the studio cameras feeding the control room are SD only, as well as the switcher in the control room. All will need to be upgraded at the same time. We are recommending a new switcher that incorporates increased capabilities such as multiple upstreaming and downstream keying as well as video clip playback and internal graphic storage. Many switchers also incorporate multiviewer technology. We have accounted for this technology, either to be included in a switcher or as a stand-alone. Currently, a stand-alone multiviewer is being used in the News control room.

All audio recorded in the control room is analog. We are recommending migration to digital audio within the transition period. Although the News control room has a multi-channel character generator system, we are recommending upgrades and replacements throughout the transition period as well as other key pieces of equipment, including miscellaneous HD distribution amplifiers and cabling.

6. B. 3. e. Field Acquisition

As with Public Access, field acquisition is the easiest to transition to HD digital because it is an independent process that does not rely on the other functional areas.

However, due to requirements for Staff Production, cameras require higher end equipment with more robust features. The Equipment Upgrade and Replacement spreadsheets account for these additional capabilities.

6. B. 3. f. Post Production

Again as with Public Access, Post Production is another functional area that lends itself to ease in transitioning to HD due to the fact that it can be done independently. Staff is capable of producing programming in HD and downconverting to play back their programs over the cable system. Therefore, we are just recommending the replacement of edit systems as needed and continuing with HD technology. The major types of equipment involved in the baseline transition are ingestion, monitoring, edit equipment, and digital audio mixing. Moving forward, the editing ingestion process should continue to match the camera recording technology used. As with field monitoring, edit monitors need to be compatible with the digital technology used in other portions of the post production system.

6. B. 3. g. Audio Voice Over Booth

The audio voice over booth is used mainly for news production but can be used for other needs by staff whenever voice over is needed to compliment video production. We've included key components of the voice-over booth in the Equipment Upgrade and Replacement spreadsheets along with the migration of analog to digital audio.

6. B. 4. Ancillary Equipment

The purpose of this category is to enable NWSCCC to budget for equipment needed that is not specifically part of the HD digital upgrade and other transition activities. This type of equipment would include items such as microphones, conventional sets, teleprompter equipment, PA, miscellaneous stands, tripods, recorders, etc, plus their upgrades and replacements. Essentially, it is the other equipment needed to complete the production facility.

6. B. 5. Options

An optional category has also been added to give the NWSCCC flexibility in considering newer technology. The option profiled is Video over Cellular Transport. This will enable high quality HD video to be sent from a remote location back to master control for use in live news and other programs. Keep in mind that this technology is considered high latency meaning that there could be lip-sync issues compared to other traditional forms of remote transport (such as microwave).

7. BUDGETARY IMPACT

Proposed Expenditures

When reviewing the budgetary impact of the forecasts made in this report in order to transition the PEG Access and LO channels to HD digital production, post production and signal transport, as well as to increase on-demand program provision and use of other media platforms, it is important to first look at the overall costs and how they breakdown into functional areas.

Specifically, the onetime transition cost is projected to be $4,808,840. Most of the transition would occur in Years 1 through 4 of the transition period, as further detailed below. This breaks down into the following:

- Public Access - $544,100
- Infrastructure throughout the entire NWCT facility, as well as archival/storage costs, headend/playback costs and on-demand/video streaming costs for all related equipment in the NWCT facility - $575,500
- Government Access, including transitioning all council chamber production areas, council chamber control rooms and creation of a "Channel 16" headend at the NWCT facility that incorporates the transport electronics to the facility - $1,171,500
- Truck and Van-based Mobile Production, including the microwave transmission technology needed for remote signal origination purposes - $985,000
- Local Origination and professional staff production and post-production equipment - $875,500
- Ancillary Support equipment - $30,000

This totals $4,181,600.

All of this one time equipment transition cost is escalated by 15% to account for initial capitalized installation/maintenance/warranty costs. This cost equates to $627,240, and together with the associated equipment cost, results in a total onetime transition cost of $4,808,840.

Most of this equipment is replaced once during a ten year period, depending upon the projected equipment life cycle (most equipment varying from 5 to 7 years before replacement, with some as much as 9 years [infrastructure-related components] or more [microwave equipment and vehicles]).

Ancillary equipment involves a different complement of equipment each year, so we have projected an average of $30,000 annually throughout the period.

As noted above, all this is escalated by 15% annually to account for installation/maintenance and warranty costs. As noted in Section 6, other types of planning, design and system integration costs which may or may not be needed, and may or may not be considered operational costs, are not projected in our analysis, and would have to be separately projected as needed.

The transition forecasts have resulted in significant projected upfront costs in Year One of $1,603,675. In Year One the priority focuses are, the mobile production vehicles, microwave transport, the 12 News Studio facilities and related equipment. In Year 4, a significant cost of $1,700,850 is also required (this covers the transition for all government council chambers, plus professional staff field acquisition and editing).

Other Years vary from a low of $161,000 in Year 5 (after nearly all transitions have been completed through Year 4) to $1,811,940 in Year 10 (this Year covers multiple replacements of previously transitioned technology for multiple functional areas at the end of the 10-year period).

Overall, over ten years, $9,010,480 is forecast to be needed to support public access, government access and local origination transition activities and continued replacement in all functional areas. This breaks down into $7,835,200 in total equipment cost, plus the 15% escalator for installation, training and warranty equaling $1,175,280.

The cost for educational access transition activities is not forecast in the attached spreadsheets, although, as noted earlier in the report, educational entities can use similar unit costs to those shown in order to project their transition costs, based on their priorities and available funding.

Additionally, one priced option, an alternative cellular video transport system, is projected to be an initial $32,900 if implemented in Year Two, with $2,400 in annually recurring charges thereafter and replacement in Year 7. This provides a ten year total for the alternative of $82,600. It should be noted that this technology is relatively new and potentially has high latency for remote signal transport (causing delays, and potential video/audio syncing problems). It is not yet seen as a mature technology. This option should be further evaluated in the next couple of years based on its capabilities and cost at that point.

Additionally, these projections assume that the current complement of personnel and supporting operational funds for the NWCT facility will remain steady. As noted in Section 5, to fully engage in iTV and closed captioning activities, additional in-house or contract personnel may be necessary.

Potential Revenues

Concerning revenues to support the procurement of the recommended equipment to complete all transition activities, for all functional areas, the Community Needs Assessment findings note that the Community Television fee prescribed by the franchise has generated $7,387,239 over the past 10 years. This level would not be enough to support the procurement of all necessary equipment.

Also, it is clear that upfront grants would be needed to meet the priorities noted for transition early in the ten year period. Some of these priority expenditures are also foundational, such as infrastructure, upon which other transaction activities rely. The Community Needs Assessment notes that there was a capital grant of $1.2 Million dollars in 1998, but this was for expansion of

facilities. Similar grants, this time for equipment, would be needed to support meeting the recommendations noted herein.

8. GLOSSARY

The following are definitions for the key technical terms and acronyms used in this Report

Aspect Ratio (Pixel Aspect Ratio) – A ratio or relationship between the number of pixels in the width of an image compared to the number of pixels in the height of an image. Standard displays are 4:3 or 4 pixels across for every 3 pixels high. Wide screen displays are 16:9 or 16 pixels across for every 9 pixels high.

Autostereoscopy – A method of displaying an image on a flat screen that gives the perception of 3D without the viewer having to wear glasses.

Bit – A base unit of information utilized in computing and telecommunications.

CRT – Cathode Ray Tube – A traditional television with a vacuum tube used to produce a television picture.

Chroma keying – A technique used to combine two separate images onto one screen. Equipment removes a single color or background and inserts the resulting image onto another image.

CC – Closed Captioning – The addition of text, through transcription, on a television screen to provide information to persons desiring to access it. Typically, closed captioning is used to deliver program audio in text form for the deaf and hard of hearing.

CGI – Computer Generated Imagery – Computer graphics utilized to simulate a scene or provide special effects. CGI can include virtual sets with the benefit of controlling the scene being chroma keyed into a program.

DSL - Digital Subscriber Line – A telephone system-based data communications service that utilizes modulation schemes that allow high speed transmission of data, including compressed digital video, on copper or phone lines.

DTV- Digital Television – Provision of television signals in a digital format. Also, televisions with tuners capable of receiving digital signals.

EBIF- Enhanced Binary Interchange Format – An Enhanced TV (ETV) standard designed to enable interactive services to function across cable set-top platforms.

FCC – Federal Communications Commission – A Federal Government Agency which regulates non-federal government use of the radio spectrum and telecommunications**.**

FTTH – Fiber to the Home – (aka, FTTP - Fiber to the Premise) – A network architecture whereby signals are fed from the headend, or Central Office for phone systems, to the customers' premises via fiber optic cable. The signal is in the form of light up to the residences where it is transformed into electronic signals and inserted onto coaxial cable and phone twisted pair.

Gbps – Giga bits per second – A unit of data transfer equaling 1 billion bits per second

HDMI – High-Definition Multimedia Interface – a compact cable interface used in transmission of uncompressed digital data between devices.

HDTV – High Definition Television – Digital television broadcasts with higher levels of resolution than Standard Definition Digital Television. Three standards are utilized in the US today; 720p, 1080i and 1080p.

HFC – Hybrid Fiber Coaxial – A network design deployed by most cable television operators incorporating fiber optic cable into a coaxial network. The headend feeds fiber optic cables which feed fiber optic nodes in the systems' neighborhoods. These nodes transform the light from the fiber into electronic signals and feed them to the customers' premise via coaxial cables.

iTV – Interactive Television – Programs and systems that allow a consumer to influence, interact with or respond to the program they are viewing, while watching.

Interlaced Scanning – See Scanning below

IPTV – Internet Protocol Television – A system allowing digital television signals to be transmitted using Internet Protocol packet-switched infrastructure.

Java – A computer programming language platform designed to allow simplicity, portability, robustness and security while being architecture neutral and dynamic. It is a basis for open software and application development.

LCD – Liquid Crystal Display televisions - A flat screen technology used in place of a CRT. The most widely produced flat screen technology.

LED- Light Emitting Diode – A semiconductor diode that emits light when voltage is applied. LED technology is becoming the preferred form of video monitors and studio lighting because of its long life, high intensity light and low power consumption.

Long Tail – Multi-platform delivery of information. Several long tail services combine to appeal to large numbers of consumers.

MHz – Mega Hertz – Hertz represents a unit of frequency. 1 hertz equals 1 complete cycle per second. 1 MHz equates to 1 million complete cycles per second.

Mbps – Megabits per second – A unit of data transfer equaling 1 million bits per second.

MPEG-2 – The second set of standards for coding of moving pictures and audio including video compression, audio and methods for storage and transmission of video media. Developed by the Moving Picture Expert Group (MPEG)

MPEG-4 – The fourth set of MPEG standards, enabling high quality at high compression ratios.

NCI – National Captioning Institute – A non-profit organization providing closed captioning for television and movies.

Pixel – a picture element or single point in a television picture.

Progressive Scanning – See Scanning below

QAM – Quadrature Amplitude Modulation – A Digital over Analog modulation scheme where the amplitude of two, 90° out of phase, or Quadrature, carrier waves are changed or modulated. This is the most widely used modulation technique in cable television systems (versus Analog or IPTV technologies).

QoS – Quality of Service – Priority given to data packets on an IP network. Often employed for realtime services such as voice and video.

Scanning:

Interlaced Scanning – Displaying a television picture by skipping every other line (odd lines) and then starting at the beginning and filling in every other line (even lines). In the example below, pixels 1, 2, 3 and 4 are scanned, then 9, 10, 11, and 12. Then the scan begins at Pixel 5, 6, 7 and 8 and moves to Pixel 13, 14, 15 and 16. The scan then restarts at Pixel #1. Interlaced scanning is utilized in digital television to conserve bandwidth.

Progressive Scanning – Displaying a picture line by line (no skipping of lines as in Interlaced Scanning). In the example below, the scan begins at Pixel number 1 and progresses in numerical order to the bottom of the screen.

Scanning Diagram

Line 1	1	2	3	4
Line 2	5	6	7	8
Line 3	9	10	11	12
Line 4	13	14	15	16

16 Pixels Total

SD – Standard Definition – Digital Television video with resolution levels comparable to analog television. However, digital television is not prone to many of the distortions and noise that occur during transmission that degrade Analog television signals and thus provides a higher quality picture.

SDI- Serial Digital Interface – Digital video interfaces used for broadcast grade video.

SAN – Storage Area Network – Attachment of remote computer storage devices to increase capacity, functionality and reliability of underlying data systems.

SDV - Switched Digital Video - SDV operates in much the same way as VOD whereby channels with a small audience, niche services, are only transmitted to one or more nodes when a customer elects to watch by tuning their converter to the channel. This technology is designed to conserve bandwidth on a cable television network when channels are not being watched by customers.

TB - Terabyte – A unit of storage of digital information. 1 Terabyte equates to 1 trillion bytes of information.

Tru2way – Formerly known as OCAP (Open Cable Applications Platform). Developed by CableLabs as a standard iTV platform.

Virtual Sets – The use of Chroma keying to give the impression of being in a place other than where taping of a program is occurring. An example is a person speaking on camera in a studio and the background is a local beach or park.

VOD – Video-On-Demand – a technology that allows consumers to watch programs at their convenience while allowing pause, fast forward and rewind capabilities.

720p – A High Definition Television standard with 720 horizontal scan lines or lines of resolution progressively scanned. A resolution of 1280 x 720p equates to 921,600 pixels on the screen.

1080i – A High Definition Television standard with 1080 lines of resolution, interlaced scanned. A resolution of 1920 x 1080 equates to 2.07 million pixels on the screen.

1080p – A High Definition Television standard with 1080 lines of resolution progressively scanned. A resolution of 1920 x 1080 equates to 2.07 million pixels on the screen.

3DTV– 3 Dimensional Television – Broadcast of a program giving a perception of depth on a flat screen television or monitor.

9. ATTACHED SPREADSHEETS

Cost projections for all the NWCT public access, LO Channel 12, government access, and associated facilities and functional areas related to all of the transition findings and recommendations made herein are included in the attached spreadsheets. As noted earlier, public schools' facilities such as those utilized for ED's TV, can rely on the same baseline projections found in the spreadsheets for similar functional areas (such as Board of Education meeting room production areas versus Council chambers production areas), adjusted for their budgets, priorities and associated procurement phasing. As indicated previously, the equipment types, phasing and costs indicated in the spreadsheets are based on current information, future needs assessed, and associated going forward projections, but should be reviewed annually to determine whether adjustments need to be made based on available funding, programmatic requirements, additional shifts in technology and changes in the focus of any individual entity's mission.

Functional Area	Comments*	Unit Cost	Quantity	Extended Costs
Public Access				
Field Acquisition Public Access			9 Field kits	
Camera Field Packages	Should include one HD camera, one tripod, lighting package, 2 channels wireless audio and accessories. A 10 year replacement schedule indicates replacement of this equipment be a 5-year replacement as opposed to a 7-year because of anticipated wear and tear by Public Access users.	$15,000	9	$135,000
Flypack (Anycast Replacement)	To replace current Sony Anycast portable switcher with HD units. System also includes 2 portable field packages similar to the ones listed above for use with Anycast system.	$45,000	2	$90,000
Sub Total-Field Acquisition Public Access				**$225,000**
Studio Acquisition Public Access			2 studios	
Cameras	Should be capable of HD production. Costs listed are per camera and include CCU, camera head, studio viewfinder, tripod adapter, and lens. Staff requested 2 sets of cameras, 1 set per studio. Second set of cameras included in cost of Flypack (Studio in a box).	$25,000	3	$75,000
Studio Monitoring	Capable of HD signal. Prices are per monitor. To be used for confidence and on-set.	$1,200	4	$4,800
Virtual Set Technology	Includes digital sets, backdrops for chromakey; HD versions, with greater depth and camera motion compensation.	$50,000	1	$50,000
Sub Total-Studio Acquisition Public Access				**$129,800**
Studio Control Public Access				
Switcher	Should be capable of HD production. Some newer switchers also have the ability to incorporate virtual set and multiviewer technology, if this is desired. Switcher should also have capabilities such as external device control, clip store, customizable configuration, have multiple keying technology both upstream and downstream and have the ability to do macros.	$60,000	1	$60,000
Character Generator	Prices vary greatly depending on features, I/O, and single/multi-channel systems. System could include multiple I/O, simultaneous HD animations on 2 channels, built in DVEs, built-in stillstore, 3D graphics, and motion clip playback. A separate CG might be optional depending on the type of switcher, as some switchers have this type of functionality built in.	$30,000	1	$30,000

Functional Area	Comments*	Unit Cost	Quantity	Extended Costs
Digital Audio Mixing Consoles	Price for adding stereo digital audio mixing and encoding to facility. Digital audio conversion is not necessary immediately, but should be provided for all new upgrades and can be transitioned as needed. Price is for 32 channel digital audio mixer capable of multi-channel output including SAP/MAP audio.	$5,000	1	$5,000
Multiviewer Control	Only standalone multiviewers have been priced here and do not include display monitors. Many of today's current switchers are incorporating multiviewer technology in their products and would be included in the switcher costs. This should be researched when purchasing a specific switcher, because the cost of a separate multiviewer may be unnecessary. Prices are per multiviewer device needed. Multiviewer devices generally run as a standalone quad split or a virtual monitor wall, cascaded to accommodate more inputs.	$8,000	1	$8,000
Multiviewer Monitoring	Monitors to be used to display multiviewer images. Assuming 1 48" monitor per multiviewer control unit, but this may vary depending on need.	$1,500	2	$3,000
DVD Recorder	Professional level.	$300	1	$300
Mini-DV Recorder	Initial replacement will be Mini-DV Recorder but they will be phased out during the life of the replacement schedule. Should be replaced with updated recording format.	$3,000	2	$6,000
Misc. HD D/A's and cabling	This is for miscellaneous distribution of HD equipment	$10,000	1	$10,000
Engineering/Confidence Monitoring	Used for monitoring video output signal. Should incorporate built-in waveform/vectorscope.	$3,000	1	$3,000
Sub Total-Studio Control Public Access				**$125,300**

Functional Area	Comments*	Unit Cost	Quantity	Extended Costs
Post Production Public Access			4 systems	
Ingestion	Since most field acquisition has gone tapeless, the editing ingestion process needs to match the technology, whether it is card-based or optical disc-based. This price reflects the cost for card reader configured for non-linear editing.	$2,000	4	$8,000
Digital Audio Mixing Consoles	Price for adding stereo digital audio mixing. Digital audio conversion is not necessary immediately, but should be considered for migration during the life of the franchise. This cost reflects the price of a digital mixing console of 8-10 inputs.	$1,500	4	$6,000
Monitoring	Must be capable of at least SDI/HD, or SDI/HDMI inputs. Includes multi-standard, multi-format digital waveform monitor. Prices are per monitor.	$3,000	4	$12,000
Edit Equipment	Price is for a turnkey (including both hardware and software) dual quad-core Mac with I/O card with dual monitors. Performance will be slower when trying to edit HD on older MACs. Turnkey systems can vary in cost depending on storage, graphics cards, I/O cards and system RAM needed.	$8,000	4	$32,000
Mini-DV Recorder	Initial replacement will be Mini-DV Recorder but they will be phased out during the life of the replacement schedule. Should be replaced with updated recording format.	$3,000	2	$6,000
Sub Total-Post Production Public Access				**$64,000**
Total-Public Access				**$544,100**

Functional Area	Comments*	Unit Cost	Quantity	Extended Costs
Whole Facility				
Infrastructure				
Video over Ethernet Encoder/Decoder Pair	Capable of transmitting HD-SDI video and audio over IP networks. Would need an additional upgrade if optional Government Facility Headend is developed. As another alternative, native HD/SDI transport can be used if Comcast delivers signals locally from the hub (rather than encoding and transporting IP-based signals via the C-RAN back to the Master headend).	$25,000	1	$25,000
Optical Transmitters/Receivers	One per channel. Used for receiving and transmitting AV signals should include transmitters/receivers.	$2,000	5	$10,000
SDI cabling	Price range is per foot and for regular shielding or plenum (fire-retardant) shielding. Cabling should be able to accept both SD-SDI and HD-SDI signals. Actual costs are dependent on lengths needed, and should be quoted from an integrator. Cost includes cabling and installation.	$2.50	2000	$5,000
SDI routing	Routing and cabling need to have bandwidth capable of HD. Costs vary widely depending on number of inputs and outputs needed. This baseline should provide a 64X64 HD router within a 128x128 frame with cabling.	$75,000	1	$75,000
SDI patching	Costs are per patch bay and final costs could vary widely depending on number of patch bays needed. Standard configuration is usually 24 inputs per bay and should be wired in at the same time as the router install.	$1,500	11	$16,500
Signal Converters	For up-converting any legacy equipment that is analog or down-converting any newer equipment such as HD to SD. We recommend signal converters that work as "Swiss Army knives", i.e. have the ability to up-convert and down-convert any signal from HD to analog to VGA and even HDMI.	$3,500	4	$14,000
Sub Total-Infrastructure Staff Production				**$145,500**
Archival/Storage				
Storage Server	Budgets should account for a three-tiered storage approach accommodating high-end HD performance as well as lower performance and an offline tape backup systme. Costs on storage can vary widely depending on performance, the number of users, and the amount of storage needed. 100 TB of high-end storage, 150 TB of low-end and a tape library capable of 100 tape slots. The price reflects a blended cost for all types of storage.	$300,000	1	$300,000
Sub Total-Archival/Storage Staff Production				**$300,000**

Functional Area	Comments*	Unit Cost	Quantity	Extended Costs
Headend/Playback				
Server-based Playback System	New or replacement headend/playback equipment should be HD or HD compatible. The cost reflected is for one system for standard playback performance. A separate higher end system will be purchased before year one of franchise. Minimum bit rates should be 20 Mb/sec for HD. This should include multi-playback capability.	$70,000	1	$70,000
Sub Total-Headend/Playback Staff Production				**$70,000**
On Demand/Streaming				
Encoders	Need one encoder per channel for streaming live 24/7 content. Price varies depending on format and performance. Price represents a professional turnkey multi-channel encoder system, which includes hardware and software capable of running 24/7.	$20,000	3	$60,000
Sub Total-On Demand Streaming Staff Production				**$60,000**
Total-Whole Facility				**$575,500**

Functional Area	Comments*	Unit Cost	Quantity	Extended Costs
CITY FACILITIES - 9 CITIES				
Council Chambers				
Cameras	These cameras are HD robotic cameras capable of panning and zooming. Should include head, lens and P/T controller. 4 cameras per location	$40,000	9	$360,000
Document Camera	This HD camera is ceiling mounted and used for overhead display of documents. Should include head, lens and P/T controller	$10,000	9	$90,000
Audio Microphones	Combination of omni directional microphones with Mute functions and lectern microphones. 24 microphones per location at $175 each.	$4,200	9	$37,800
TV Monitor	55 inch. 2 monitors per location	$3,000	9	$27,000
Sub Total-City Facilities-Council Chambers				**$514,800**
Council Chamber Control Room				
Switcher	Capable of HD production. More economic switcher with only one M/E capable of upstream and downstream keying and multi-viewer output.	$20,000	9	$180,000
Robotic Camera Control	Controller should be capable of controlling multiple cameras with the ability of stored presets and camera setup capability	$2,500	9	$22,500
Character Generator	Features could include both single and multi-channel operation. Including stillstore, rolls and crawls, 2D and 3D graphic capability.	$15,000	9	$135,000
Digital Audio Mixing Consoles	Price includes the cost of DPS audio mixing of 24 channels of Council audio.	$2,500	9	$22,500
Multi-view Monitoring	Monitors to be used to display multiviewer images. Assuming 1 48" monitor per multiviewer control unit, but this may vary depending on need.	$2,000	9	$18,000
DVD Recorder	Professional Level	$300	9	$2,700
Engineering/Confidence Monitor	Used for monitoring video output signal. Should incorporate built-in waveform/vectorscope.	$4,000	9	$36,000
Playback System	New or replacement headend/playback equipment should be HD or HD compatible. Minimum bit rates should be 20 Mb/sec for HD. Requires less storage capacity than Facility playback.	$10,000	9	$90,000
Government Facility Transport to create a "Channel 16" Headend	Replaces current Comcast links from City Halls to Comcast hubs, with direct connections from City Halls to NWSCCC. Specifically, connection of all City Hall facilities with HD video and embedded audio to NWSCCC facility. Direct HD/SDI transport (requires 1 full Fiber per link); also may include multiplexing. This cost does not include any fiber cabling costs or monthly bandwidth rental costs (potential LOGIS costs).	$150,000	1	$150,000
Sub Total-City Facilities-Council Chambers Control Room				**$656,700**
Total City Facilities				**$1,171,500**

Functional Area	Comments*	Unit Cost	Quantity	Extended Costs
Staff Production				
Mobile Production Truck (MPT)				
Local Origination, Sports & Events MPT	The current Production truck is SD and needs many upgrades. The vehicle itself has low mileage and is in good condition. Price is for equipment only. Price includes equipment such as multiple channels of CG, multiple channels of hard drive recording and playback, switching capable of 2D and 3D effects, multi-channel slow motion video playback, small HD routing systemand patching system, multi-viewer monitors and 4 high-end cameras similar to the News Studio and 1 lower-end camera similar to Public Access Studio, 32-channel digital audio mixer. Should also include Fiber Encoder for live transmission over fiber origination connections and miscellaneous converters and accessories. Included in this cost is a high powered 36x telephoto sports lens.	$550,000	1	$550,000
MPT Box Truck	This cost is for a replacement truck. Equipment for truck is addressed above. HD/SDI Rack Ready, A/V Patchbays for Video and Audio Monitoring.	$110,000	1	$110,000
Microwave Transmission (ENG) Truck	The vehicle itself has low mileage and does not need to be replaced immediately. The equipment does need to be replaced with either continued microwave technology or new forms of technology such as cellular. This should be a smaller vehicle than the Production truck, capable of ENG technology. Vehicle should also include necessary cabling for multi-camera shoot and transmission technology. Cost is for vehicle only.	$80,000	1	$80,000
Microwave - Transmission Truck and Receive Tower Equipment	The equipment to be used in this vehicle will include a multi-camera flypack. Intent is to utilize 1 flypack already included in the Staff Production Field Acquisition cost spreadsheet. Cost includes necessary cabling for multi-camera shoot and transmission technology. Cost also includes a new digital microwave system (transmit and receive), as well as 1 Microwave Repeater Station at the south end of the NWSCCC territory. This assumes that the receive site can also serve as a retransmit site to the NWSCC. If not, the microwave cost would reduce by $45,000, but fiber or other backhaul cost would need to be factored in. The need for additional repeaters will depend on where deadspots, if any remain and the height of the new repeater installation. No microwave will be necessary, if the optional cellular transport system is chosen, unless it is to be used as a back-up.	$245,000	1	$245,000
Sub Total-Mobile Production Truck Staff Production				**$985,000**

Functional Area	Comments*	Unit Cost	Quantity	Extended Costs
News Studio				
Camera	High-end Camera system capable of HD production. Costs listed are per camera and include CCU, camera head, studio viewfinder, tripod adapter, and lens.	$60,000	3	$180,000
Ceiling Camera	Lower end camera used for wide studio shot. Usually mounted on ceiling	$25,000	1	$25,000
Studio On-set Monitoring	Capable of HD signal. Includes 13 monitors (Either Plasma or LCD), 4-7" in-desk monitors, and 1 HD projector	$25,000	1	$25,000
Sub Total-News Studio Staff Production				**$230,000**
News Control Room				
Switcher	Should be capable of HD production. Some newer switchers also have the ability to incorporate virtual set and multiviewer technology, if this is desired. Should also include specialized capabilities for news production such as high level of graphics and clip store capabilities. Multiple M/E technology as well as multiple device control, file playback, multiple keying both upstream and downstream, built in multiple DVE technology for such things as picture in picture.	$75,000	1	$75,000
Character Generator	Prices vary greatly depending on features, I/O, and single/multi-channel systems. System could include multiple I/O, simultaneous HD animations on 3 channels, built in DVEs, built-in still store, 3D graphics, and motion clip playback. This should also include a hard drive of at least 1 TB. Real-time multi-scene compositing and interactive messaging	$70,000	1	$70,000
Digital Audio Mixing Consoles	Price for adding stereo digital audio mixing and encoding to facility. Digital audio conversion is not necessary immediately, but should be provided for all new upgrades and can be transitioned as needed. Price is for 32 channel digital audio mixer capable of multi-channel output including SAP/MAP audio.	$5,000	1	$5,000
Multiviewer Control	Only standalone multiviewers have been priced here and do not include display monitors. Many of today's current switchers are incorporating multiviewer technology in their products and would be included in the switcher costs. This should be researched when purchasing a specific switcher, because the cost of a separate multiviewer may be unnecessary. Prices are per multiviewer device needed. Multiviewer devices generally run as a standalone quad split or a virtual monitor wall, cascaded to accommodate more inputs.	$8,000	3	$24,000
Multiviewer Monitoring	Monitors to be used to display multiviewer images. Assuming 1 48" monitor per multiviewer control unit, but this may vary depending on need.	$1,500	4	$6,000
Misc. HD D/A's and cabling	This is for miscellaneous distribution of HD equipment	$10,000	1	$10,000
Engineering/Confidence Monitor	Used for monitoring video output signal. Should incorporate built-in waveform/vectorscope.	$4,000	1	$4,000
Sub Total-News Control Room				**$194,000**

Functional Area	Comments*	Unit Cost	Quantity	Extended Costs
Field Acquisition				
Camera Field Packages	Should include one HD camera, one tripod, lighting package, 2 channels wireless audio and accessories. These cameras should be using P2 technology and integrate with Post Production Equipment	$30,000	10	$300,000
Sub Total-Field Acquisition				**$300,000**
Post Production		10 systems (8 for Editing, 2 Advertising/Sales)		
Ingestion	Since most field acquisition has gone tapeless, the editing ingestion process needs to match the technology, whether it is card-based or optical disc-based. This price reflects the cost for card reader configured for non-linear editing.	$2,000	10	$20,000
Digital Audio Mixing Consoles	Price for adding stereo digital audio mixing. Digital audio conversion is not necessary immediately, but should be considered for migration during the life of the franchise. This cost reflects the price of a digital mixing console of 8-10 inputs.	$1,500	10	$15,000
Monitoring	Must be capable of at least SDI/HD, or SDI/HDMI inputs. Includes multi-standard, multi-format digital waveform monitor. Prices are per monitor.	$3,000	10	$30,000
Edit Equipment	Price is for a turnkey (including both hardware and software) dual quad-core Mac with I/O card with dual monitors. Performance will be slower when trying to edit HD on older MACs. Turnkey systems can vary in cost depending on storage, graphics cards, I/O cards and system RAM needed.	$8,000	10	$80,000
Sub Total-Post Production Staff Production				**$145,000**
Audio Voice Over Booth				
Digital Audio Workstation	Should include computer, audio editing software, monitor, keyboard, mouse, microphone and ingestion interface	$5,000	1	$5,000
Digital Audio Mixing Consoles	Price for adding stereo digital audio mixing. Digital audio conversion is not necessary immediately, but should be considered for migration during the life of the franchise. This cost reflects the price of a digital mixing console of 8-10 inputs.	$1,500	1	$1,500
Sub Total-Audio Voice Over Booth Staff Production				**$6,500**
Total-Staff Production				**$1,860,500**

Functional Area	Comments*	Unit Cost	Quantity	Extended Costs
Ancillary Equipment				
Ancillary Equipment**				
	Ancillary/ Support Equipment such as microphones, teleprompters, stands, tripods, portable production accessories, racks, batteries, cards, physical sets, office equipment, etc. will be an aggregated total in the summary spreadsheet.	$30,000	1	$30,000
Sub Total-Ancillary Equipment				**$30,000**
Total-Ancillary Equipment				**$30,000**
SubTotal One Time Transition Cost				**$4,181,600**
15% Installation/Training/Warranty				**$627,240**
Total One Time Transition Cost				**$4,808,840**
Options				
Video over Cellular Transport System	Would replace microwave system. Portable video-over-cellular technology capable of addressing demands for full HD quality, mobility and low latency. Combines multiple cellular connections and can be used for one-way or two-way video transport. System should include 3-5 cell cards as needed. Cost also includes annual service cost of $2,400 ($200 per month x 12).	$32,900	1	$32,900

* Description of type of equipment needed for each major item in a functional area, and brief purpose. Longer form discussion is included in the narrative report. HD costs are based on 1080p format.

** This is included as a unit cost in the one-time transition cost calculation to ensure that it is reflected. In actuality, the one time cost for ancillary equipment will likely be higher until it reflects the next replacement of each item. The maximum extended costs would be the 10 year total of $300,000 (plus 15% Installation/ Training/Warranty)

Functional Area	Unit Cost	Quantity	Extended Costs	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9	YR10	10 Year Total
Public Access														
Field Acquisition Public Access		9 Field kits												
Camera Field Packages	$15,000	9	$135,000			$135,000					$135,000			$270,000
Flypack (Anycast Replacement)	$45,000	2	$90,000		$90,000					$90,000				$180,000
Sub Total-Field Acquisition Public Access			**$225,000**											
Studio Acquisition Public Access		2 studios												
Cameras	$25,000	3	$75,000			$75,000							$75,000	$150,000
Studio Monitoring	$1,200	4	$4,800			$4,800							$4,800	$9,600
Virtual Set Technology	$50,000	1	$50,000			$50,000							$50,000	$100,000
Sub Total-Studio Acquisition Public Access			**$129,800**											
Studio Control Public Access														
Switcher	$60,000	1	$60,000			$60,000							$60,000	$120,000
Character Generator	$30,000	1	$30,000			$30,000							$30,000	$60,000
Digital Audio Mixing Consoles	$5,000	1	$5,000				$5,000							$5,000
Multiviewer Control	$8,000	1	$8,000			$8,000							$8,000	$16,000
Multiviewer Monitoring	$1,500	2	$3,000			$3,000							$3,000	$6,000
DVD Recorder	$300	1	$300			$300							$300	$600
Mini-DV Recorder	$3,000	2	$6,000			$6,000							$6,000	$12,000
Misc. HD D/A's and cabling	$10,000	1	$10,000			$10,000							$10,000	$20,000
Engineering-Confidence Monitor	$3,000	1	$3,000			$3,000							$3,000	$6,000
Sub Total-Studio Control Public Access			**$125,300**											

Functional Area	Unit Cost	Quantity	Extended Costs	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9	YR10	10 Year Total
Post Production Public Access		4 systems												
Ingestion	$2,000	4	$8,000			$8,000						$8,000		$16,000
Digital Audio Mixing Consoles	$1,500	4	$6,000			$6,000						$6,000		$12,000
Monitoring	$3,000	4	$12,000			$12,000						$12,000		$24,000
Edit Equipment	$8,000	4	$32,000			$32,000						$32,000		$64,000
Mini-DV Recorder	$3,000	2	$6,000			$6,000						$6,000		$12,000
Sub Total-Post Production Public Access			**$64,000**											
Total-Public Access			**$544,100**	**$0**	**$90,000**	**$449,100**	**$5,000**	**$0**	**$0**	**$90,000**	**$135,000**	**$64,000**	**$250,100**	**$1,083,200**

Functional Area	Unit Cost	Quantity	Extended Costs	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9	YR10	10 Year Total
Whole Facility														
Infrastructure														
Video over Ethernet Encoder-Decoder Pair	$25,000	1	$25,000	$25,000									$25,000	$50,000
Optical Transmitters/ Receivers	$2,000	5	$10,000	$10,000									$10,000	$20,000
SDI cabling	$2.50	2000	$5,000	$5,000										$5,000
SDI routing	$75,000	1	$75,000	$75,000									$75,000	$150,000
SDI patching	$1,500	11	$16,500	$16,500										$16,500
Signal Converters	$3,500	4	$14,000	$14,000									$14,000	$28,000
Sub Total-Infrastructure Staff Production			**$145,500**											
Archival Storage														
Storage Server	$300,000	1	$300,000		$300,000					$300,000				$600,000
Sub Total-Archival Storage-Staff Production			**$300,000**											
Headend-Playback														
Server-based Playback System	$70,000	1	$70,000			$70,000					$70,000			$140,000
Sub Total-Headend-Playback Staff Production			**$70,000**											
On Demand Streaming														
Encoders	$20,000	3	$60,000		$60,000					$60,000				$120,000
Sub Total-On Demand Streaming Staff Production			**$60,000**											
Total-Whole Facility			**$575,500**	**$145,500**	**$360,000**	**$70,000**	**$0**	**$0**	**$0**	**$360,000**	**$70,000**	**$0**	**$124,000**	**$1,129,500**

Functional Area	Unit Cost	Quantity	Extended Costs	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9	YR10	10 Year Total
City Facilities - 9 Cities														
Council Chambers														
Cameras	$40,000	9	$360,000				$360,000						$360,000	$720,000
Document Camera	$10,000	9	$90,000				$90,000						$90,000	$180,000
Audio Microphones	$4,200	9	$37,800				$37,800						$37,800	$75,600
TV Monitor	$3,000	9	$27,000				$27,000						$27,000	$54,000
Sub Total-City Facilities-Council Chambers			**$514,800**											
Council Chamber Control Room														
Switcher	$20,000	9	$180,000				$180,000						$180,000	$360,000
Robotic Camera Control	$2,500	9	$22,500				$22,500						$22,500	$45,000
Character Generator	$15,000	9	$135,000				$135,000						$135,000	$270,000
Digital Audio Mixing Consoles	$2,500	9	$22,500				$22,500						$22,500	$45,000
Multi-view Monitoring	$2,000	9	$18,000				$18,000						$18,000	$36,000
DVD Recorder	$300	9	$2,700				$2,700						$2,700	$5,400
Engineering Monitor	$4,000	9	$36,000				$36,000						$36,000	$72,000
Playback System	$10,000	9	$90,000				$90,000						$90,000	$180,000
Government Facility Transport to NWCTV	$150,000	1	$150,000			$150,000							$150,000	$300,000
Sub Total-City Facilities-Council Chambers Control Room			**$656,700**											
Sub Total City Facilities			**$1,171,500**	**$0**	**$0**	**$150,000**	**$1,021,500**	**$0**	**$0**	**$0**	**$0**	**$0**	**$1,171,500**	**$2,343,000**

Functional Area	Unit Cost	Quantity	Extended Costs	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9	YR10	10 Year Total
Staff Production														
Mobile Production Truck (MPT)														
P&G Channels' MPT-Equipment	$550,000	1	$550,000	$550,000					$550,000					$1,100,000
MPT Box Truck	$110,000	1	$110,000					$110,000						$110,000
Microwave Transmission Truck (ENG)	$80,000	1	$80,000						$80,000					$80,000
Transmission Truck and Receive Tower Equipment	$245,000	1	$245,000	$245,000										$245,000
Sub Total-Mobile Production Truck Staff Production			**$985,000**											
News Studio														
Camera	$60,000	3	$180,000	$180,000							$180,000			$360,000
Ceiling Camera	$25,000	1	$25,000	$25,000							$25,000			$50,000
Studio Monitoring	$25,000	1	$25,000	$25,000							$25,000			$50,000
Sub Total-News Studio Staff Production			**$230,000**											
News Control Room														
Switcher	$75,000	1	$75,000	$75,000							$75,000			$150,000
Character Generator	$70,000	1	$70,000	$70,000							$70,000			$140,000
Digital Audio Mixing Consoles	$5,000	1	$5,000	$5,000							$5,000			$10,000
Multiviewer Control	$8,000	3	$24,000	$24,000							$24,000			$48,000
Multiviewer Monitoring	$1,500	4	$6,000	$6,000							$6,000			$12,000
Misc. HD D/A's and cabling	$10,000	1	$10,000	$10,000							$10,000			$20,000
Engineering-Confidence Monitor	$4,000	1	$4,000	$4,000							$4,000			$8,000
Sub Total-News Control Room-City Facilities			**$194,000**											

Functional Area	Unit Cost	Quantity	Extended Costs	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9	YR10	10 Year Total
Field Acquisition														
Camera Field Packages	$30,000	10	$300,000				$300,000							$300,000
Sub Total-Field Acquisition			**$300,000**											
Post Production														
Ingestion	$2,000	10	$20,000		$4,000		$16,000			$4,000		$16,000		$40,000
Digital Audio Mixing Consoles	$1,500	10	$15,000		$3,000		$12,000			$3,000		$12,000		$30,000
Monitoring	$3,000	10	$30,000		$6,000		$24,000			$6,000		$24,000		$60,000
Edit Equipment	$8,000	10	$80,000		$16,000		$64,000			$16,000		$64,000		$160,000
Sub Total-Post Production Staff Production			**$145,000**											
Audio Voice Over Booth														
Digital Audio Workstation	$5,000	1	$5,000				$5,000							$5,000
Digital Audio Mixing Consoles	$1,500	1	$1,500				$1,500							$1,500
Total Audio Voice Over Booth			**$6,500**											
Total-Staff Production			**$1,860,500**	**$1,219,000**	**$29,000**	**$0**	**$422,500**	**$110,000**	**$630,000**	**$29,000**	**$424,000**	**$116,000**	**$0**	**$2,979,500**

Functional Area	Unit Cost	Quantity	Extended Costs	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9	YR10	10 Year Total
Ancillary Equipment														
Ancillary Equipment														
Ancillary Equipment	$30,000	1	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$300,000
Sub Total-Ancillary Equipment			**$30,000**											
Total-Ancillary Equipment			**$30,000**	**$30,000**	**$30,000**	**$30,000**	**$30,000**	**$30,000**	**$30,000**	**$30,000**	**$30,000**	**$30,000**	**$30,000**	**$300,000**
Yearly Equipment Totals				**$1,394,500**	**$509,000**	**$699,100**	**$1,479,000**	**$140,000**	**$660,000**	**$509,000**	**$659,000**	**$210,000**	**$1,575,600**	**$7,835,200**
15% Inst/Train/Warranty				**$209,175**	**$76,350**	**$104,865**	**$221,850**	**$21,000**	**$99,000**	**$76,350**	**$98,850**	**$31,500**	**$236,340**	**$1,175,280**
TOTAL				**$1,603,675**	**$585,350**	**$803,965**	**$1,700,850**	**$161,000**	**$759,000**	**$585,350**	**$757,850**	**$241,500**	**$1,811,940**	**$9,010,480**

Total One Time Transition Cost	**$4,181,600**
15% Inst/Train/Warranty	**$627,240**
Total One Time Transition Cost	**$4,808,840**

Options														
Cellular Transport System	$32,900	1	$32,900		$32,900	$2,400	$2,400	$2,400	$2,400	$32,900	$2,400	$2,400	$2,400	$82,600