



Rolling Out <tru2way>[™]

An Operator's Experience

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1 Introduction

This paper was prepared for the 2009 SCTE Cable-Tec Expo®. It discusses the experience of Cox in rolling out Tru2Way to their customers. More information about SCTE Cable-Tec Expo 2009 can be found at <http://expo.scte.org/>.

1.1 Purpose

This paper provides insight into and a summary of the Tru2Way rollout experience. It is intended primarily for other operators and vendors so that as others begin to deploy Tru2Way they might benefit from the Cox experiences. In addition, this paper is part of a growing body of knowledge supporting the broader market development and operational effectiveness of Tru2Way technology across the cable industry.

1.2 Audience

The target audience is the group of engineers and operators who are currently deploying or who plan to deploy Tru2Way technology. The primary group is the SCTE membership, but others across the industry will have an interest in the material covered here if they are planning to provide Tru2Way technologies on their networks.

1.3 Organization

The document is organized into several sections that cover the general business and technical considerations, then Cox experiences from implementation.

- Business Considerations – Discussion of the business drivers motivating Tru2Way deployment
- Engineering Factors – Overview of the factors that engineers need to consider in planning
- Operations Issues – Overview of the Operational issues that must be addressed for Tru2Way
- Cox Experiences – A discussion of the experiences at Cox in rolling out Tru2Way
- Lessons Learned – The short list of lessons learned from doing a Tru2Way rollout at Cox
- Appendix – A glossary of acronyms used in this document

Some readers may wish to skip sections that are not of primary interest. The document is written to be read in order of presentation, as the material is organized much like the overall project would be – from requirements and business goals to detailed planning and implementation. The final sections are not unlike a project close-out at which the teams review the experience in order to improve processes and planning on future projects.

2 Business Considerations

Multiple Service Operators (MSO) who are considering rolling out Tru2Way need to identify the business and technical requirements for Tru2Way in their networks. The business requirements will drive the planning for the rollout which must include getting the Head Ends and the network ready for Tru2Way launch. This paper focuses on the technical and operational aspects of the rollout.

Here are some questions that the MSO should answer to guide the engineering in planning for the Tru2Way rollout:

- What medium do we use for two way communication (Legacy or DOCSIS Settop Gateway (DSG))?
- What are the features that would be launched with Tru2Way – guide, value added applications, multi-room DVR and home networking? What is the phased rollout approach based on priorities?
- How will we measure the success of the rollout?
- How can MSO's reduce operational cost at the same time increase efficiency and improve service?

The launch of Tru2Way is usually driven by the desire to make use of the advancements in technology in multiple areas so that users can be presented with improved service. In considering the business requirements, Cox decided to move forward with the following baseline configuration

- FCC rules and guidelines compliance
- DSG as two way communication medium
- Providing better user interface, faster product, converged services

Though CableLabs provides specifications, suggestions, and guidelines on most of the listed elements it only mandates some of them. It is up to the MSO to define what makes their specification compliant product offering. Clear, precise business goals are fundamental to guiding the rollout to a successful implementation.

2.1 Headend Readiness

The Headend will need to be upgraded – both hardware and software – in almost any Tru2Way rollout. At a minimum, the controller and associated software (e.g. DAC or DNCS) needed to support Tru2Way must be considered and the system brought to the correct revision levels in order to support the rollout.

In certain cases, the rollout includes the need for a new carousel that can provide the capacity needed to support the service. Some operators will need to make more extensive changes to support Tru2Way such as an addition of a server complex.

2.2 Target STBs

MSO's should define STB features based on the overall business needs and the required functionality to support targeted features. This will require careful consideration of the Tru2Way stack software matched with the targeted devices. Future needs must also be carefully considered in the selection of devices and stack software to ensure adequate support. Improper considerations could hamper future feature rollouts due to an inability to leverage the current install base.

The choice of target STBs and the feature set (including future services) depend on one another. A given feature set can generally be targeted to specific hardware while hardware with less power will not support all of the features. The process of target STB selection is an iterative one that matches the best feature set and hardware for the MSO's business needs. More detail about how Cox selected STBs can be found in the Engineering Considerations section below.

2.3 Support for Tru2Way Retail

By agreement with CableLabs, five major MSO's had agreement to have their systems Tru2Way-ready for retail vendors to sell Tru2Way TV's or devices. Supporting retail devices operationally has multiple open ended questions:

- How will the device image be managed operationally?
- How are defects identified, tracked, communicated, and ultimately resolved?
- What is the best approach to provisioning the device, balancing both operational and technical requirements?
- How will the devices be validated and/or certified to ensure all functionality is operational?

These questions will drive the operational efforts to ensure billing and provisioning can handle the new devices, Customer Care is properly equipped to handle calls, installation technicians are properly trained, and monitoring is in place.

2.4 DVR

Digital Video Recording (DVR) has been extremely popular across the cable subscriber base. It is therefore critical that any initial rollout of Tru2Way technology include a DVR offering. Since many subscribers have only a single DVR device in their home, there has been growing interest in providing a technology that will allow the subscriber to enjoy DVR services from multiple STBs in the home, including non-DVR. This technology, called Multi-room DVR, is gaining wide acceptance and is providing pressures due to competitive offerings. This technology is also seen as a must-have in initial offerings for a guide on the Tru2Way platform.

One of the challenges in offering this DVR technology is providing functionality to the subscriber without confusing those who have experience with a legacy STB or other retail device. This requires careful design and considerations for the guide's user interface in presenting DVR and Multi-room DVR functionality to the subscriber.

The Cox Tru2Way effort has considered these factors in the design of their new guide and in the projected mix of DVR and non-DVR hardware for deployment.

2.5 Home networking

In-home networking technologies must be carefully considered to implement the box-to-box communication required for Multi-room DVR. The Tru2Way specification has provision to support home networking technologies, allowing customers to stream content from an in-home source to the STB. Home networking will allow a customer to stream music, photos and video between devices in the home. This includes personal devices (e.g. personal computers, mobile devices, etc.) as well as STBs. The first production Tru2Way deployment for Cox on leased STBs includes home networking capabilities, specifically MR-DVR.

2.6 Baseline applications

While launching new technology some MSO's will want to provide most or all of the features of the existing product while providing additional services and features that appeal to the customer. Cox has chosen to implement as much of the existing functionality as possible in order to gain better acceptance of the new technology while raising the bar in terms of functionality. The Tru2Way STB should have the same applications and features of existing devices in the initial rollout. For example, Cox already has Caller ID, a weather application, bill pay, email and a remote scheduling application available for legacy STBs. The Tru2Way STB needs to have all of the existing applications in order to be acceptable to the customer. This baseline set of applications has been designed to be enhanced and improved over a short period of time as deployments continue.

This brings another activity of migrating existing legacy applications to Tru2Way and supporting them side by side to legacy systems without stepping on each other. These co-existence requirements must be carefully considered in planning the Tru2Way rollout.

2.7 Value added applications

In addition to the baseline applications, the Tru2Way rollout should include one or more enhanced services or applications. It may be that the Tru2Way implementation of the baseline applications has more functionality or is easier to use. Some MSO's will want to take advantage of the rich application environment that Tru2Way provides to bring new applications to their customers like an Internet portal for accessing photos or blogs, advanced home networking features (e.g. picture viewing, music streaming, etc.), advanced EPG search or others.

2.8 Budgeting

Not only must the hardware cost be considered, but also the development costs for implementing the baseline applications that will be configured on STBs for the rollout. Some MSOs will want to license Tru2Way software for this purpose and a number of third party vendors offer development services that can create custom applications to meet specific needs. Many larger MSO's who have established development capabilities will create the software using in-house resources.

Tru2Way introduces a "build once, deploy anywhere" model where the application does not need to be ported to different networks before it can be deployed. The ability to plan for more uniform code and application download methodologies may allow the operator to achieve operational efficiencies above that of the legacy environment, thereby offering significant cost savings. These are real costs that must be considered in the rollout planning.

2.9 Operational Considerations

All elements of system operation will be impacted in the rollout of Tru2Way. Some of these operational elements include:

- **Billing:** System should support Tru2Way devices on customer accounts and associated billing features. The MSO must be able to record and track information such as device serial number, MAC addresses, host ID, etc.
- **Provisioning:** System should be able to provision the CableCARD and host so that the device would receive proper signaling of applications.
- **Customer Care:** When customers call in with issues or queries regarding service, authorization, application or other concerns, the customer care team should have all the necessary expertise and tools to diagnose the problem and resolve or escalate it.
- **Engineering Support:** Support team should be able to provide around the clock assistance ensuring uninterrupted service by fixing broken systems when failures occur. This group will likely need monitoring tools to manage the network, systems and settops.
- **Engineering Operations:** To carry out regular upgrades, enhancements and fixes the operations team should be trained and equipped to meet the needs of the business.
- **Training:** The MSO should have a proper process to replace churn in Customer Care, Operations and Support resources. The training team should be equipped with good documentation for reference and trainers should be prepared with coursework suitable for the needs.

2.10 Reducing Cost

While the capital costs of new equipment and upgrades to infrastructure are a large portion of the overall cost in a Tru2Way rollout, the operational costs must also be considered. The fundamental operation of the network will

not really change. There are some new technologies and the network characteristics that may vary from the non-Tru2Way environment, but on the whole rolling out Tru2Way is not a fundamental change to operations.

Some things to consider with respect to the operational costs are:

- Training costs for Tru2Way installation
- Rollout and day to day support from Customer Care
- Engineering support for rollout (project work)
- Additional headcount in Support/Customer Care (some MSOs will need to consider this)

Since Tru2Way supports standardized interfaces and operations, there is considerable opportunity to save operational costs by standardizing operations across systems. For example, much of the same technology for distributing the application will be identical across Cisco-based and Motorola-based systems. Efforts such as centralization and process standardization may provide the MSO with significant opportunity to recover Tru2Way investment costs quickly and save operational costs in the long term.

Initial support costs will always be higher during the Tru2Way rollout simply due to the number of changes that impact the network and every customer who gets the new service. Planning for the rollout should include additional Support staff trained in Tru2Way technologies to be onboard before the rollout begins and for up to six months after the rollout is completed.

2.11 Licensing

To use Tru2Way devices and associated services, all the associated licensing from the hardware and stack needs to be addressed. Licensing includes Tru2Way stack and possibly interactive applications, OCAP guide, EPG data feeds, and others.

2.12 Bringing Customers Onboard

While engineers may care about the technology itself, the customers will not care at all about whether a Tru2Way STB is being delivered. All they care about is being able to watch their programs, get information about what's on and control their use of the TV set. Getting a successful deployment completed depends heavily on how receptive the customers are to this change. Cox understands this and works very hard to plan a quick, smooth and painless transition for customers.

We trial the new technology in an introductory period in order to discover any issues and work through solutions. This introduction period could normally be a couple of months where all the systems need to operate as expected and all the details are addressed. Cox takes a standard industry approach by doing trials and rolling out new technology like Tru2Way in a targeted, phased set of projects. When the procedures and back office infrastructure has been tuned to execute these projects efficiently we are ready for the larger customer base.

Cox will execute a marketing campaign to drive interest and raise awareness about the new services. It is not Tru2Way that is being sold. It is services. As operators, developers and engineers we understand the value of the Tru2Way technologies that make the service offerings and enhancements possible.

3 Engineering Factors

There are a number of engineering factors to be considered in rolling out Tru2Way. Most flow from two main sources: the business needs and the state of the network and current technology. As time passes, technology continues to be improved. The rate of change in the technology world seems to be increasing each year while the business cycles remain relatively stable. This is one of the main drivers for rolling out Tru2Way in the first place: a technology refresh that will enable significant new business functionality.

This section discusses the engineering considerations that should drive the planning of any Tru2Way rollout.

3.1 STB Specification

The MSO must consider the basic features and configuration of the STB including amount of RAM, the number of tuners, amount of flash, disk size, input/output ports and many others. Since MSOs have a large base of deployed legacy STBs, leveraging them as much as possible is a necessity. Very old STBs cannot support Tru2Way generally due to the limited resources of those STBs. OnRamp (JSR 242) or some subset of Tru2Way is an option.

For operators who are deploying Tru2Way with a long-term plan to expand into new services and who want to be able to leverage the technology for future expansion, choosing STBs with plenty of RAM and a powerful CPU is important, as these always turn out to be limiting factors over time.

Some of the primary items to consider in the selection of STB hardware and stack are:

- How many concurrent streams (number of tuners) will be supported?
- What amount of disk space is needed on the STB?
- What graphics resolutions will required to render guide features?
- How much memory does the device need to have to support planned services and still have space for growth?
- Will the device provide DSG?
- Will the device support MoCA or other connectivity for home networking?

In an effort to accelerate the development schedule and to collect as much early feedback on features as possible Cox decided to phase the field trials in sync with the hardware and stack development efforts. Early field trials were limited to basic functionality and hardware available. This allowed for invaluable feedback on the basic stability and functionality for driving enhancements and defect resolution in subsequent phases.

3.2 Tru2Way Version

The version of OCAP will determine the functionality that the MSO can deploy to some extent. It will also help to determine which of the existing infrastructure components must be upgraded in order to successfully be deployed. It is therefore imperative for the MSO to participate in Tru2Way working sessions and reviews of specifications so that they can drive this knowledge back into internal feature development efforts. Allowing internal development and Tru2Way specifications to get out of sync will provide significant difficulties in future efforts.

The MSO must consider which Tru2Way features they will use in the Tru2Way rollout. If certain features are needed for future services but not needed for the initial rollout then a phased rollout plan should be considered where the feature set includes all that is needed to support today and in the future.

An example would be that the MSO can roll out Tru2Way with basic services provided today with guide and VOD, but they would choose the Tru2Way feature set (and STB, architecture, etc.) to support Multi Room DVR and/or Home networking in the future.

When the baseline applications and features are decided upon and consideration is given to the time period over which the application set will grow or be expanded, the operator can use this criterion for selecting STB hardware. In some cases, the operator will want to look at hardware first, setting the platform to which the application set must be designed, developed and optimized.

In either case, there is almost always an iterative process of estimation and testing followed by software modifications and optimizations to gain better efficiency and more performance.

3.3 Tru2Way Stack

The choice of Tru2Way stack is critical as it provides the foundation for initial and future development. Although Tru2Way stacks are developed toward a standard, changing to another stack as the development platform can often bring significant development costs and time. The follow criteria should be considered in selecting a Tru2Way stack:

- Tru2Way Specification compliance
- Performance: Boot times, response times
- Stability
- Video and audio related features, MPEG4, Dolby,

3.4 DOCSIS Set top Gateway (DSG)

Support for DSG is a considerable factor because many newer services need a higher amount of bandwidth to support faster two way communication; else we would be limited to legacy's capacity. The current generation of Tru2Way devices are DOCSIS 2.0 capable, but Tru2Way can be delivered to devices that support DOCSIS 1.0 or higher. The MSO should improve the network infrastructure to ensure that it is capable of supporting the selected DOCSIS specification and also plan for future support. Since the DOCSIS requirement is normally led by the cable modem MTA requirements they are expected to be present by the time Tru2Way rolls out.

3.5 Headend and Systems Upgrades

The Head End consists of multiple servers and sub-systems that include conditional access controller, legacy communication devices, modulators, demodulators, encryption devices, video groomers and multiplexers. The Head End may need significant updates in its operation in delivering services to Tru2Way. Some of these services may include System Information (SI) delivery, application signaling, multi-stream cable card support, and other code upgrades. In many situations the old Head End hardware will need an upgrade due to lack of support from hardware vendors, or lack of capacity. The role of operations and support is to create a plan to get all upgrades done in a manner that will not bring down services for legacy systems while still performing the needed updates.

Some operators will not find upgrading the Head End to be difficult. This will depend in part on the age and complexity of the equipment.

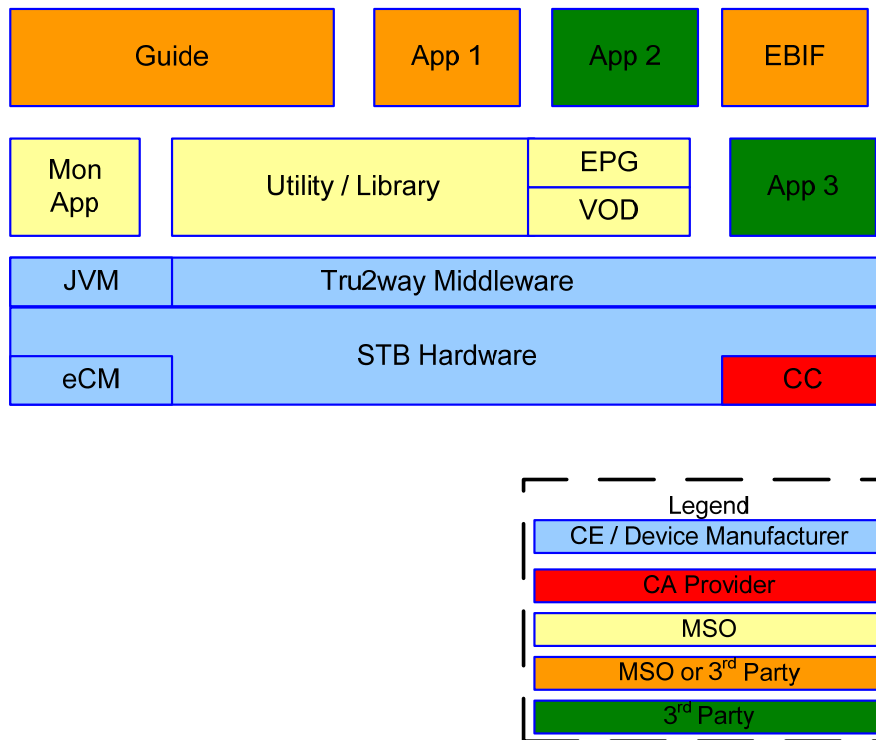
3.6 Testing Tools

Standards and specifications allow MSO's to build intelligent, automated and cost effective test beds where manual testing can be kept to very minimal levels. This helps in keeping the testing costs low and reducing the time it takes to offer new services. This also helps in attracting tech savvy customers to cable. One important aspect of Tru2Way is it provides various troubleshooting mechanisms with the physical presence of resources using technologies such as SNMP walk of devices. This again saves time and resources before and after deployment. There are third party test suites on the market that can also provide a level of compliance reporting on the device. This is another way of evaluation so that any 3rd party apps can run on the device without major issues. These tools are often high priced, but experience has shown that they can potentially save much more in support and Customer Care costs.

3.7 Target Tru2Way Applications

Selection of the features and applications that will be deployed to customers on the Tru2Way devices is a primary focus of Product Management. Engineering is tasked with getting all of this into the selected platform and running in the network environment without disrupting the existing services. This collection of features and applications comprises the service that the end users will see when the Tru2Way STBs are deployed. Basically, now that Tru2Way is deployed on Cox's networks the services on the Tru2Way devices are comparable to the currently provided services on legacy STBs. Beyond that there are value-added services to be included while rolling out Tru2Way that provide customers with enhancements not easily provided on the legacy devices.

The diagram below provides an insight of applications in Tru2Way



There are a number of baseline applications that Cox has designed and delivered based on this software architecture. This section provides a summary of the applications.

Monitor Application

Tru2Way provides MSO's the control of the device using a privileged 'Monitor Application' (or "Mon App") which is the highest priority application or service that is started on the device when the STB is booted.

Mon App is not a mandatory application, but most MSOs will choose to have one to have control over malicious applications or services that impact the customer experience. The Mon App has the ability to prevent unauthorized or ill-behaved applications from running and to resolve resource contention. It can allocate and control the resources of the device and perform management over the other applications on the STB. The Mon App has no user interface. It is launched as the first application by the Tru2Way stack and manages resources on the STB after it is launched.

The MSO needs a Mon App to police the STB so that the customer gets uninterrupted service as designed by MSO, where approved applications perform designated services. The Mon App is usually developed by an MSO as we have done at Cox. A complimenting server infrastructure runs in the server back office to provide the Mon

App with policy files and other needed interaction. These two are tightly coupled and constitute the primary control on the STB for delivering services to customers via Tru2Way.

Guide

The Guide is a familiar application that customers use to find out what is being broadcast, manage recordings on DVR STBs, display detailed information about programs and more. It is a baseline application for all MSO's that allows the user to control their viewing experience and find entertainment for viewing.

The key here is to meet or exceed the features of the existing legacy STB Guide(s) in the new Tru2Way implementation, specifically:

- Look and Feel
- Responsiveness
- Functionality
- Ease of Use

It is the overall user experience that must be considered when re-writing the Guide for a Tru2Way rollout.

Potential for new UI and Functionality

Because the software that controls the STB will be new it offers the MSO an opportunity to design a fresh user interface (UI) that will be appealing to the customer. Tru2Way can be made to allow the user to change the UI by selecting from a number of "themes" that change the on-screen appearance of the interface without changing any of the functionality. This is typical of many existing, non-Tru2Way deployments as well.

There is also an opportunity for the MSO's to provide new functionality with the Tru2Way rollout because the Tru2Way platform typically provides a much more rich application environment.

Personalized Viewing for Multiple Users

Since the viewing preferences of each person within the home varies, devices may provide various accounts within the household where the users can choose their favorite channels and other preference setting. This also helps in enforcing the parental controls within the household and customizable views. One user may like to see a Picture-In-Picture (PIP) window and current program listing on their home page while another user would prefer to see the DVR recorded programs list with the current weather conditions and a stock ticker.

Users can set up their own preferences and could also have a home page similar to the start page for an internet browser. This feature improves acceptance of the new technology and provides an incentive for customers to move to the new platform.

There are any number of ways that an MSO can design rich, functional, customizable interfaces when a Tru2Way platform provides the runtime environment.

Value Added Applications

One of the long time promises of the Tru2Way platform is the ability to run rich applications beyond the baseline applications found on the current STB. These applications may reach far beyond TV viewing to include CallerID, Online Billpay, Home Security, Home Appliance Control, Web Portal, and many more. This list will expand as the Tru2Way services are more widely deployed.

News Tickers

A common application that a customer might want on their home page is a localized news feed. Such an application is not difficult to write for the Tru2Way platform and would be considered a baseline application in most deployments.

Weather and Traffic

Like the news application, most MSO's will want to deploy baseline applications for getting local weather and traffic information. This application might be another candidate for the user's home page.

Stock Ticker

Another application most MSO's will want to deploy in the baseline application set is a stock ticker and watching application for getting information about the major market indexes and individual stocks. This application might be a candidate for the user's home page.

Targeted ads

One of the areas of interest to most MSO's is the potential for retail applications that allow the customer to interact with content on the TV and transact directly from the STB. The business driver for this is the potential for new revenue associated with advertising and interactive programming that results in financial transactions.

3.8 Impact to Existing Infrastructure

Tru2Way impacts the cable Head End in multiple ways for deploying Tru2Way, including

- Support for Multi stream CableCARDS
- Delivery of System Information (SI) in legacy and DOCSIS Settop Gateway (DSG)
- Tru2Way application signaling

There are several changes to the Head End hardware and software that will be needed so that Tru2Way can be supported.

CableCARD

To support Tru2Way the features such as CableCARD modes, passing of IP based traffic between the CableCARD and host as well as decrypting multiple streams for host need to be handled in the CableCARD. One important aspect of video is to ensure the conditional access related features are handled as expected and communication between STB and all back office systems operates as expected.

Carousel

When we deploy Tru2Way infrastructure, the MSO's need to consider implementing a carousel to deliver application and data (EPG, configuration files, etc), device code download, application signaling, code download signaling, EAS file delivery and even SI. All the above mentioned items are generated based on SCTE and CableLabs standards and delivered to Tru2Way STB over appropriate medium (DSG / Legacy OOB).

Considering the delivery of all items over DSG the infrastructure should be appropriately configured, which includes the CMTS, networking (all that comes from source to destination), and the carousels themselves. Configuration of a carousel is most challenging due to the interpretation of the specification and the differences between STB developers.

Network changes

The rollout of Tru2Way will require many of the following changes to the network. Here are some of the typical changes that we have seen deploying Tru2Way at Cox:

- STB should access the carousel and application server infrastructure that provides application data

- STB to Head End for delivery of SI
- STB to code upgrade infrastructure
- STB to Guide back office infrastructure
- EAS delivery infrastructure to CMTS

An important task is to identify the different types of data that are provided to the STB under the following categories: Real time data (such as XAIT, CVT), important but non-real-time (such as applications, EPG data) and transactions (such as VOD, bill pay, email, chat, tickers). Based on the identified traffic the configurations should ensure appropriate service levels.

A requirement that comes with Tru2Way in Cox deployments is that a standard networking and operational approach must be implemented for Tru2Way. What we mean here is the devices, method of configuration and configuration itself needs to be similar if not the same across the network. This approach avoids complex integration and the configuration anomalies of different systems, simplifying the operation and maintenance of the network. The network components such as switches, routers and backbone should provide the same functionality in all systems uniformly so that the Tru2Way system can operate uniformly. This is a key design principle in the Cox approach to Tru2Way rollout: simple, standard, uniform network design works best.

DSG implementation

The Tru2Way STBs can provide DSG services that Cox takes advantage of to allow

- STB to get Head End data like SI, EMM, CVT, XAIT over the DSG tunnels
- Customer to use the device for IP applications where the application and its associated data is delivered over DSG (either through tunnels or over HTTP)
- MSO to configure CMTS tunnel to provide two way IP interactions

SI delivery

With Tru2Way and DSG the System Information (SI) needs to be delivered to STB over the DSG broadcast tunnels delivered via the CMTS. The simplest way is to deliver the SI that originates from the Head End. An alternate approach is to generate SI information from custom back office servers to the DSG tunnels.

Application delivery

Delivery of applications to the STB will require some planning. At a minimum the MSO will want to be able to manage the baseline applications on the STB and be able to apply patches and upgrades. In some cases the rollout will provide for applications that can be downloaded to the STB.

Monitoring Tools

With the introduction of many subsystems to support Tru2Way, the MSO will need to identify the systems, subsystems and hardware that need constant monitoring so that any failures can be proactively detected and addressed before customers are impacted. The carousels, EPG importers, parsers, application servers (that deliver applications or huge chunks of data to STBs), provisioning systems, CMTS, network elements, caching systems, STBs and VOD systems will all need constant monitoring. Monitoring could be done in various ways based on the needs like

- Automated health checks over constant period of time (Polls)
- Looking for alerts (like SNMP alerts) when failure occurs
- Real time manual monitoring based on needs or particular events

Methods and procedures for the monitoring team must be clearly defined so that failure alerts are addressed even before customers experience the failures. The operations group has tools that allow them to monitor the network.

With the Tru2Way devices that will be deployed across the network there is a need for additional monitoring and tools that are designed to help the operator manage Tru2Way devices.

Troubleshooting

As with any new technology, Tru2Way comes with its own set of issues and challenges. Some of these can be anticipated and planned for but in any real deployment there will be unanticipated problems. Engineers, operators and support staff will need to plan for capturing the body of knowledge needed to effectively address issues as they arise and to leverage this knowledge base to simplify procedures and apply standard solutions to known problems.

3.9 Transition Plan to Tru2Way

The transition plan to Tru2Way is needed when the existing hardware currently supports legacy software but is capable of supporting Tru2Way. This applies to STBs, and other sub systems like VOD and CMTS. Each of the components has to be individually analyzed and a transition plan is made such that there is no breakdown in service while the upgrade or new configuration is implemented.

Better integration, navigation, performance

Tru2Way devices have hardware and software built to the specification. This makes integration easier (compared to legacy system integration). The only challenge is the interpretation of specifications and ambiguous items. The whole integration is not such a nightmare as it used to be. With standards in user interface using HAVI the user interface becomes portable, backward and forward compatible and may offer enhanced audio/video functionalities irrespective of manufacturer. These user interface advantages help the MSO and application developers to provide consistent experience across a range of devices.

Support for multiple back-ends / Head Ends

Larger operators must be able to support hardware and software from a variety of vendors, as their Headend and backend system varies. This makes the work more challenging because the solution must work across multiple configurations.

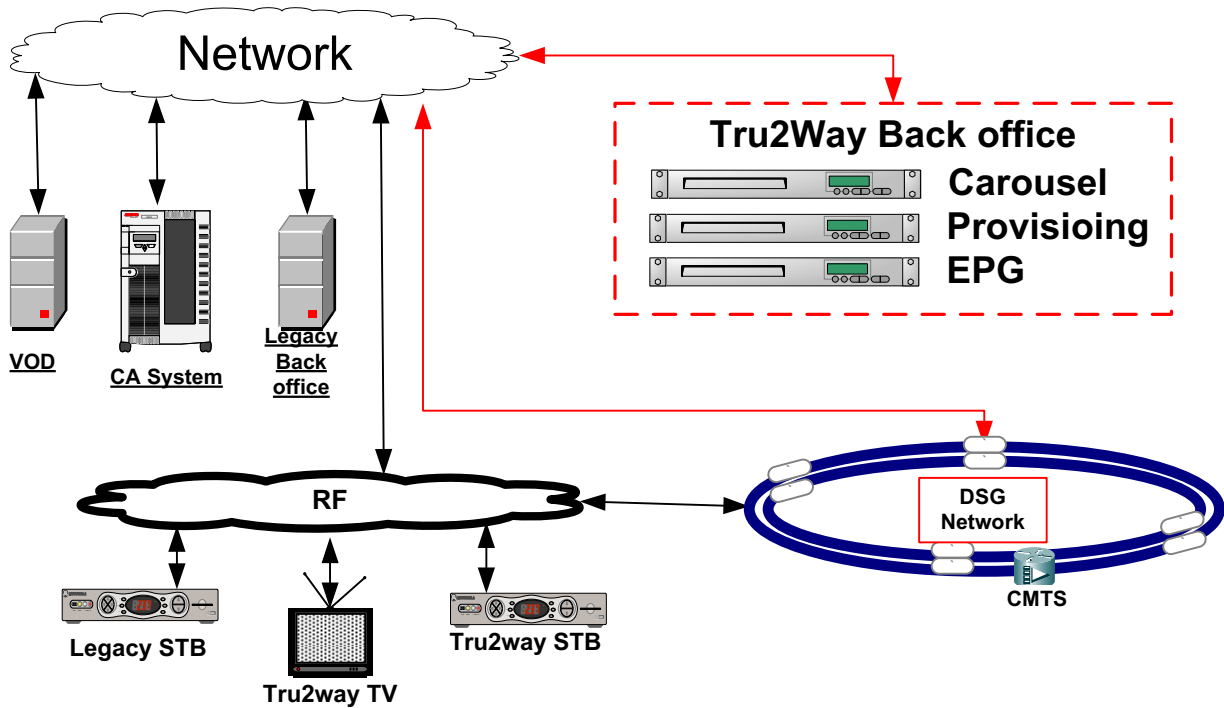
Retail equipment

As Tru2Way is deployed the retail market for devices that are Tru2Way capable will continue to grow. These devices present additional complexity and challenges.

3.10 No Impact to Existing Services

It goes without saying that all the services offered and supported today would continue to function during and after the Tru2Way transition. Every aspect of the system is built, upgraded or modified such that legacy and Tru2Way solution can exist and do not step on each other. Customers must be provided with uniform services and preferably uniform experience irrespective of the technology used.

The diagram below provides a generic MSO system which has legacy and Tru2Way supported simultaneously



4 Operations Issues

A number of issues in the Operations area will need to be addressed in order to successfully roll out the Tru2Way capabilities to customers. This section provides an overview of these issues.

4.1 Billing

The existing provisioning system will need new workflow process implemented to support Tru2Way. Since the components have well known data (STB, cable modem, cable card – serial numbers and MAC) we can try automating the workflow and simplifying the manual steps. The Tru2Way service may be offered in tiers with different pricing for levels of service. The pricing and special offers that will be needed during the rollout period must be specified and the billing system will need to support the changes so that customers do not see errors on their bills due to the rollout. The staff will need to be trained on how to accomplish the changes needed to convert a customer from their current service plan and equipment to the Tru2Way service and equipment.

4.2 Support for Tru2Way Rollout

Operations will need to be able to support the rollout of Tru2Way when the deployment begins. Training on the new equipment will be needed and standard operating procedures will need to be updated to reflect any new procedures. Engineering should ensure all the methods and procedures are documented and provided to the support team with adequate training. Also, involving the support team during the trail phases will be very useful as they can begin to identify the differences in architecture, process and procedures which need to be addressed.

4.3 Support Retail

Operations will need to be able to detect and support retail equipment that is added to the system by the customer. Supporting retail devices involves more preparation such as

- Ensuring the stack would work fine with the library and applications of the MSO
- Ensuring the device is supported by provisioning and billing system of MSO to support authorization
- Ensuring the code upgrade of the device (firmware) is handled
- Customer support and service have all information and tools they need to support customers

4.4 Provisioning Must be Coordinated

Provisioning of the equipment must be coordinated with the rollout so that the customer has a simple, painless experience during the install process. The challenge to the MSO's is to keep all the technology and complexities away from the user experience. Remember the objective is to enhance the experience and not make it painful.

During legacy days the only item to consider was to provision and manage the conditional access. Tru2Way gets the conditional access along with host, normally tracked using the MAC's of host and / or cable modem.

4.4.1 Host Serial and MAC addresses

The system changes must be in place to allow new devices to be provisioned including the new models of hosts and CableCARDS. The authorization information should be accessible to the video infrastructure, CMTS, VOD and other back office systems based on the requirements.

Following are the numbers that come available with Tru2Way host, CA serial Number, CA MAC, Host Serial Number, Host MAC, Cable Modem MAC, Host ID, and custom data based on CA infrastructure. The needed information should be appropriately entered and handled.

4.4.2 Device activation and control

As the devices are deployed in the network each will need to be properly activated in order to complete the installation process. Activation involves authorization of the Conditional Access and Cable Modem. The

activation of devices will need to be planned so that this process goes smoothly, is efficient and can be done in a minimal amount of time.

4.5 In-home installation

Execution of the rollout will mean in-depth planning of the installation process, preparation of the MSO network to support Tru2Way, making RF network ready for Tru2Way, and planning for installing Tru2Way devices in the customer's home. This section discusses some of the areas of focus that are important for success. Home installers should have all necessary tools to troubleshoot the installation progress and perform any action needed on the infrastructure to complete the install.

To reduce the install duration, self install training videos preinstalled in the box or providing On Demand troubleshooting videos would be considered.

4.5.1 Gather the Needed Information

Lots of information is needed to successfully deploy to the customer's premises. The in-home installation involves interaction with the customer and brings terms and technology into the home that are unfamiliar to the customer. The customer experience will be greatly improved if the operator has collected all the needed information prior to scheduling the installation. This is done by using the existing customer information and adding all other data that will be needed to deploy services to the home.

If there is no way to obtain all the information without asking the customer or finding the information by being onsite, then the plan must make this efficient and simple for the customer.

Most operators will want to deploy using an automated voice recognition system that walks the customer through the steps needed to activate their devices. This type of plan helps to keep costs down and provides tracking information that is captured through the use of the system.

Custom diagnostic and installation applications may have to be written and/or deployed in order to ease the setup and configuration process in customer's home. This is true for self install as well as technician installs.

4.6 Troubleshooting

Troubleshooting procedures must be developed and communicated. Escalation procedures need to be reviewed to ensure proper escalation among CSRs, local and national support and engineering teams as well as vendors.

Troubleshooting procedures must include a way to quickly identify cause of the problem – is it a stack problem, a guide problem, an application problem? Is it a network problem?

With the availability of MIBs for Tru2Way devices we have very good information about the devices while troubleshooting. The system should be built such that the MIBs are walked in an automated manner for monitoring and statistics.

4.7 Trials

Every MSO chooses a subset of requirements and performs some level of trials in their market to get lessons learned and gaps identified so that they can plan for wide deployment of Tru2Way. Since the introduction of Tru2Way is a significant change in the way that cable service is delivered the trial helps the MSO's to arrive at a detailed plan for Tru2Way rollout.

Trials provides first hand experience of what Tru2Way introduces - good and bad - so that MSO's can improve the architecture, solution, technology, support model, troubleshooting mode and prepare for larger deployments. All the parties involved (device provider, Head End provider, application developer) also get to know their shortfalls and areas of improvement before they get ready for the actual battle. Though the inter-ops of the CableLabs are also used to address this, the MSO specific items are highlighted in the trials.

4.8 Use Lessons Learned

While performing trials all the issues, process deviations, wrong assumptions, unmet requirements, feedback and blunders are captured. Even the feedback from engineering, field, test users are gathered into a report. The report is then used as input for a retrospect document which helps Cox to make necessary changes where needed. The device manufacturers are able to identify the gaps of their STBs so that they can close the Tru2Way implementation gaps, improve performance and fix the identified software issues.

4.9 Engineer Training on Tru2Way

The Cable industry is used to operating hardware and software for a long time so any new introduction is seen as a risk due to the lack of awareness of what it entails and other factors. A thorough training program must be put in place that includes

- Architecture and overview of Tru2Way solution
- Operation and maintenance of new back office components (carousels, EPG server, ...)
- Changes and new features to existing solutions
- Advantages of Tru2Way
- Comparison of existing solution against Tru2Way
- How similar and how different Tru2Way is to existing solution
- Methods and procedures for installation, configuration, troubleshooting and maintenance
- STB/stacks and known differences among the supported STB/stack combinations

4.10 Training of Support Group

Introduction of new technology involves training the existing training staff and also training on new tools and systems that are being introduced. The changes may dramatically affect the organization as it may totally differ in approach and concept.

4.11 Consumer Equipment Upgrades

Though all of the equipment is manufactured based on standards, it will be relatively new to Customer Support and Operations. MSO's should not choose to swap a considerable volume of equipment unless there is a pressing need to do so. Other training area to consider is how well skilled the staff of customer support call center, engineering, customer care when Tru2Way is launched. To provide good service in all areas we would need a bake time of 6 to 12 months where not many customers are using Tru2Way devices so that the infrastructure, process, procedures and people skills come to a point where they would be ready to support more customers.

5 Cox Tru2Way Experiences

This section provides an overview of the experiences that Cox has had in implementation of Tru2Way over the recent past.

5.1 DOCSIS/DSG

The rollout of DSG for two way communication of set top boxes can be challenging for a couple of reasons. First MSO's infrastructure needs to accommodate spectrum for video services and additionally add spectrum for DSG. The fact is, existing cable wiring in many homes is old and may not have adequate RF levels to support DSG without changes to home wiring. Even homes that currently use cable modems for data services has separate run feed. Hence to confirm DOCSIS/DSG communication of set top boxes, RF issues at homes are important concern that needs attention. DSG/DOCSIS specification is open to interpretation, especially the external interfaces to Head Ends, STBs, and back office servers. This makes integration a challenge – especially when MSO's buy products from variety of manufacturers. Hence during the Tru2Way trials, Cox decided to closely monitored DSG implementation and handle Tru2Way rollout in an independent phase

5.2 Centralization of Management

Tru2Way introduces standard delivery of services which intuitively introduces standard back office support for Tru2Way. Since MSO's will be rolling out the service in multiple locations, there is an advantage to centralize the management of the service to consolidate policy and service offerings in a single, centralized management facility. There are many hidden issues related to the normalization of services across the various locations and time zones, Channel management and uniformity, consolidation of service offerings and service naming. Once all the issues of centralization are addressed, it adds value and saves time and effort. Cox is taking this approach to managing services associated with Tru2Way.

5.3 Software and Hardware issues

Like other MSO's, Cox would like to continue to get revenue from existing legacy STBs that are already deployed so the infrastructure must support both legacy and Tru2Way devices until all legacy devices are decommissioned. To achieve this Cox had to go back to the vendors and get the architecture of the systems modified such that legacy and Tru2Way can be supported simultaneously. Some examples are VOD, EAS, Conditional Access and Billing. In all these areas the legacy equipment will continue to operate on the existing VOD system. Since vendors involved have their own priorities and may not agree to required timelines from MSOs, partnerships should be carefully established to ensure win-win scenarios for everyone involved. Several software patches and configuration changes were needed, and the cost and management of distributing these had to be worked out through these established partnerships. These actions added additional costs and time, which should be considered early in the planning stages.

5.4 Changes to Provisioning System

It was challenging to get the provisioning workflow as needed to have cable system and data network (for embedded cable modem) and optimizing for efficiency. The need to automate the workflow and simplify the manual steps took several iterations before the system was in an acceptable state, provisioning equipment correctly and efficiently. The main challenges were in getting the process working such that boxes transitioned between legacy and Tru2Way.

5.5 Phased Rollout

Considering simultaneous update of cable infrastructure, a phased method of upgrade is acceptable by the local markets and becomes manageable for the corporate needs. The critical elements of Tru2Way rollout are identified as 'Must' implement and the remaining elements are categorized as 'Like to have', 'Recommended' items. Generally the 'Must' have's are Head End, two way communication (CMTS and network for DSG) Tru2Way carousels, Tru2Way back office (EPG, search, etc) are provided to DOCSIS and Tru2Way teams for implementation.

6 Lessons Learned

This section provides a summary of the lessons learned at Cox in deploying Tru2Way.

6.1 Adequate and Complete Planning

Considering the complexity and sheer volume of the tasks involved in Tru2Way deployment, any kind of meticulous, detailed planning is highly challenging to make it adequate. There are multiple of programs and project components to consider such as product strategy, device / host architecture, application development, provisioning, field upgrades, integration testing, quality assurance testing, support, training, customer care and more. The challenge to the MSO's is to coordinate the activities between inside and outside partners to ensure all plans are in sync and information is flowing between constituents. We should also consider that the MSO needs to continually support its entire customer base without any interruption. The team should be strong in people, technical, project management, and organizational skills to ensure project success.

6.2 Length and Unpredictability of Integration

Hurdles can be categorized into controllable and uncontrollable hurdles. Some uncontrollable items to list are host stack implementation (for specification and stability), conditional access issues, CMTS issues, issues that needs to be addressed by external parties, etc. Application developers, cable card vendors and CMTS vendors hugely impact MSO's deadlines. Due to these uncontrollable items the integration of host with application and Tru2Way back office takes a long time to achieve.

6.3 Third Party Communication

With the variety of vendors and third-party partners required to develop and assemble the components required for Tru2Way, it is imperative that the disparate quality and issue-tracking systems be synchronized to the extent possible in order to ensure project and quality issues are properly managed. Tasks, defects, project deliverables must be monitored and managed by all parties, with solid communication across party lines. This should be managed by either the MSO or an appointed 3rd party contracting agency.

7 Conclusion

The most important factor to consider is the importance of teamwork. Some of the factors included are MSO's dedication in support for Tru2Way, technical excellence of Cable Labs, MSO, device and application developers and Head End / CA providers.

Cox has committed to rolling out Tru2Way to its customers and is well down the road in fulfilling that commitment. We have invested considerable capital, resources and time needed to reach a point where the business value begins to be realized. Moreover, we are positioning the company to take advantage of Tru2Way technology in the months and years ahead.

8 Appendix A – Glossary of Acronyms

Term	Definition
OCAP	Open Cable Application Platform
DSG	DOCSIS Set-Top Box Gateway
DOCSIS	Data Over Cable Service Interface Specification
CA	Conditional Access
STB	Set Top Box
eCM	Embedded Cable Modem
MSO	Multiple Service Operator
DVR	Digital Video Recorder
MR DVR	Multi-Room Digital Video Recorder
MAC	Media Access Control address
CMTS	Cable Modem Termination System
SI	System Information
MoCA	Media over Coax Alliance
DLNA	Digital Living Network Alliance
PIP	Picture in Picture
CVT	Coordinated Video Timing
EPG / IPG	Enhanced Program Guide / Interactive Program Guide
HAVI	Home Audio Video Interoperability. Firewire to control Audio and Video