CWMP BOF

June 5, 2012

Webster, NY

PWG F2F Meeting

Agenda

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  - CWMP Overview – more details
  - Why use CWMP for Printers/MFDs?
  - Benefits of CWMP for Printers/MFDs
  - Collaboration Approach
  - CWMP Functionality
  - Celstream's Print Service Attribute Table
  - Previous meeting slides for backup

CWMP BOF Overview

- CWMP is a standard internet application protocol developed by Broadband Forum (BBF).

- CWMP allows all IT devices in a customer's premise be remotely managed by a central Auto-Configuration Server (ACS) over the Internet.

- CWMP BOF is providing guidance for developing the standard CWMP data model for Printers and MFDs directly based on PWG Semantic Model.

- CWMP data model allows Printers and MFDs of all brands to be remotely deployed, installed, and managed through entire life cycle like other IT devices (routers, servers, PCs, smart phones, etc.).

- Once CWMP data model for Printers and MFDs has been developed, BBF members from PWG should propose the data model to BBF as a standards project.

CWMP Overview

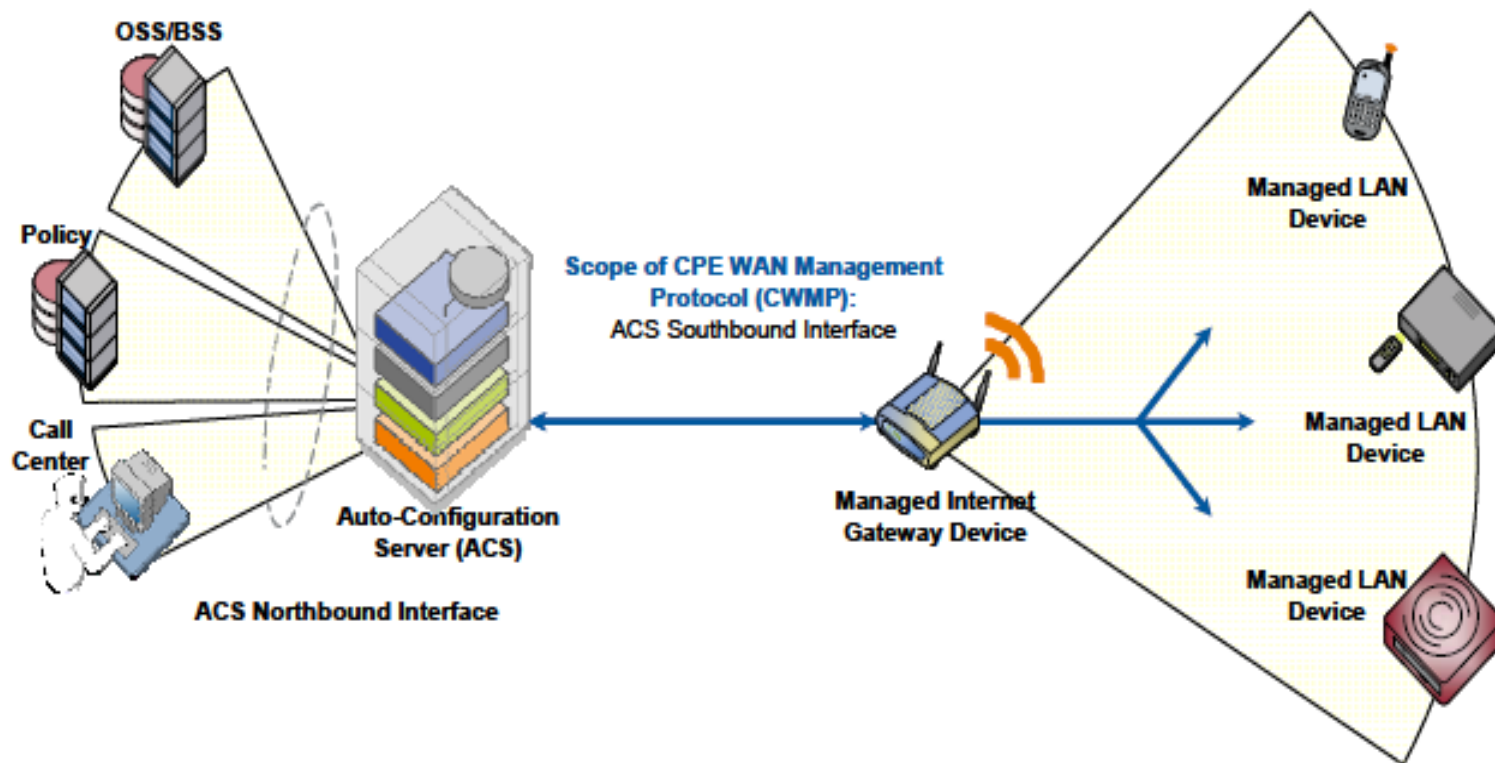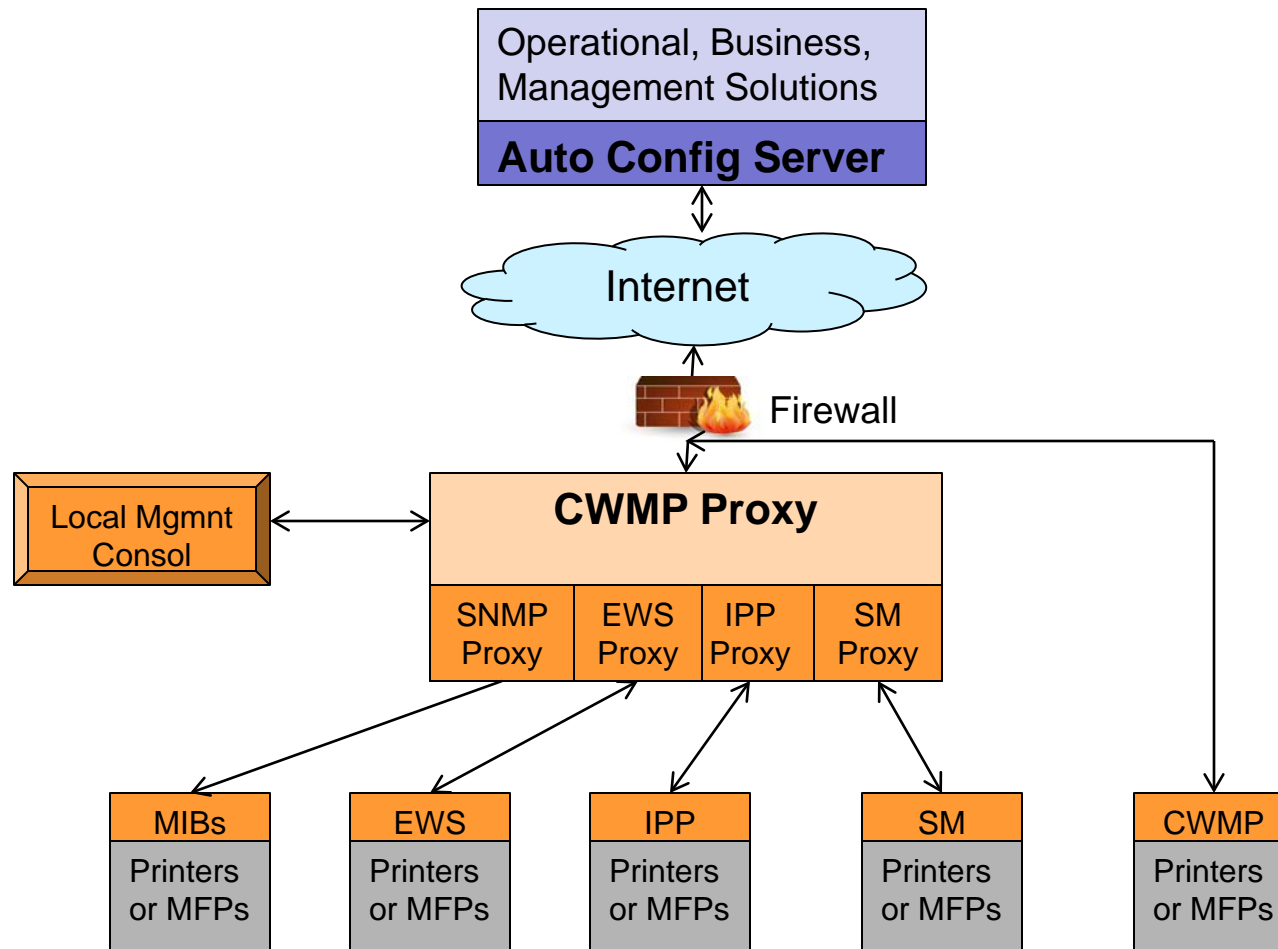The following figure places TR-069 in the end-to-end management architecture:

Figure 1 – Positioning in the End-to-End Architecture

- Standard interfaces to policy servers, call centers, and business applications (e.g. OSS/BSS/CRM)
- Strong security – transaction confidentiality and data integrity

CWMP Management for Printers/ MFDs – an example architecture

Current Activities

- Develop PWG whitepaper on CWMP for Printers and MFDs
  - Rationale for developing the standard model
  - Guidance for remote management of Printers and MFDs via CWMP
  - Guidance for CWMP Data model for Printers and MFDs
    - first phase, for Printers based on the BBF Data Model Template for CWMP-Enabled-Devices (TR-106)
    - second phase, for MFDs.
  - Guidance for CWMP Proxy implementations that communicate with Printers and MFDs using their native IPP, SNMP, web services, etc.
    - Mapping of SM elements to IPP attributes for Print Service
    - Mapping of SM elements to Printer MIB objects for Print Device

- Develop translation tool for mapping PWG SM to CWMP data model – first Print Service – second MFD

- Incrementally prototype and demonstrate CWMP data model for Printers via a CWMP proxy and an embedded CWMP client emulator for Printers.

Status

- Machine translation of PWG Print Service XML Schema to TR-106 based CWMP Print Service XML Schema is complete w/ optimization issues for the future. Thanks for Celstream engineering team's impressive speed!

  - Data model translation document, XML schema, and code – reviewed at February 2012 PWG meeting.

    1) Document: "Translation of PWG Semantic Model to CWMP Data Model"
    ftp://ftp.pwg.org/pub/pwg/BOFs/cwmp/cwmp-pwgsm-to-cwmpdm-20120204.docx
    2) Presentation slides of 1)
    ftp://ftp.pwg.org/pub/pwg/BOFs/cwmp/cwmp-pwgsm-to-cwmpdm-20120204.pdf
    3) Translated XML file of CWMP Data Model
    ftp://ftp.pwg.org/pub/pwg/BOFs/cwmp/cwmp-data-model-20120130.xml
    4) Translator code:
    ftp://ftp.pwg.org/pub/pwg/BOFs/cwmp/cwmp-translation-dm-20120204.zip

Status

- Updated Whitepaper –

  "CWMP Data Models for Printers and MFDs"
  ftp://ftp.pwg.org/pub/pwg/BOFs/cwmp/white-cwmpmfdmodel10-20120604.pdf

  - Updated "PWG SM PrintService Model" to add ISSUE for System object (based on Thinxtream feedback from CWMP Proxy effort)

    - System object includes SystemTotals, Power Management, Configured Resources, and Configured Subunits.

  - Updated "PWG PrintService to IPP Proxy Guidance" subsection of "CWMP Proxy Implementation Guidance"

    - "PWG PrintService to IPP Proxy Mapping" table covers the mapping of key remote management elements from PWG Semantic Model Print Service attributes to IPP Print Service attributes documented in RFC 2911, RFC 3381, PWG 5100.x, and IPP JPS3.

    - This mapping table has been very helpful for prototyping of Thinxtream's IPP proxy.

Status

- Thinxtream originally provided a list of management elements for Printers implemented in a CWMP proxy for Printers using SNMP (Printer MIB) and HTTP (EWS).

- Thinxtream first implemented the PWG standard CWMP data model (machine translated from PWG SM) for Printers in the CWMP proxy.

- Thinxtream next demonstrated that a local or remote CWMP management app can access the PWG SM Print Service / Print Device properties in the CWMP data model via the CWMP proxy using SNMP and HTTP.

- Thinxtream recently enhanced their CWMP proxy to access Print Service properties via IPP.

CWMP Proxy source of data

Parameter	Source	Access	PWG SM compliant CWMP DM
Serial Number	SNMP	Read	…PrintServiceStatus.SerialNumber
Device Description	SNMP	Read	…PrintServiceDescription.ServiceInfo
Memory Capacity	SNMP	Read	…PrintServiceConfiguration.Storages.Storage.{i}.StorageStatus.StorageSize
Contact	SNMP	Read-Write	…PrintServiceDescription.OwnerVCard
Location	SNMP	Read-Write	…PrintServiceDescription.ServiceLocation
MAC Address	SNMP	Read	…InterfaceStatus.InterfacePhysicalAddress
Front Panel Display	SNMP	Read	…ConsoleDescription.ConsoleDisplayBuffer.ConsoleDisplayText
Printer Color	SNMP	Read	…PrintServiceDescription.ColorSupported
Printer Status	SNMP	Read	…PrintServiceStatus.State
Toner Levels	SNMP	Read	…MarkerSupplies.MarkerSupply.MarkerSupplyDescription.MarkerSupplyCurrentLevel
Tray status	SNMP	Read	…InputTrayStatus.SubunitStatus.SubUnitState
General Page Count	SNMP	Read	…PrintServiceCounters.MediasUsed.MediaUsed.{i}.MediaUsedTotalSheets
Default Orientation	IPP	Read-Write	…PrintServiceDefaults.DefaultPrintJobTicket.PrintDocumentProcessing.FeedOrientation
Default Number of sides	IPP	Read-Write	…PrintServiceDefaults.DefaultPrintJobTicket.PrintDocumentProcessing.Sides
Default Print Resolution	IPP	Read-Write	…PrintServiceDefaults.DefaultPrintJobTicket.PrintDocumentProcessing.Resolution.Units
Default number of copies	IPP	Read-Write	PrintServiceDefaults.DefaultPrintJobTicket.PrintDocumentProcessing.Copies

Next Steps

- Continue to update the whitepaper.

- Update and enhance the PWG SM to CWMP data model machine translator whenever necessary.

- More progressive prototyping with demonstration of CWMP data model for Printers connected to a CWMP proxy via IPP, SNMP, and HTTP.

- Next teleconference: Friday June 22, 10am EDT?

Supplements

CWMP Overview

- CWMP (CPE WAN Management Protocol) is a Broadband Forum standard (TR-069) that defines a set of WAN management interfaces between an Auto-Configuration Server (ACS) and a set of CWMP-enabled CPEs (Customer Premise Equipments)

- CWMP supports service contract based **remote** and **secure** management and provisioning of CPEs *throughout their entire lifecycle* – **deployment, installation, management, and support**

- CWMP supports all of the following functionality via an ACS:
  - Auto-configuration and dynamic provisioning of CPEs and services
  - Software/Firmware image management of CPEs
  - Software module management of services
  - Status and performance monitoring of CPEs and services
  - Diagnostics execution and reporting of CPEs
  - Standard interfaces to policy servers, call centers, and business applications (e.g. OSS/BSS/CRM)
  - Strong security – transaction confidentiality and data integrity
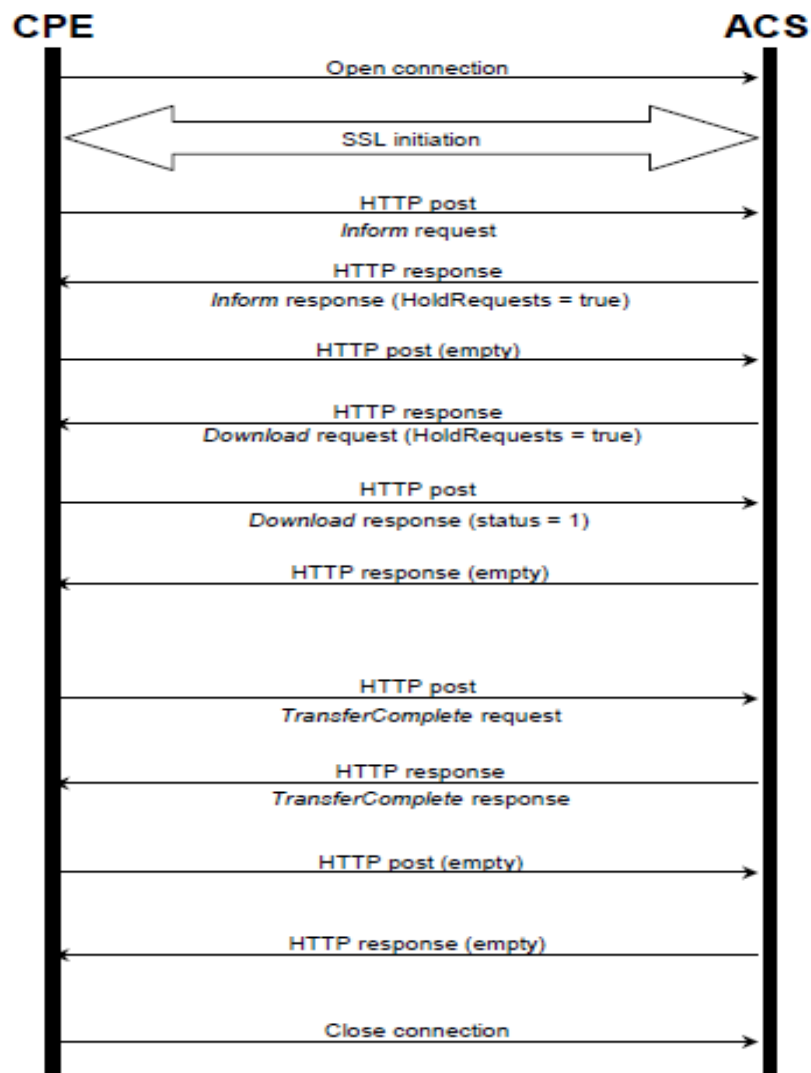
CWMP Overview

- Protocol message exchange: SOAP over HTTP 1.1

- Security Mechanisms
    - TLS 1.2 or higher is RECOMMENDED
    - Alternative authentication using shared secrets via HTTP is also supported for lower security environments

- Data Model
    - Data hierarchy
        - Root object: "Device" – common objects (in TR-181)

            – components (in TR-143 & 157)

            – single "Services" object
        - Each Service Object – objects

            - sub-objects

                - parameters

    - Object Versioning – two integers (ObjectName:Major.Minor)
    - Profiles – define conformance requirements for object

CWMP Overview – cont'd

- **An example CWMP protocol exchange sequence**
  - ACS initiates a short file download, and CPE sends a TransferComplete later in the same session
  - This happens in parallel when CPE still performing on-going CWMP session - hence ACS needs to set HoldRequests to true until it has completed sending all requests to the CPE

*Note: Figure 4 is copied "verbatim" from BBF TR-069.

Figure 4 – Example with the ACS using HoldRequests equal true

CPE	ACS
Open connection →
← SSL initiation →
HTTP post *Inform* request →
← HTTP response *Inform* response (HoldRequests = true)
HTTP post (empty) →
← HTTP response *Download* request (HoldRequests = true)
HTTP post *Download* response (status = 1) →
← HTTP response (empty)
HTTP post *TransferComplete* request →
← HTTP response *TransferComplete* response
HTTP post (empty) →
← HTTP response (empty)
Close connection →

Why use CWMP for Printers/MFDs?

- In recent years the telecom industry and IT MSPs have migrated to using CWMP to remotely and securely manage and provision all kinds of devices in home, SOHO, SMB, and enterprise environments based on service contracts

- CWMP is supported in routers, bridges, cable modems, DSL modems, and Internet/residential gateways, set-top boxes, IP phones, cell phones, storage devices, PCs and laptops

- Standard CWMP data models for Printers and MFDs are important – to ensure interoperability of all CWMP-based solutions across all imaging products

- Devices supporting CWMP-based management must implement:

  - A set of standard interfaces between ACS and all CPEs

  - CWMP device data model(s) to expose device/service info to ACS

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Benefits of CWMP for Printers/MFDs

- Enables Telecom and IT MSPs (Managed Service Providers) to include Printers/MFDs in their service offerings.

- Enables MPS (Managed Print Service) providers to include mainstream IT devices in their service offerings.

- CWMP serves as a common protocol to simplify remote administration and problem resolution for both customers and service providers.

- Customers benefit since they are no longer locked into one vendor for their IT devices.

- Advanced remote management capabilities help reduce service dispatch and other customer support costs.

Collaboration Approach

- PWG and Thinxtream participants collaborate closely
  - CWMP BOF calls at 8am US PST 11am US EST on Friday roughly bi-weekly (w/ participation of Bangalore engineers)
  - CWMP whitepaper updates to document technical progress
  - Architecture and pseudo-code for machine translation tool
  - New focus – Printer data model for first phase

- Current CWMP BOF participants
  - PWG: Ira McDonald (Samsung), Nancy Chen (Oki Data), Bill Wagner (TIC)
    - **Others are welcome!**
  - Thinxtream: Ranga Raj (CTO), Anil Takkar (Product Manager), Laxman Bhat, Subramanyan Krishnan, Nagaraj Ghatigar

CWMP Functionality

- Auto-configuration and Dynamic Service Provisioning
  - At the time of CPE connection
  - Re-provision and re-configure at subsequent time
  - Asynchronous ACS-initiated re-provisioning
  - Based on the requirements of a specific CPE or on collective criteria, e.g. vendor, model, software version, etc.
  - Straightforward future extensions

- Software/firmware image management
  - ACS initiated and optional CPE initiated download of img file
  - Version identification
  - Notification of download success/failure

CWMP Functionality – cont'd

- Software module management
  - Install, update, uninstall software modules in CPE
  - Notify ACS of success/failure
  - Start and stop applications
  - Enable/disable execution environment
  - Inventory software modules available

- Status and performance monitoring
  - CPEs make information available to ACS for monitoring
  - ACS monitors CPE's status and performance statistics
 - CPE actively notifies ACS of change to CPE state

CWMP Functionality – cont'd

- Diagnostics reporting
  - CPEs make information available to ACS for diagnostics
  - ACS diagnoses and resolves CPE's connectivity/service issues
  - ACS instructs CPEs to execute defined diagnostic tests

- Standard interfaces to operational/business support systems, policy servers, and call centers for:
  - Order fulfillment
  - Billing
  - Subscriber management
  - Change management
  - Manufacturer management
  - Service level agreement management
  - Performance analysis

CWMP Functionality – cont'd

- Protocol Stack Requirements

Figure 2 – Protocol stack

| CPE/ACS Management Application |
| RPC Methods |
| SOAP |
| HTTP |
| SSL/TLS |
| TCP/IP |
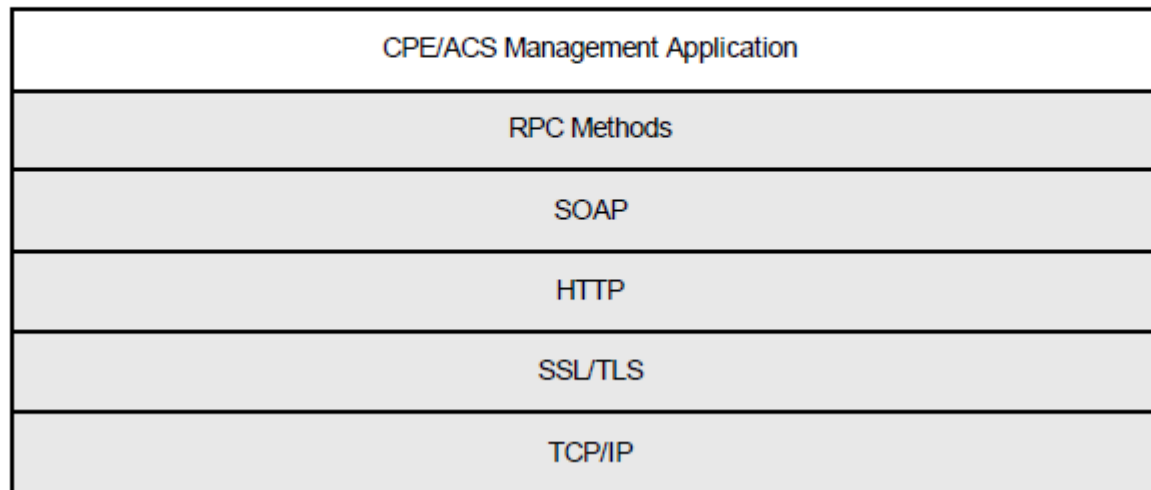
*Note: Figure 2 above is copied "verbatim" from BBF CWMP (TR-069)

CWMP Functionality – cont'd

- Security Mechanisms
  - Use TLS/1.2 for secure transport between CPE and ACS (RECOMMENDED)
    - Provides transaction confidentiality, data integrity
    - Supports certificate-based authentication of CPE and ACS
  - Alternative authentication in HTTP layer between the CPE and ACS – based on shared secrets

Status

- Review issues of the first Machine translation

  - How to fill "Access" attribute of parameters and objects?
  - How to fill activeNotify, forcedInform and requirement attributes for translated objects and parameters?
  - How to fill description text of objects? manually? Skip?
  - Naming optimization needed
  - How to translate "choice" in complex type?
  - How to translate "union" member types – either NMTOKEN or string => all string?
  - How to take advantage of object-oriented structure for CWMP data models used in BBF CWMP namespace

Status

- Guidance whitepaper in progress – "Broadband Forum CWMP Multifunction Device Data Model"
  ftp://ftp.pwg.org/pub/pwg/BOFs/cwmp/white-cwmpmfdmodel10-20111205.pdf

  - Considering the following changes in CWMP data model –
    - Power Management elements:
      - Read-only Power Log to be added to Processor subunit
      - All other power management elements already in all subunits
    - Support of Capabilities but not CapabilitiesReady
    - Add CapabilitiesFactory:
      - "as-shipped" capabilities of the device, before any site admin configuration
      - For recovery of factory defaults when necessary
      - Read-Only
    - No MediaColDatabase: just Media and MediaType
    - Exclude ActiveJobs (but keep JobHistory):
      - Focus on Service and Device management (instead of full MPS)

Status

- Celstream has provided a top-level list of management elements for printers implemented in a CWMP proxy.

- Received a list of Printer management elements generated in the WIMS WG to be considered in PWG SM –

  ftp://ftp.pwg.org/pub/pwg/wims/white/Management_elements-20120116.pdf

  - Observed that printers and MFDs have more network configuration elements than what are included in the common device data model of BBF CWMP.

  - Will consider including additional printer network and font configuration elements added to PWG SM when that occurs.

- Future – BBF CWMP Data Model for Printers (TR-xxx)
  - BBF members (from PWG) should propose a new BBF project

Status

- Current approach for BBF data model for Printers
  1) Define translation rules for PWG complex datatypes and element groups
  2) Machine-translate all PWG SM XML schema well known values and datatypes into control files for the tool
  3) Machine-translate the PrintService subtree of the PWG SM XML schema into the equivalent BBF model/object/sub-object/parameter statements, with BBF parameters mapped one-to-one from PWG SM simple XML elements.
     - **Thinxtream software team has developed the first version of machine-translation tool**
  4) Hand-edit machine-translated CWMP data model to fix artifacts and add XML documentation (e.g., PWG SM mapping notes)
     - **Ira, Nancy, Bill, Pete (?) and perhaps others to ensure the closest mapping from the PWG semantic model XML schema**

Thinxtream Embedded Stack

- POSIX compliant cross platform implementation
  - Tested on Embedded Linux and VxWorks
  - Can work on other RTOS platforms
  - Implemented in C

- The distribution has TR069 and gSOAP stack
  - If device has inbuilt gSOAP, then TR069 stack can use existing gSOAP implementation

- The "Interface Manager" is a device specific implementation to handle device status and configuration parameter values besides other CWMP functions

- Stack size
  - TR069 Size: ~300 KB, gSOAP Size: 177 KB

- Memory usage : ~450 KB