



## In Short

## 1 Introduction

BECS is THE Network Management System to enable automation of Network build-out, Configuration management, Service Activation, Service Provisioning and Resource Management.

PacketFront Software has delivered BECS to approximately 100 customers in more than 20 countries making it a field-proven solution in many network environments. Some examples of BECS native support of network designs are:

- Residential networks based on any technology (for example xDSL, FTTx or WiFi).
- Enterprise networks based on Ethernet or MPLS
- Core networks based on Ethernet or MPLS

As BECS also supports any choice of hardware technology on all network levels from Core down to CPE's, it can be used in practically all networks.

BECS is not only a tool for the technicians to operate the network, but it also provides the Product Management and Sales means to easily create, maintain and document service configuration and bundling enabling:

- Fast service deployment
- Effective service customization
- Complete overview of the service utilization.

Characteristic for BECS is that it is a product ready to use out-of-the-box. Besides being able to keep the initial investment and support costs at minimum, it also means minimized adaptation costs during the lifetime of the product. And we continuously provide new functionality to all our customers as a part of the support.

## 2 Network Challenges

Network Management is one of the largest OPEX costs for an operator. The high maintenance cost is mainly caused by the fact that networks are usually managed either manually or integrated directly towards the OSS/BSS layer. Both of these methods have drawbacks.

### 2.1 Manual Management

Most networks are today managed either manually, or semi-manually by using scripts. Not only time and OPEX consuming, the manual network management creates a number of other challenges, such as:

- Poor, incoherent or sometimes completely lacking documentation
- Configuration errors
- Configuration erosion, i.e. configured but unused resources and ports
- Person specific dependency
- Unique configuration style of the network technicians

### **2.2 Direct Integration**

In this case the network elements, or element managers, are directly integrated with the OSS and BSS systems. Even if this type of integration enables a highly automated network management and service provisioning, it at the same time creates a complex integration matrix. Changes in the network affect the integration between the OSS/BSS systems and the network. The consequences of introducing new hardware are:

- Long time to market
- Expensive integration changes
- Growing integration matrix, i.e. increasing complexity for each change

### **2.3 Network management with BECS**

BECS can be seen as an adapter between the OSS/BSS systems and the network. It abstracts the network for the OSS/BSS layer providing one, network independent, integration point. The OSS/BSS systems do not need any knowledge of the network structure or hardware. Adding a new hardware vendor or element type becomes merely an issue of loading the right element manager to BECS.

Service provisioning systems only need to know service and port id, which BECS translates to correct network configuration adding, modifying or deleting services and resources in all affected elements. This ensures the optimal use of the network resources and minimizes the risk for configuration errors. At the same time BECS provides always up-to-date documentation of the managed network.

## **3 Core Functions**

### **3.1 Scalability and High Availability**

BECS has been designed to meet requirements at any scale – from hundreds to millions of ports deploying any type of network technology.

The architecture of BECS is separated into Core and Cell systems. The smallest BECS deployment supports a network with approximately 1,000 network elements, or 120,000 clients/services. As the network expands, the scale-as-you-grow feature of BECS allows for you to add extra capacity by adding Cells. Each Cell supports an additional 120,000 clients/services.

High availability (HA) allows the network to continue to deliver services in the unlikely event of a fatal hardware or software error. The system modularity combined with the architecture fulfill the demands of a carrier class solution.

The High Availability setup allows both the Core and Cell to be coupled in pairs where each server can be located at separate sites in order to increase the reliability of the system.

### **3.2 Network Management**

BECS automates the complex and time-consuming tasks of configuring and controlling network elements. Initial configuration and software is provisioned to elements when they connect to the network. BECS renders correct configuration based on information like hardware model, element role, network topology and elements location in the network. This allows zero-touch, mass deployment of elements in any network, such as:

- Layer2 networks
- Layer3 networks
- MPLS networks

To minimize the time and complexity of the network creation in BECS, easy to use wizards and configuration templates are used. BECS uses a tree structure to organize the elements and resources.

### **3.3 Service Provisioning**

Service provisioning can triggers numerous updates and BECS automates these tasks, thus reducing manual work to a minimum. Every activation, deactivation or change in a service starts the configuration of affected elements.

The Service provisioning can be done directly in the BECS GUI or via the northbound API. The minimum information required by BECS is the port id, service name and optional service

parameters. BECS will solve how the service is activated hence keeping the northbound system network agnostic.

The services consist of all service characteristics, such as QoS profiles, access-lists and resources, such as IP addresses, VLANs etc.

Services can include dependencies on multiple elements in a network. This means that BECS not only configures the element where the service is located, but also all other affected elements. Some examples of situations where BECS can modify multiple network elements:

- Adding a service to an access node port triggers a VLAN configuration in a CPE and a policy mapping in a BNG node
- Adding a service to an access node port triggers a VPN tunnel creation in MPLS PE
- VPLS modification in a full mesh updates all VPLS end-points automatically

As BECS has a powerful Scripting Engine, it can be used to perform a number of non-network related actions during a service mapping. For example BECS can contact a SIP server to fetch a phone number and other configuration data from a VoIP server during the CPE provisioning.

### **3.4 Resource Management**

BECS automates the use of network resources, such as IPv4 and IPv6 addresses, including definition of IP scopes and management of static and dynamic IP addresses. In addition BECS handles scalar resources, which can consist of any numerical information. Typical scalar resources are e.g. VLANs or AS-numbers. BECS can thus be used to automatically assign and document almost any type of resources.

The resources are organized in a tree structure. A resource, such as a VLAN or an IP address can be assigned on several levels of a network, such as global, network branch, element or interface level. Resources can be configured to be unique or re-usable, so that e.g. IP-addresses never conflict, but VLANs can be re-used in different parts of the network.

The automated resource management guarantees optimal resource utilization, but even more importantly, it guarantees that resource conflicts cannot occur.

### **3.5 Statistics**

BECS provides statistics gathering and performance monitoring for elements, services and resources. The information can be graphically displayed on the BECS GUI, or made available for external systems. External systems can collect the information via BECS message queue at different intervals or use the API for real time data collection.

## **4 Element Management**

BECS provides flexibility in the choice of technology in all network levels from the core network down to CPEs. This is achieved by using Element Managers that can be acquired from PacketFront Software. Adaptations and customizations can be ordered from PacketFront Software or selected partners Professional Services or done by the customers themselves.

### **4.1 Vendor independent**

BECS can manage the entire network, regardless of the used network technologies or element models. The support for a new element type can be achieved by installing a new BECS Element Manager, without affecting the rest of the BECS system or the network.

BECS communicates with the network elements through standard protocols like Telnet, SSH, SNMP, TFTP/HTTP, NetConf or TL1. Alternatively, integration to product specific element managers can be done instead of communicating directly with the elements.

PacketFront offers 3 types of element managers: Supported, Actualizer based and CPE Element Managers.

### **4.2 Supported Element Managers**

PacketFront provides certified Supported Element Managers for most of the common network elements. Such Element Managers are designed and tested by the PacketFront Software. The supported Element Managers are also included in PacketFront Software's standard support agreement.

The Supported Element Managers enable a number of deployment scenarios out-of-the-box. However, if an operator is using a deployment scenario that is not supported by the Element Manager, it is easy to make modifications or add features by using the Actualizer tool.

### **4.3 Actualizer**

BECS includes an optional Actualizer product kit to create and modify element managers quickly and efficiently. With its easy-to-use GUI, Actualizer does not require any programming skills. The user only needs to know how to natively configure the hardware. You simply type the commands and learn BECS the required syntax.

The Actualizer provides means to create a light-weight element manager in a couple of hours. It also enables the network operator to create and modify existing element managers themselves.

### 4.4 CPE Management

The CPE Element Managers generate unique configuration for the CPEs. The configuration may include base information, such as firmware version, VLAN and IP addresses, but also service related configuration, such as VoIP, CaTV or WiFi parameters.

The configuration is done in real-time based on:

- Base configuration template
- Services provisioned to the port
- Parameters

In addition BECS can fetch information for trouble shooting and statistics from the CPEs.

### 5 OSS/BSS integration

BECS has a powerful SOAP/XML based API for integration with OSS and BSS systems. The API is well defined and documented to allow integration towards northbound systems.

To further simplify the integration BECS provides a number of adapters. These adapters can convert a simple API call to multiple tasks in BECS. For example a troubleshooting API call can generate data not only from the addressed access port, but collects statistics from all network elements on the path to customer. Examples of available adapters are:

- SPAPI – Service Provisioning
- IPAPI – Statistics and Resources
- TSAPI – Troubleshooting

BECS can also be used as mediation point between the OSS and BSS layer and other systems, such as Performance and Network Monitoring systems.

### 6 BECS as a Point Product

BECS is an extensive Network Management system and thanks to its modular design it can be used as a point product for a number of purposes. Examples of such use are:

- Network design and documentation (Plan & Build).
- Zero-touch element configuration enabling automated network roll-out.
- Service provisioning and activation using BECS Radius and DHCP servers in residential networks.
- Service provisioning using BECS Element Managers in MPLS, Enterprise and/or residential networks.

BECS can also be used to manage only a certain part of the network, such as Customer Premise Equipment, access, aggregation and core elements, complementing existing management systems or manual configuration.

## **7 Deploying BECS in an existing network**

Migrating an existing network to BECS control can be done in a number of ways depending on the operator requirements and the network conditions.

The migration project is usually divided into following main phases:

- Prepare desired configuration
- Discovery and import of the network elements and topology
- Create subscribers and services configuration
- Import services into BECS

Configuring a complete network including services can be relatively large task, so it is often done in smaller subsets, for example based on geography, element manufacturer or topology.