

SymbioNode (Description)



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June 2012

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DOCUMENT: eLearningDTN-SymbionodeDescription_v01.doc

DOCUMENT HISTORY

VERSION	DESCRIPTION	DATE	AUTHORS
01	Creation of the document	19.06.2012	Sašo Vrbinc

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1. Introduction

A typical data mule has connectivity with other nodes over Wireless LAN (WLAN) or other type of communication, such as Bluetooth. In contrast to a typical data mule, SymbioNode is a storage device and the data exchange is possible only when it's physically connected to another node. Therefore, some manual interaction is required for successful data transfer. All other tasks are autonomous and completely automatic with help of PLUTI functionality.

2. Basic concept

When a storage device is attached to the node, the system needs to assure appropriate running environment and network interface for new PLUTI process. The process requires loopback interface to communicate with the host or any another node in the network. Figure 1 describes the concept of a communication between two PLUTI instances on one computer. From PLUTI #1 perspective another there's no difference between PLUTI #2 or any other node in the network since both are capable to communicate over TCP/IP.

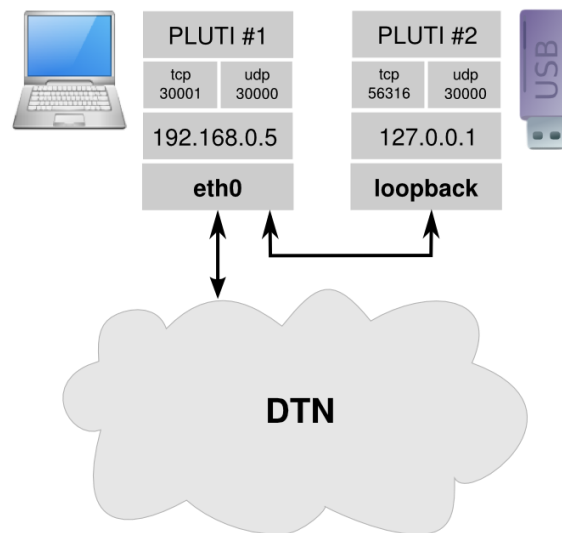


Figure 1: SymbioNode communicate concept

On the upper schema is presented SymbioNode as PLUTI #2 instance. It can communicate with PLUTI #1 or any other DTN node in the network over loopback interface.

Many different solutions have been tried to create a virtual network interface, including Virtual LAN(VLAN), but the only workable solution was loopback interface that successfully establish communication with other nodes in the network. The given solution supports only one attached SymbioNode at a time since only one loopback device exists on the system. It's possible to add additional loopback interfaces to handle multiple SymbioNode at a time.

2.1 Automatization requirements

The operating system must provide a system for auto detection of newly attached or detached storage devices. Most operating systems (OS) provide such systems which are in principal more or less similar. In contrast to Windows Autorun, Linux has more sophisticated "Autorun" system.

Each node should include a special "Autorun" script that ensures appropriate environment for running SymbioNode PLUTI #2 instance. The following

summary of requirements must be provided by the OS and the script for complete SymbioNode functionality:

- auto detect an USB key when added or removed
- mount the device to appropriate location
- provide loopback device
- start PLUTI and watchdog

2.2 Special PLUTI script

The script is written in Bash scripting language which is supported on all GNU operating systems. The script can also be used on Windows platforms with Cygwin emulator.

The script provides functionality for automatic execution of PLUTI Application when storage device is attached and removal of PLUTI active process after certain amount of time elapses. Figure 2 depicts a normal life cycle of the script.

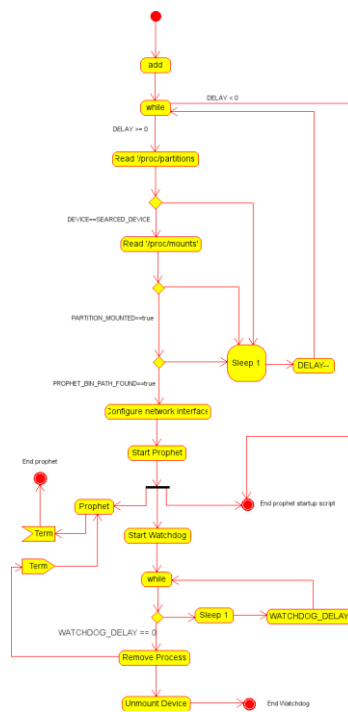


Figure 2: Normal life cycle of the script

The watch dog is responsible for terminating the PLUTI process after a certain period of time elapses. The termination must be completed before the storage device is unmounted otherwise some unexpected events can occur.

2.2.1 PLUTI script parameters description

The script was primarily written for “Hotplug” system, default “Autorun” system included in openWRT and other embedded systems. The script can be configured with editing the parameters on the beginning of the script. In **Error! Reference source not found.** are generally described all significant parameters.

SCRIPT_LOCATION	Location directory of the startup script.
SCRIPT_PATH	Full path of the startup script.
DELAY	The script automatically searches for mounted device and since the mount is not instantaneous, the variable defines waiting period for the device become available by the kernel.
VIP_ENABLED	If you want to use Virtual IP then set this flag to 1
LOG_PATH	This log holds information about running PLUTI invoked by the SymbioNode. Each entry has the following information: <prophet_proc_id> <network_if> <device_name_path> <watchdog_proc_id>
DEVICE_DIR	System device directory. Standard location is /dev/
SEARCH_DEV	Regular expression for searching the attached device.
PROPHET_DIR	When device is mounted at location defined in fstab, the PLUTI binary is executed with command: <mount_point>\$PROPHET_DIR\$PROPHET_BIN.
PROPHET_BIN	IP1 defined in \$PROPHET_CONF is required if \$VIP_ENABLED flag is set to 1.
PROPHET_CONF	
PHYSICAL_IF_NAME	If \$VIP_ENABLED this variable defines an interface used for Virtual IP configuration.
VLAN_IF_PREFIX	VLAN interface name can vary with a platform. Most often used syntax is \${PHYSICAL_IF_NAME}.<id> or just vlan<id> The <id> is found automatically.
WATCHDOG_DELAY	Watchdog live period in seconds. When time expires PLUTI is terminated and storage device unmounted for safe removal.
SUSPEND_CMD	This variable is part of the power management and it's used as part of the locking system, described later in this section.

Table 1: Description of PLUTI script(prophet.sh) parameters

2.3 Pros and Cons

SymbioNode technology has some great advantages over standard DTN node. Generally, SymbioNode gives the following advantages and disadvantages.

Advantages:

- very low cost system
- especially suitable for “production” of several mule nodes for test bed
- complete DTN functionality

- quick installation & configuration
- very suitable for any kind of “long range” transportation, for example, using postal services for storage device delivery between the nodes or deliver storage device between tipi and village router
- current script implementation has only been tested with Prophet, however it should be feasible with DTN2 as well
- support for different OS on the same storage device

Disadvantage:

- Physical contact is needed through USB interface which can be a difficulty if routers are placed outdoor (due to precipitation, condensation, ...)