SpiderMux by Unix Research Labs

TDMoE Multiplexer

Product manual

rev. 1.3b

English

Declaration of Conformity

We, Manufacturer

Unix Research Labs Ltd.
Parchevitch 44 str., Sofia, Bulgaria
declare that this product

SpiderMux

is in conformity with 89/336 EEC-EMC Directive
(**http://ec.europa.eu/enterprise/electr_equipment/emc/directiv/89_336_eec.pdf**)

✓ EN 55022   Limits and methods of measurement of radio disturbance characteristics of information technology equipment
✓ EN 61000-3-2 Disturbances in supply systems
✓ EN 61000-3-3 Disturbances in supply systems caused by household appliances and similar electrical equipment "Voltage fluctuations"
✓ EN 55024   Information Technology equipment-Immunity characteristics-Limits and methods of measurement

The manufacturer also declares the conformity of the above mentioned product with the actual required standards in accordance with the EEC RoHS Directive.

$C \epsilon$

Manufacturer

(stamp)

Date: November 06, 2006

Signature: _____

Name: _____Spas Angelov_____

English

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Product Manual Classification

In order to assist in the use of this product, Unix Research Labs has categorized the product manual in the following:

- For detailed product information and specifications, please carefully read the "SpiderMux Technical Specification" chapter.
- For detailed information related to SpiderMux' unique features, please go to Unix Research Labs' website to read or download the information you need.

For more product details, please click onto Unix Research Labs' SpiderMux website at **http://www.SpiderMUX.org**.
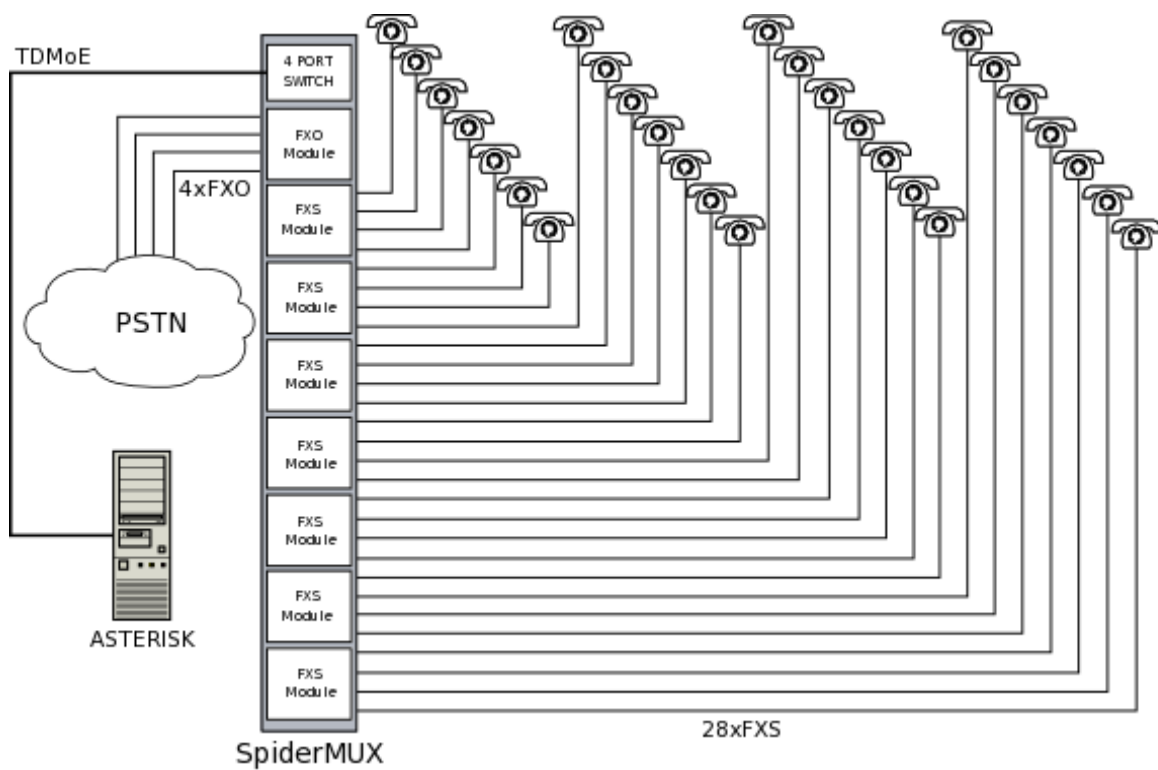
English

Table of contents

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Item Checklist

- ✓ SpiderMux Chassis
- ✓ SpiderMux MCU module
- ✓ SpiderMux FXS module and/or
- ✓ SpiderMux FXO module
- ✓ RJ 45 COM port cable
- ✓ -48 VDC power supply (external)

Usage Diagram

/Diag. 1 - most simple configuration/

1 - SpiderMux Technical Specification

Chassis

- 2x16 LED screen for information and diagnostics
- 1U rack-mountable in 19" and ETSI racks
- Dimensions: 440 x 290 x 45 mm
- Weight: ~ 2 kilograms

Power

- Power supply voltage: -48 VDC. External power supply from 110/220 AC Provided.
- Power consumption: 20W
- Peak power consumption: 40W

Ethernet

- Integrated IEEE 802.3 MAC and 10 BASE-T port
- Fully compatible with 10/100/1000 BASE-T networks
- Full/Half duplex with auto-negotiation
- Automatic polarity detection and correction
- Automatic retransmission on collision

Console

- **RS232** port compatible with VT100 console
- Rate: 115000 baud asynchronous
- Protocol: 8 Bit, No Parity, 1 Stop Bit
- Hardware flow control: no
- Software flow control: no
- Connector: RJ45 (EIA/TIA - 561)

FXS

- 4 ports on module
- Auto-calibration if needed
- Force calibration on demand
- Bandwidth: 300Hz - 3400Hz
- Loop current limit: 20mA
- Battery voltage: -48V DC
- Ring voltage: 48V AC
- Ring offset: 7V DC
- Ring frequency: 25Hz sine wave, 48V AC (peak to peak) (for TRB21 countries list - according to the specifications and telecoms specs)
- Transmit gain control: -12dB to +3dB, step 1dB; reset/recommended value 0dB
- Receive gain control: -12dB to +3dB, step 1dB; reset/recommended value -6dB

FXO

- 4 ports on module
- Auto-calibration on start
- Bandwidth: 300Hz - 3400Hz
- Transmit gain control: -12dB to +3dB, step 1dB; reset/recommended value 0dB
- Receive gain control: -12dB to +3dB, step 1dB; reset/recommended value -6dB
- Line parameters, Ring frequency, Voltage, Timings - according to the telecoms specs in the selected country

TDMoE

- 4-32 channels
- Encoding: A-Law/u-Law
- Signaling: Loop start / Koolstart
- Automatic fail over
- Clock synchronization: master or slave

2 - Device Configuration

There are two possibilities to change configurations of SpiderMux device. Either by serial console, or using configuration utility over Ethernet. There are some limitation of the Ethernet utility. So we suggest the initial configuration to be made over serial console.

On boot there is 5 seconds delay while the device is waiting for interrupt to enter the configuration menu:

```
Booting the SpiderMux OS ...

SpiderMux MAC address: 000B3C004022

Press space bar to enter menu ...
```

On space bar press it will present you the configuration menu:

```
          SpiderMUX V4.36 control menu
      <<< Copyright 'Unix Research Labs' 2006 >>>


     (P) Primary PBX MAC        : 000AEB41674C
     (B) Backup PBX MAC         : 000000000000
     (Y) Synchro clock          : Internal
     (C) Channels in use        : 32
     (L) Codecs law used        : m Law
     (T) Select country         : Bulgaria
     (D) Display timeout        : 15 Sec.
     (F) Force calibration      : OFF
     (U) Remote update access   : Enabled
```

```
           (R)  Remote update password : 000B3C004022
           (O)  FXO port settings
           (S)  FXS port settings
           (G)  Codec gains settings
           (M)  Make factory default settings

           (X)  Exit without saving
           (W)  Save changes and boot
```

Pushing the key in brackets will either toggle the value or prompt you to input new one.

2-1 PBX MAC

Push "P" or "B" to change the MAC address of the PBX/Backup PBX. If there are more than one Ethernet adapters on the PBX, enter the MAC of the adapter that is connected to the same Ethernet segment as the SpiderMux device. Enter either column separated MAC address or only digits:

```
 Enter PBX MAC address: 00:10:5A:0C:1D:B6
```

2-2 Synchronization

Push "Y" to change the synchronization to be either External or Internal.

```
 (Y) Synchro clock         : External
```

2-3 Channels

Push "C" to change the number of channels that are communicated with PBX over Ethernet.

```
 Enter number of channels (1-32): 20
```

2-4 Codecs

Press "L" to toggle between A Law / m Law lossless codecs used to encode the voice data.

2-5 Country

To change the country and to tweak the device according to the local telecommunication agreements press "S". It presents you a menu to choose country. Every country has its own signalization. There are a total of 73 choices.

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2-6 Display timeout

Pressing "D" will prompt you for input of display timeout (in seconds). The value is the time of lines non-activity after which monitoring information is displayed on the LED screen.

2-7 Force calibration

Pressing "F" will toggle the force calibration flag. If it is set to ON there will be scheduled extensive line calibration on this boot sequence. After the calibration process finishes the flag will be cleared automatically so the next reboot will be faster because using the saved values of the time consuming calibration procedure.

We suggest you schedule force calibration after installing new modules in the SpiderMux device.

2-8 Remote update

You can update SpiderMUX configuration remotely through Ethernet. Firmware can be updated only through console. Our suggestion is that you keep secure passwords, at least 8 symbols, letters and digits. Pressing "U" will enable or disable this option and pressing "R" will change the password. It's case sensitive.

```
        (U) Remote update access   : Enabled
        (R) Remote update password : 000B3C00404C
```

CAUTION!!! Password changing dialog will not provide asterisk signs, and therefore password will be visible:

```
        Enter the remote update password: sp1d3muxrulz
```

2-9 Port configuration

```
        (O) FXO port settings
        (S) FXS port settings
```

Pressing "O" will allow you to make changes in FXO line termination settings, line balancing, impendance and assure there is no echo. Pressing "S" will allow you to choose FXS line termination type. Both have global or single line choice:

```
    Channel   LT   TT   Extra        Channel   LT   TT   Extra
       1      03   01   (BOR)           17      03   01   (BOR)
       2      03   01   (BOR)           18      03   01   (BOR)
       3      03   01   (BOR)           19      03   01   (BOR)
```

English

```
      ...       ...      ...          ...         ...       ...
     16       03    01   (BOR)        32        03    01   (BOR)

                         (G) Set all
                         (C) Set by channel
                         (X) Exit menu
```

For FXO you have the choices for line type with length in feet or meters and short line/loop back testing:

```
      Select line model, nearest to your line type (LT) for all channels


              1. LT:01 -> Short line - laboratory test
              2. LT:02 -> 26AWG line,   610m =  2Kft
              3. LT:03 -> 26AWG line,  2135m =  7Kft
              4. LT:04 -> 26AWG line,  2745m =  9Kft
              5. LT:05 -> 26AWG line,  3660m = 12Kft
              6. LT:06 -> 26AWG line,  5185m = 17Kft
              7. LT:07 -> 24AWG line,  9150m = 30Kft
              8. LT:08 -> 24AWG,15Kft + 22AWG,15 Kft = 30Kft


                   Press Esc key to cancel
                   Select Line Type (1-8):
```

Also you may choose to set all lines termination impedance accordingly:

```
   Select Termination impedance of the FXO port for all channels


              A. TT:01, 600ohm
              B. TT:02, 900ohm
              C. TT:03, 270ohm+ (750ohm|150nF)
              D. TT:04, 220ohm+ (820ohm|120nF)
              E. TT:05, 370ohm+ (620ohm|310nF)
              F. TT:06, 320ohm+(1050ohm|230nF)
              G. TT:07, 370ohm+ (820ohm|110nF)
              H. TT:08, 275ohm+ (780ohm|115nF)
              I. TT:09, 120ohm+ (820ohm|110nF)
              J. TT:10, 350ohm+(1000ohm|210nF)
              K. TT:11,   0ohm+   (900W| 30nF)
              L. TT:12, 600ohm+ 2.16uF
              M. TT:13, 900ohm+ 1uF
              N. TT:14, 900ohm+ 2.16uF
              O. TT:15, 600ohm+ 1uF
              P. TT:16, Global Impedance
              X. Toggle extra termination: Best Overall Rejection (BOR)

                   Press Esc key to cancel
                   Select the CO Termination Type (A-P):
```

For FXS there are line capacitance compensations in nano farads:

```
         FXS channels line parameters menu


    Channel  LCC  TWIS  TWISEnab  Channel  LCC  TWIS  TWISEnab
       1     Off   01   Disabled     17     Off   01   Disabled
       2     Off   01   Disabled     18     Off   01   Disabled
       3     Off   01   Disabled     19     Off   01   Disabled
       4     Off   01   Disabled     20     Off   01   Disabled
       5     Off   01   Disabled     21     Off   01   Disabled
```

English

```
         6      Off    01    Disabled      22      Off    01    Disabled
         7      Off    01    Disabled      23      Off    01    Disabled
         8      Off    01    Disabled      24      Off    01    Disabled
         9      Off    01    Disabled      25      Off    01    Disabled
        10      Off    01    Disabled      26      Off    01    Disabled
        11      Off    01    Disabled      27      Off    01    Disabled
        12      Off    01    Disabled      28      Off    01    Disabled
        13      Off    01    Disabled      29      Off    01    Disabled
        14      Off    01    Disabled      30      Off    01    Disabled
        15      Off    01    Disabled      31      Off    01    Disabled
        16      Off    01    Disabled      32      Off    01    Disabled

                        (G) Set all
                        (C) Set by channel
                        (X) Exit menu
```

It can be set on selected ports or to all of them:

```
                        Select Line Type (1-8):
 Select the Line capacitance compensation (LCC) for all channels


                  1. LCC: Off
                  2. LCC: 4.7nF capacitance
                  3. LCC:  10nF capacitance

                        Press Esc key to cancel
                        Select LCC (1-3):


--------------------------------------------------------------------------------

        Select two-wire impedance synthesis (TWIS) for all channels


            1. TWIS:01, 600ohm
            2. TWIS:02, 900ohm
            3. TWIS:03, 600ohm + 2.16uF
            4. TWIS:04, 900ohm + 2.16uF
            5. TWIS:05, 270ohm + (750ohm | 150 nF)
            6. TWIS:06, 220ohm + (820ohm | 120 nF)
            7. TWIS:07, 220ohm + (820ohm | 115 nF)
            8. TWIS:08, 370ohm + (620ohm | 310 nF)
            X. Toggle TWIS: Disabled

                  Press Esc key to cancel
                  Select the TWIS (1-8):
```

The ProSLIC in device provides on-chip programmable two-wire impedance settings to meet a wide variety of worldwide two-wire return loss requirements. The two-wire impedance is programmed by loading one of the eight available impedance values into the TISS[2:0] bits of the Two-Wire Impedance Synthesis Control register. If direct Register 10 is not user-defined, the default setting of 600 Ω will be loaded into the TISS register.

2-10 Codec gains

Pressing "G" will show you the current values for line gains and give you a choice to select new gains ether for all lines or for specified line. Pressing "C" you set gains for only one channel. Pressing "G" enters you in the similar procedure for setting gains for all the lines.

2-11 Save and reboot

Finally press "W" to save configuration changes and boot or "X" to boot discarding changes.

2-12 Factory default

Pressing "M" will reset the device in its most basic settings, default password, zeroed values on most settings and password set to equal the device MAC address.

2-13 Boot sequence

```
Initializing the peripherals ...

Linking, negotiating ...................Done

Channels found: 20

Channel types:  SSSS SSSS SSSS SSSS OOOO .... .... ....
   Number x10:  0000 0000 0111 1111 1112 2222 2222 2333
   Number x01:  1234 5678 9012 3456 7890 1234 5678 9012
```

This a sample result of scanning the installed modules. It "S" stands for FXS and "O" for FXO. The number of the port is written in column.

At the end of the boot procedure it presents you the operating settings:

```
        SpiderMUX MAC address: 000B6A959B2E
        PBX MAC address      : 000B3C003797
        Ethernet protocol    : 0DD0
        Samples in packet    : 8
        Channels in use      : 20
        Codecs law used      : u Law
        Selected country     : US/Canada
        Display timeout      : 10 Sec.

        SpiderMUX is running ...
 ->
```

While running there is some diagnostic data printed:

'P'	The Primary PBX found and connected to it (PBX eth)
'B'	The Backup PBX found and connected to it (PBX eth)
'D'	Packet dropped, because it is for the MUX, but it is not from the right PBX (Primary or Backup) (PBX eth).
'd'	Packet dropped by other reason
'T'	Error in transmit eth queue (PBX eth)
'S'	Sync found (PBX eth)
'X'	Bad management pack occurred (remote Ethernet management)
's'	Status returned successfully (remote Ethernet management)

English

'G'	Full configuration returned OK (remote Ethernet management)
'Z'	Disabled/rejected remote update (remote Ethernet management)
'Q'	Bad password in set new configuration (remote Ethernet management)
'q'	Bad checksum in set new configuration (remote Ethernet management)
'A'	New password accepted (remote Ethernet management)
'a'	New password rejected (remote Ethernet management)
'E'	Remote update enabled (remote Ethernet management)
'e'	Remote update enable rejected (remote Ethernet management)
'W'	Remote update disabled (remote Ethernet management)
'w'	Remote update disable rejected (remote Ethernet management)
01-32	Faulty FXS/FXO port - error in communication with this port (Internal SPI bus) /can continue work, or if letter 'C' appears after port number, a device reset was performed/

If you want now to reboot the device press Ctrl+R.

3 - Asterisk PBX Configuration

There are three steps in configuring the Asterisk PBX to use SpiderMUX ZAP channels. The first two concern the zaptel driver layer and the third the Asterisk server. We will give examples based on the already described configuration of the SpiderMUX device.

3-1 Dynamic span definition

To define ZAP channels in the Asterisk PBX you have to declare your TDMoE span in /etc/zaptel.conf. For example:

```
dynamic=eth,eth1/00:0B:3C:00:37:97,20,0
```

The syntax is the following:

dynamic = driver, interface/MAC,channels, timing source

driver
    For connecting with SpiderMUX the driver is always "eth".

interface
    LAN interface name that is connected to the same

Ethernet segment as the SpiderMUX device.

MAC
    the MAC address of the SpiderMUX device. It is displayed by the SpiderMUX on LED screen and on console after boot.

channels
    The number of transmitted over TDMoE voice channels. It must be the same number as configured in the SpiderMUX device channels.

timing source

0, 1 or 2. This is who gives the time source for synchronization. 0 means PBX, 1 means external clock (eg. SpiderMUX), 2 means low priority external clock (backup).

3-2 Channels signaling

Next you have to declare the channel signaling (also in /etc/zaptel.conf). For example:

```
fxoks=1-16
fxsks=17-20
```

So for the FXS lines you have to define FXO channel signaling (fxoks) because the PBX is the opposite end of the a symmetric communication pair. And visa versa for each FXO line in the SpiderMUX device you declare FXS signaling (fxsks). "Koolstart" (ks) is Asterisk modified and backward compatible "Loopstart" signaling with answer and end of call supervision.

Finally you have to insert the new drivers and configure the channels according to configuration.

```
root@pbx3:/etc# ztcfg -v

Zaptel Configuration
======================

Dynamic span 1: driver eth, addr eth0/00:0B:3C:00:37:97, channels 20, timing 0

20 channels configured.

root@pbx3:/etc#
```

3-3 Asterisk configuration

Next you have to declare the new ZAP channel to be used by Asterisk server in /etc/asterisk/zapata.conf. The example follows:

```
context = default
echocancel=yes
echotraining=yes
usecallerid=yes
threewaycalling=yes
callwaiting=yes
transfer=yes
cancallforward=yes
signalling = fxo_ks
channel => 1-16
signalling = fxs_ks
channel => 17-20
```

After restart of the Asterisk PBX they will be visible in the server:

```
root@pbx3:/etc/rc.d# asterisk -vvvrc
  == Parsing '/etc/asterisk/asterisk.conf': Found
  == Parsing '/etc/asterisk/extconfig.conf': Found
Asterisk 1.2.7.1, Copyright (C) 1999 - 2006 Digium, Inc. and others.
Created by Mark Spencer <markster@digium.com>
Asterisk comes with ABSOLUTELY NO WARRANTY; type 'show warranty' for details.
This is free software, with components licensed under the GNU General Public
License version 2 and other licenses; you are welcome to redistribute it under
certain conditions. Type 'show license' for details.
=========================================================================
Connected to Asterisk 1.2.7.1 currently running on pbx3 (pid = 3218)
ctionCLI>
Verbosity is at least 3
pbx3*CLI> zap show channels
   Chan Extension  Context         Language   MusicOnHold
 pseudo            test
     1            default
     2            default
     3            default
     4            default
     5            default
....
```

Finally you have to describe your call routing policy in /etc/asterisk/extensions.conf but this is out of the scope of the current manual. If you have any additional question for asterisk, **http://www.asteriskguru.com** is a good place to start.

4 Quick start guide

4-1 Zaptel and Asterisk

Compile and install Asterisk server. Add the following into the zaptel.conf file:

```
#######################
loadzone = us
defaultzone = us

dynamic=eth,eth0/00:0B:3C:00:40:22,32,1
fxoks=1-32
#######################
```

Where:
        - (dynamic) eth0 is the network interface the SpiderMUX sees (is connected to)
        - followed by SpiderMUX MAC Address
        - fxoks = port count and synchronization type (1 means the SpiderMUX will be master clock, see subchapter 4-2)

In zapata.conf :

```
[channels]

context = spider
echocancel= yes
```

```
echotraining= yes
echocancelwhenbridged=yes
usecallerid=yes
threewaycalling=yes
callwaiting=yes
transfer=yes
cancallforward=yes

signalling = fxo_ks
channel => 1-32
```

In extensions.conf:

```
[spider]
exten =>  2001,1,Dial(Zap/1)
;;;;;;;;;
exten =>  2032,1,Dial(Zap/32)
```

4-2 SpiderMUX configuration

Hold *space bar* when SpiderMUX is booting or restart with *ctrl+r*, switch Synchro clock to Internal, enter MAC address of the Asterisk server taking in mind the ports count you already entered in server's zaptel.conf (see subchapter 4.1). In case you have Asterisk with clock (eg. other SpiderMUX, Digium card or USB), Synchro clock should be set to External.

```
            SpiderMUX V4.66 control menu
    Copyright (C) 2006,2007 Unix Research Labs Ltd.


    (P) Primary PBX MAC        : 000AEB41674C
    (B) Backup PBX MAC         : 000000000000
    (Y) Synchro clock          : Internal
    (C) Channels in use        : 32
```

This successfully configures Zaptel Asterisk and SpiderMUX. Only remains to execute ztcfg -v in Asterisk server.

English

Contact Us:

Bulgaria

Headquarters
Unix Research Labs Ltd.
Sofia, 44-th Parchevitch str.
TEL: +359 2 986 86 20
FAX: +359 2 980 89 53
info@spidermux.org
http://spidermux.org

Distributors:

Bulgaria

DIGITAL SOLUTIONS , Ltd.
Sofia, "Tzarigradsko Shose" 7km,
Hi-Tech Park IZOT, fl.1, office 109
TEL: +359 2 974 30 30
FAX: +359 2 974 03 03
Sales Department : **sales@digitalsol.net**
Technical Support : **support@digitalsol.net**
Information : **info@digitalsol.net**
Office : **office@digitalsol.net**
SITE : **http://digitalsol.net/**
Contacts : Mr. Peter Iliev

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