Network Effects Controller (NEC)

The NEC is a multi-purpose controller with the following hardware:
-LCD display and rotary push-button knob for user interface
-SD/HC card slot to hold user generated lighting data and audio files
-Network port to send lighting data to NDBs and synchronize with other NECs.
-Single DMX port (2 RJ45 jacks) for sending DMX lighting data or receiving DMX commands.
-Audio WAV file player and output jack
-2 opto-isolated inputs (on RJ45 jacks) for triggering effects
-Time of day clock to turn on/off automatically
-Supports 8000 lights spread and 16 NDBs.

The NEC can be set to operate in one of many different modes:

1. Effects Player
    Generates lighting effects and plays them.

2. Light Show
    Generates light show based on user selected effects and plays.
    Can play optional WAV files at same time.

3. File Player
    Plays preprogrammed lighting files from SD card.
    Can play optional WAV files at same time.

4. Slave device
    Receives commands (via DDP, Art-Net or DMX) to play internally
    generated effects, lighting data files or audio WAV files.
    This mode is also used when synchronizing multiple NECs.

5. Triggered Player
    2 input triggers can be set to play internal effects, lighting files or WAV files.
    An idle mode can play a 3rd file or effect.

6. ArtNet to DMX gateway
    Receives ArtNet packets and sends them out DMX port.

7. DMX to ArtNet gateway
    Receives DMX packets and sends them out as ArtNet packets

8. Utility Modes
    Play a WAV file from SD card.
    Auto-Configure NDBs.
    Reset NEC to factory settings.
    Update NEC firmware from SD card.

Modes that play lighting data (Effects Player, Light Show, File Player, Slave Device and Triggered Player) can also be set to output to the DMX port instead of NDBs. In this case you are limitied to 512 channels of output data (170 RGB lights). This can be used to control DMX dimmer boards and other DMX devices.
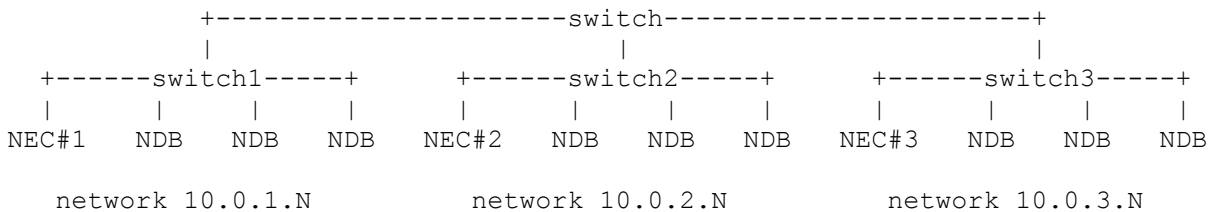
NEC and NDB NETWORK CONFIGURATION

This section is the recommended way to setup a network of NECs and NDBs, it is possible to use other settings and configurations if you understand what you are doing.

An NEC can send data to up to 16 NDBs, we will call this a cluster. Clusters can be synchronized to form larger systems.

NECs need to be connected to NDBs via a 100MB ethernet connection.   This is usually done by plugging all devices in a cluster into an ethernet switch.   A single NDB can be connected to an NEC via a crossover ethernet cable instead of a switch.

Multiple clusters can be interconnected using a higher-level ethernet switch that connects together all the cluster switches.

```
            +----------------------switch----------------------+
            |                          |                        |
   +------switch1-----+      +------switch2-----+      +------switch3-----+
   |     |     |     |       |     |     |     |       |     |     |     |
 NEC#1  NDB   NDB   NDB    NEC#2  NDB   NDB   NDB    NEC#3  NDB   NDB   NDB

    network 10.0.1.N          network 10.0.2.N          network 10.0.3.N
```

Each cluster is setup with a network number of 10.0.cluster# and netmask 255.255.255.0.

NECs are given an address N of 21 and NDBs are numbered from 101 to 116. So a cluster might be addressed as: NEC 10.0.1.21, NDB1 10.0.1.101, NDB2 10.0.1.102, NDB3 10.0.1.103.

LIGHTING CONFIGURATION

When using the NEC as an effects or file player, the configuration of multiple NDBs must be the same (except for the last NDB which can be less). For example. if you have 40 light strings, you can put 16 on NDB1, 16 on NDB2, and the remaining 8 on NDB3.   Of you could put 10 each on 4 NDBs. But you can't put 15 on NDB1, 10 on NDB2, and 15 on NDB3.

FILE NAMES AND TYPES

An SD card must be formatted before placing files on it. If you need to delete files and add new ones you must re-format the card before doing so.

File names must be in the 8.3 character length format. File names must also start with a number from 0-49.   The file number defines the order in which it gets played. File numbers can be skipped.   After the file number you can have a non-numeric character and that can be followed by any other characters.

Effects files must have the extension BIN and audio files must be WAV.   Example files names are 1.BIN, 1.WAV, 13-snow.bin, 20-2014.bin.

AUDIO FILES

Audio files must be in WAV format, saved as 16-bit stereo data at samples rates of 32khz, 44.1khz or 48khz.   To convert other formats such as MP3 to WAV, use Audacity (at audacity.sourceforge.net). Drag and drop the audio file into Audacity, pick a new "project rate" on the bottom left corner of the screen (one of 32khz, 44.1khz or 48khz). We recommend using the lowest rate possible unless you have sound quality issues. The pick "File", "Export", select the new filename and set the Type to "WAV (Microsoft) signed 16 bit PCM".

OPERATING MODE

The Operating Mode menu item lets you select the major mode of the device.   Once that is set the menu system is setup with particular items for that mode.

The following describes the modes and their menus:

UTILITIES MODE

  AutoConfig NDBs (will only work with NDB v2.0 or greater, units made after approx March 2014).
    This item will allow you to automatically discover and configure NDBs when using the DDP protocol.   Select AutoConfig, and then set a few items up:

    Controller#:   set this to 1 if it is your first or only NEC in a system. For additional NEC's, increment this by one for each.
    Total Strings: set this to the total number of strings or tubes you will be controlling from this NEC across all NDBs.
    Lights/String: set this to the number of lights on each string.
    Outputs per NDB: set this to the number of active outputs you are using on each NDB.
    T's per Output: set this to the number of Smart-Ts on each NDB output.

    For example, if you have an NEC controlling 5 NDBs, you are using 12 outputs per NDB with 4 Smart-T's on each output, and strings of 25 lights, then you would set:
    Controller#:   1
    Total Strings: 240   (5*12*4)
    Lights/String: 25
    Outputs per NDB: 12
    T's per Output: 4

    Once you have all of these number set, then pick "Begin Autoconf".   The NEC will scan your network for all the NDBs it can find. This will take 5-10 seconds. It will then set all the lights on every NDB it finds to RED. The NEC will then ask you to pick NDB#1. Click here and then spin the knob to select the first NDB. The currently selected NDB will change all its lights to WHITE.   When you've found NDB#1, push again to pick it. Its lights will turn BLUE. Now spin the knob and make selections for the rest of your NDBs in the same way.   When done, pick the "Finish Configuration" item and all the NDBs will be set up, and the NEC will reboot.

  Factory Reset
    Selecting this item will reset the NDB to the configuration and settings as it was shipped from the factory.

  Firmware Update
    This item lets you update the firmware when the factory makes updated sofware available.   The firmware file is placed on an SD card.

LIGHT SHOW

This mode runs a show using the built-in effects.

```
Show          - pick shuffle or ordered.
Setup         - see SETUP menu for details
Network Setup - see NETWORK menu for details
Save Changes  - use this to make any changes permanent
Time          - see TIME menu for details
```

EFFECTS PLAYER

This mode runs a built-in effects and lets you customize it.

```
Effect        - pick and/or edit built-ineffects
Setup         - see SETUP menu for details
Network Setup - see NETWORK menu for details
Save Changes  - use this to make any changes permanent
Time          - see TIME menu for details
```

FILE PLAYER

This mode plays effects files and audio files from an SD Card.

```
Play File     - pick a particular file# or ALL
Setup         - see SETUP menu for details
Network Setup - see NETWORK menu for details
Save Changes  - use this to make any changes permanent
Time          - see TIME menu for details
```

SLAVE

This mode puts the NEC in slave mode, where it only responds to commands from other devices.   If you have multiple NECs on a network, all of them should be in SLAVE mode except for #1.   You can also control SLAVE mode NECs via ArtNet or the DMX port (in this case all NECs should be in SLAVE mode).

```
Setup         - see SETUP menu for details
Network Setup - see NETWORK menu for details
Save Changes  - use this to make any changes permanent
```

INPUT TRIGGER

   This mode lets you use external inputs to trigger an effect and/or audio file to
play.

   The INPUTS are on RJ45 ports 1 and 2 (the DMX ports) and correspond to Trigger #1
or #2. These can be shared with DMX if needed with a custom splitter cable.   The
inputs are on pins 4 and 5 (not used by DMX). The pins are connected to an opto-
isolated input LED through a 1.2K ohm resistor. You can apply a signal between
about 3-12vdc to activate the trigger. Pin 4 is negative/ground and pin 5 is
positive. Reversing power could damage the input. Higher voltages can be used if
an external resistor is added to limit LED power (range is about 1-10ma).

```
   Trigger 1/2
     Trig1/2 Action
       None          - do nothing
       play file 1/2 - play effect and/or audio file#1/2
       play effect   - play a built-in effect
     Mode
       triggered     - when the input is set, the entire file is played or the
built-in effect is played until its "show time" setting is up.
       momentary     - the file or effect is played only as long as the input is
set.
     Select Effect
       name             - sets the name of the built-in effect to play

   Idle Settings      - what happens when no trigger is present
     Idle Action
       None          - do nothing
       play file 0   - play effect and/or audio file#0
       play effect   - play a built-in effect
     Select Effect
       name             - sets the name of the built-in effect to play when idle

   Setup          - see SETUP menu for details
   Network Setup - see NETWORK menu for details
   Save Changes  - use this to make any changes permanent
```


ARTNET=>DMX

   This mode sets the NEC to be an Art-Net to DMX gateway. Art-Net data received
for a particular Universe# are sent out the DMX port.

```
   Network Setup - see NETWORK menu for details
   Save Changes  - use this to make any changes permanent
```


DMX=>ARTNET

   This mode sets the NEC to be a DMX to Art-Net gateway. DMX data received on the
RJ45 port is send to particular IP# and Universe# out the network port.

```
   Network Setup - see NETWORK menu for details
   Save Changes  - use this to make any changes permanent
```

These Menus are used in many modes:

SETUP MENU

```
Total Strings
Lights/String
Lights per NDB
Flip Strings
Flip Lights
Intensity
```

NETWORK SETUP MENU

```
Our Addr          - set IP address of this NEC (normally 10.0.NEC#.21)
Netmask           - usually 255.255.255.0
Gateway           - usually 10.0.NEC#.1
Send To Addr      - address of first NDB (usually 10.0.NEC#.101)
Output To
  Network/DDP     - normal mode, output lighting data via DDP over the network
  DMX port        - DMX mode, send lighting data to DMX port only
```

TIME MENU

The NEC has a clock but it is not battery-backed up and will reset to 00:00 after a power failure. The clock has a timer to start and stop the LIGHT SHOW, EFFECTS PLAYER or FILE PLAYER modes automatically.   Lights and audio will be turned off during those times. Set the on and off time to 00:00 to disable.

```
Current Time      - set the current time in 24 hour format HH:MM
On Time           - set the turn-on time
Off Time          - set the turn-off time
```