KETRA

February 19, 2016
Ketra, Inc

Application Note: DMX Control Support with Ketra

Introduction

DMX512 is an industry standard control protocol, built upon RS485, that has roots in entertainment and theatrical lighting applications. It is easy to use, robust and low cost and has founds its way into many applications beyond the theater. As the name suggests it is a way to send 512 8-bit data values over a single cable.

From a physical wiring perspective there exists basic rules of thumb that should be followed with DMX networks:

- Total run length should not exceed 300m (~1000 feet)
- Maximum number of receivers connected to the cable is 32
- The end of the cable run (furthest from transmitter) should be terminated properly with a 120 ohm resister
- All products should be connected in a serial fashion, not in star or "home run" topologies

There are three basic ways in which Ketra uses DMX as part of our lighting solutions. Detailed descriptions and configuration guidelines follow.

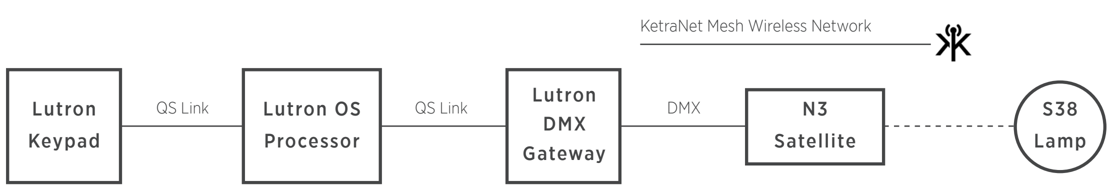
1. DMX Slave – Ketra's products receive DMX from a 3rd party device.

2. DMX Master – Ketra's products send DMX to 3rd party devices.

3. DMX Link – One Ketra product acts as DMX Master and sends data to other Ketra products which act as DMX slaves.

DMX Slave

The most common use case of this mode exists where it is desired to control Ketra's products from a 3rd party device. For example, a Lutron Homeworks QS system can control Ketra products by employing Lutron's DMX gateway. When a user presses a scene button on a Lutron keypad Ketra's products can respond to that trigger. This approach allows Ketra's products to be integrated with other lighting and control systems.



The workflow is as follows:

1. Physically install and connect power to Ketra's products.

2. Run the Design Studio software and create the installation file.

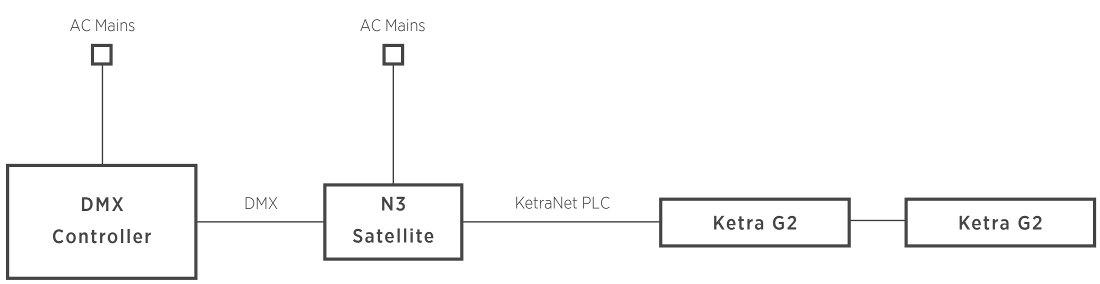
3. Create groups of lighting products as required for project application.

4. Setup DMX profiles in Design Studio and select which lighting groups each profile is mapped to.

5. Publish Ketra installation data.

6. Setup 3rd party controller by "patching" appropriate Ketra DMX profile ranges to controller channels.

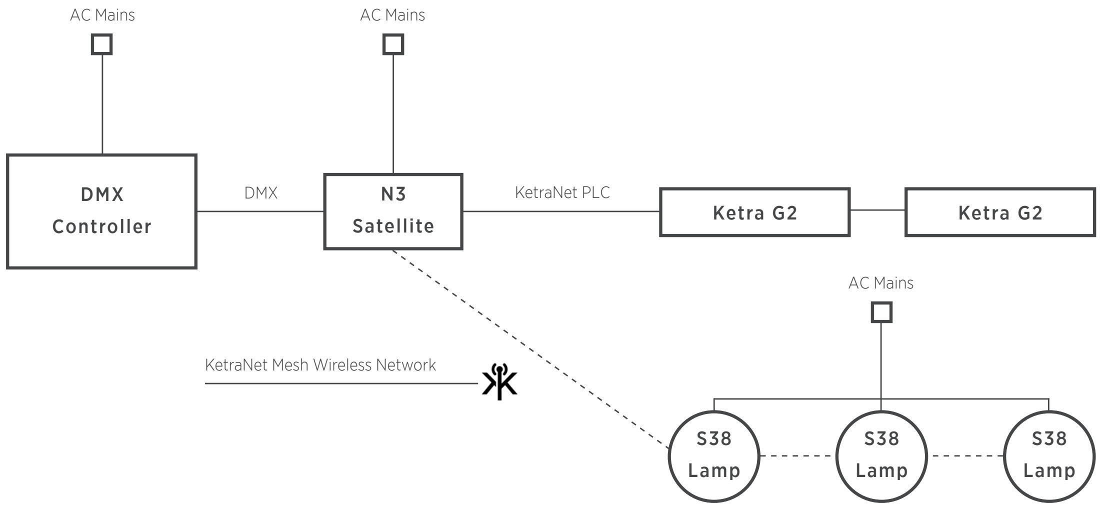
Configuration rules exist which will dictate the performance of Ketra's products. The biggest factor is which KetraNet communication protocols are used. KetraNet PLC is a power line communication protocol employed by the G2 Linear product. It transmits control data over the AC mains power line connections between the N3 Satellite and G2 Linear products connected together in a continuous run. In a simple cove lighting application Ketra's G2 Linear product is directly wired to the N3 Satellite via the G2 Leader Cable. If a 3rd party DMX controller were hardwired directly to the N3 Satellite there would only exist hardwired DMX and KetraNet PLC communication links.



- **For applications that use KetraNet PLC only:**

The KetraNet PLC frame rate is 20 Hz, which is ½ the speed of DMX512

If Ketra's A20 lamps are added to the installation the KetraNet Mesh wireless protocol must be used to communicate between the N3 Satellites and the A20 lamps. KetraNet Mesh is an IEEE802.11.4 wireless mesh networking protocol. The KetraNet Mesh network has a data throughput rate that is about half the speed of DMX. This can cause unexpected behavior and therefore one must take this into consideration when specifying and commissioning the system.



For projects that use KetraNet Mesh:

- Data frames are sent in 45 channel groups. The total number of channels iscalculated by adding up the total number of DMX channels consumed by each group profile mapping and then summing the total across all the groups. For example, if DMX addresses 1-3 are mapped to an RGB profile for group 1 and DMX addresses 1-3 are also mapped to an RGB profile for group 2 then the total number of wireless channels consumed is 6. Even though only 3 DMX addresses are "consumed" by the N3 on the data input side, the data output side is broadcasting 3 channels to each group. Therefore 6 channels are wirelessly broadcasted across the KetraNet Mesh network.

- The KetraNet Mesh network was designed such that all of the lighting products would change state in a synchronized manner. This prevents the annoying "sparkle" effect that other wireless networks experience due to wireless network latency and communication delays. All channels used in an installation are broadcast out in 45 channel frames in a serial manner before a final "go" commend is issued and all products change state simultaneously. Therefore, the total length of time from when the data transmission begins to when the final go command is issued is a function of how many channels are used in the installation.

- Each frame of 45 channels can experience up to a 1.35 second broadcast delay over the wireless network. Therefore, in an application that uses 60 wireless channels a delay of up to 2.7 seconds could occur (1.35 seconds for each frame of up to 45 channels). The N3 Satellite supports a full DMX universe input. The number of lighting "nodes" in a group does not impact this calculation.

- In an application where both KetraNet Mesh and KetraNet PLC are used, the KetraNet PLC communication speed will "downgrade" to match the KetraNet Mesh speed such that all devices are changing in synchronization.

In order to calculate the maximum delay that could occur from when a new DMX stream is received to when the lighting products would change state perform the following two step calculation.

- Multiply the number of channels per group by the number of groups anddivide the result by 45. Round up to the nearest whole number.
- Multiply the result of the previous calculation by 2.7.
- The resulting value, in seconds, is the maximum delay that may be experienced in the application.

If N is the number of channels per group, G is the number of groups, and T is the maximum delay, then the formula can be represented as:

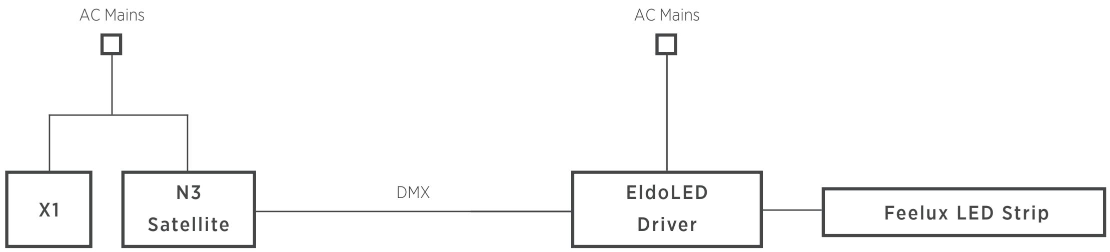
$$T = \text{Round}\left\lceil \frac{N*G}{45} \right\rceil (2.7)$$

As an exercise consider the following example. A project at a small event space calls for 36 Ketra S38 lamps divided into 12 groups (3 lamps per group). The designer is using a theatrical console with DMX512 output and would like to control each of the lamp groups in 8-bit RGBW profile mode. This means that each group has a “DMX footprint” of 4 DMX addresses. The full installation would therefore require mapping 48 DMX addresses out of the console to the N3, which would then map the data to 12 groups which would then broadcast over the KetraNet Mesh wireless network as 45 channels. Each wireless frame can send up to 48 channels of data, so this would require two frames of data. Using the above formula, the maximum delay that could occur would be 5.4 seconds. In practice what does this mean? If the scene transitions are of a medium to slow pace you may never see any delay at all. However, a worst case scenario would be a “bump” transition from all lights off to all lights full on. From the time the theater technician pushes the “go” command to the time the lights respond there could be a maximum of a 5.4 second delay. Clearly this is not acceptable. Or worse, the technician initiates a fade up or down. In this case as the DMX values from the console are changing the maximum refresh rate to the lamps could be 5.4 seconds which would result in large “steps” in intensity, not the smooth fade desired. For these reasons we do not recommend using Ketra’s wireless for “live” applications such as this.

In order to get around this wireless network latency problem Ketra has profiles that include a fade rate parameter. For example, the RGBIF profile uses red, green, blue, intensity and fade values. In this example you broadcast to all the products their respective values and then all products transition to the desired color and intensity over the time period set by the fade rate parameter. Thus you can calculate the expected network latency and then send the values in advance of when the transition should occur. Most DMX controllers include time line editing and can support this use case.

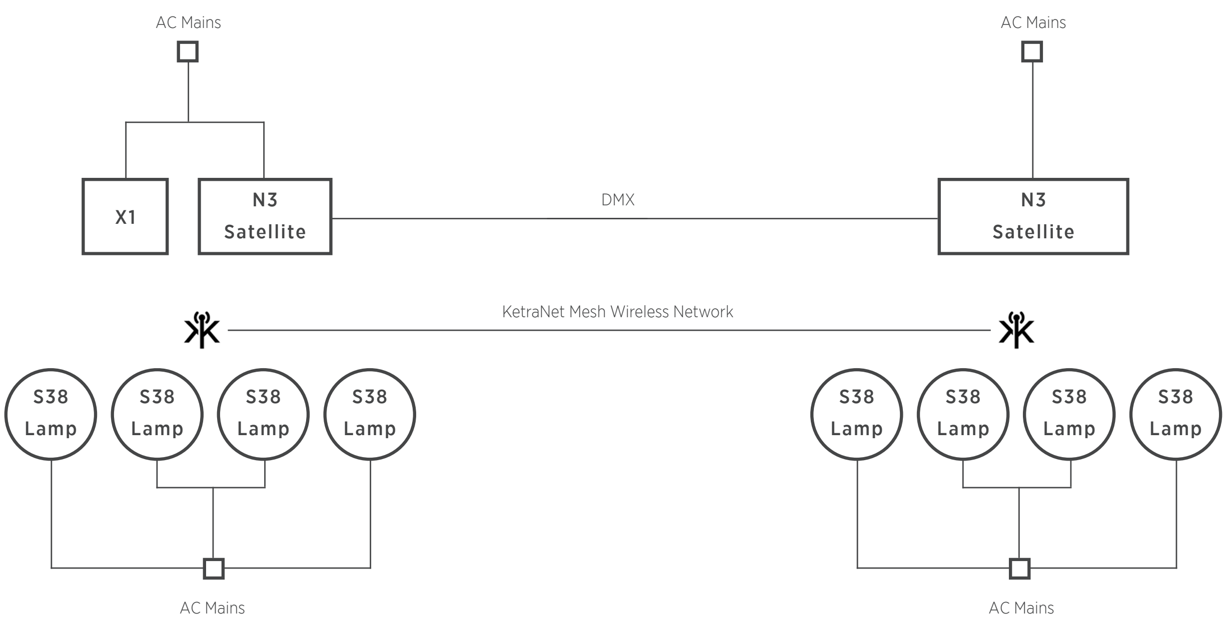
DMX Master

Ketra’s DMX output port supports a full DMX universe at full 44 Hz frame rate. DMX output values are programmed as part of scenes that can be called by pressing a button on X1 Keypads or preprogrammed time-clock events.



DMX Link

This mode enables the use of DMX as a basic data backbone for spanning multiple KetraNet Mesh wireless networks or to travel distances that exceed wireless network range and/or where a wireless repeater is not practical or desired. A good example would be retrofitting a historic building where two galleries are on opposite sides of a building but the keypad controller is in a utility closet in one of the galleries. An X1 Keypad and N3 Satellite could be installed into the utility closet near the first gallery and then a second N3 Satellite could be installed into another discrete location near the second gallery on the other side of the building. A simple CAT5 cable would then be run between the two N3 Satellites. The first Satellite is set as a master and the second satellite is set as a slave. Commands from the X1 Keypad are sent wirelessly to the lamps in the first gallery and the N3 Satellite master. The N3 Satellite master sends out DMX commands over the cable to the N3 Satellite slave located at the second gallery, which then broadcasts wireless control to the remote lamps.



If you have any questions or concerns, please don't hesitate to contact us. We're here to help!

Phone: (512) 347-1100 Email: info@ketra.com