STAR-Net

Rapidly Deployable SATCOM

Gene Harrison – N3EV

v1.0 – 16 August 2025

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- Review of Remote Area & Space Based Comms Options
- Overview of STAR-Net Project
- View of Standard Starlink System & Elements
- Describe evolution of Starlink into a flexible, capable & resilient deployable system – Four Phases
- Describe major design considerations & alternatives
- Identify key components & functions
- Expansion System Diagram <<
- *IF You had to do it, today, what should You do same or different?*
- Handy available kits...
- News & Parts lists!
- References & Credits

Remote Area Comms Options

- There are many options for communications around & out of remote, wilderness, disaster & austere areas
- HF radio is good for voice & low rate data, using ground wave, long distance skywave, & especially NVIS, but needs high power, large gear & antennas
- VHF-UHF radio is also good for voice & low rate data, both direct & via repeaters, for range extension & coverage expansion, with handheld & mobile operations & modest power, gear & antennas
- (OK, lets skip likely unavailable cell towers and POTS landline telephones…!)
- *Note!! Cave Rescuers still have & use totally autonomous Military Field Phones!!*

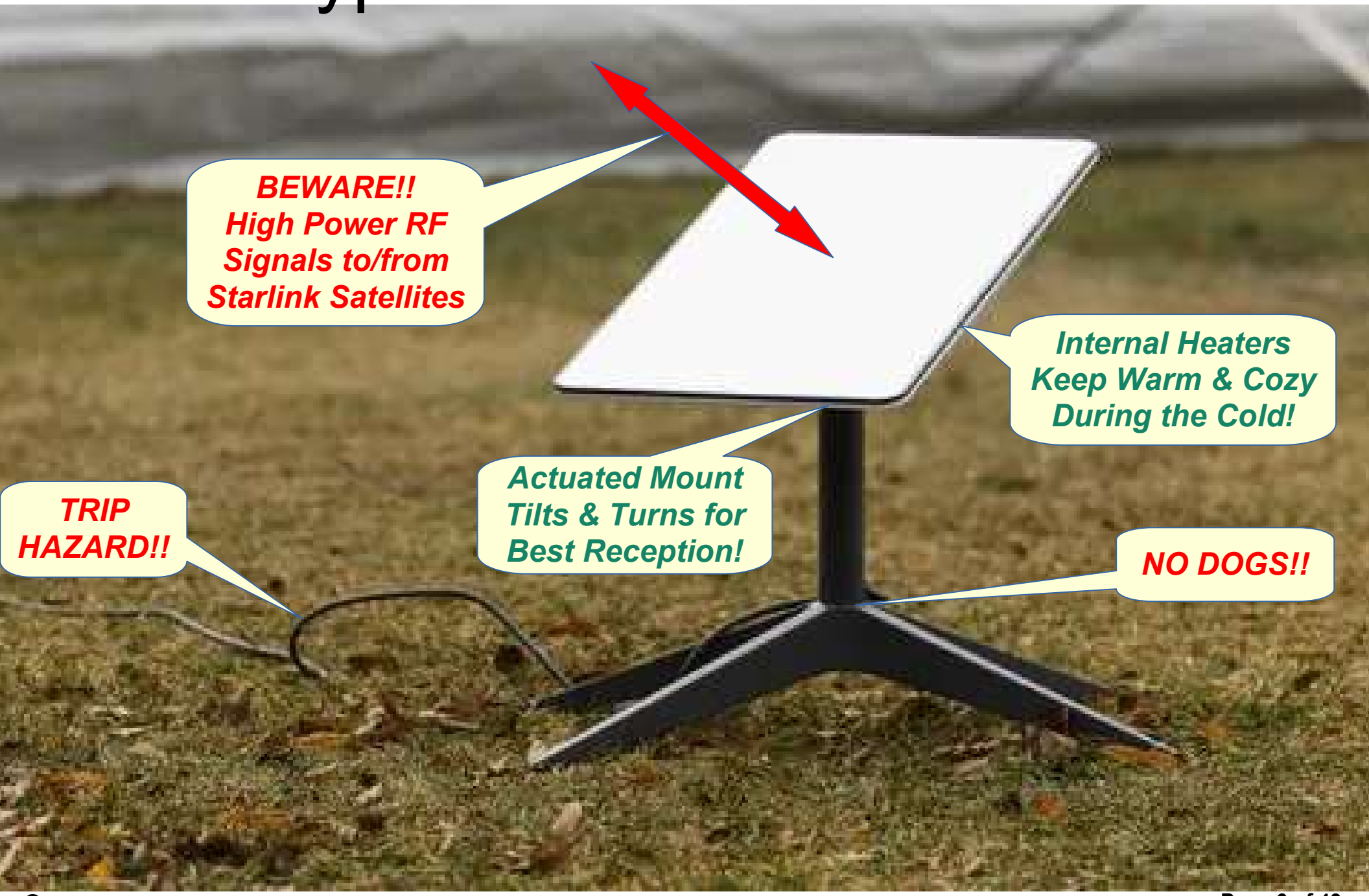
Space Based Comms Options

- There are many SATCOM options for these remote, wilderness, disaster & austere areas & missions
- Most systems use VHF-UHF-SHF Radio LOS links, to geosynchronous, MEO or LEO satellites.
- Many mobile or portable units are modest sized, but are quite limited in performance and provide only voice and/or low rate data
- Larger terminals & antennas were usually required for higher rate data services, especially IP based transport.
- Examples: ECHO, INMARSAT, BGAN, Iridium, Globalstar, TACSAT, MILSTAR, Thuraya, OneWeb, Kymeta ...
- *Today, for High Speed Internet, the "Sweet Spot" for most remote uses is the SpaceX Starlink System!*

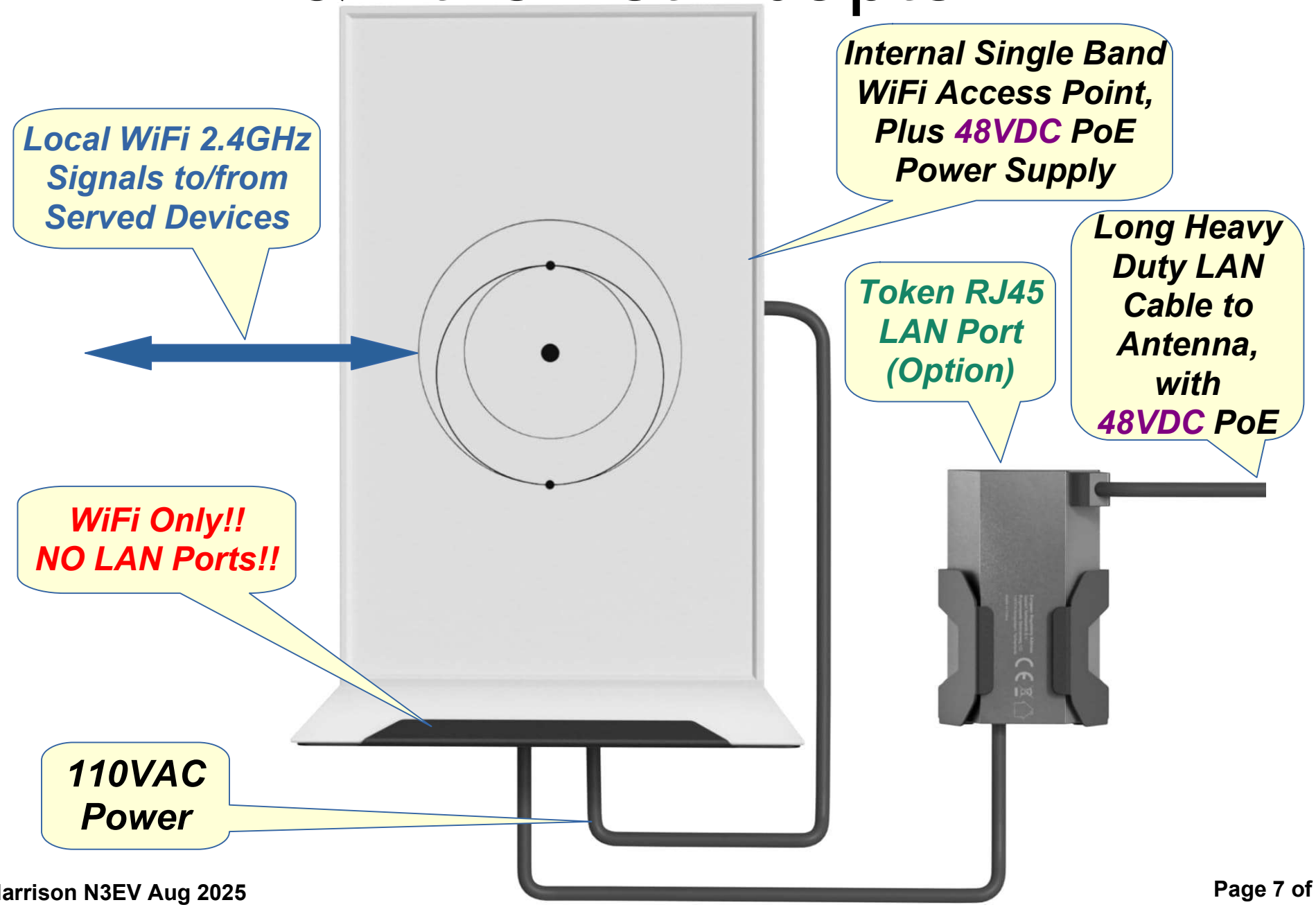
Overview of STAR-Net Project

- Describe Significant Upgrades to a Standard Starlink Terminal for Rapidly Deployable Operations
- Phase 1 - Convert to Dual Power operation
  - Add 12VDC & keep 110VAC
- Phase 2 - Upgrade WiFi Router
- Phase 3 – Add Multiple Telephone Capabilities
- Phase 4 - Environment & Transport

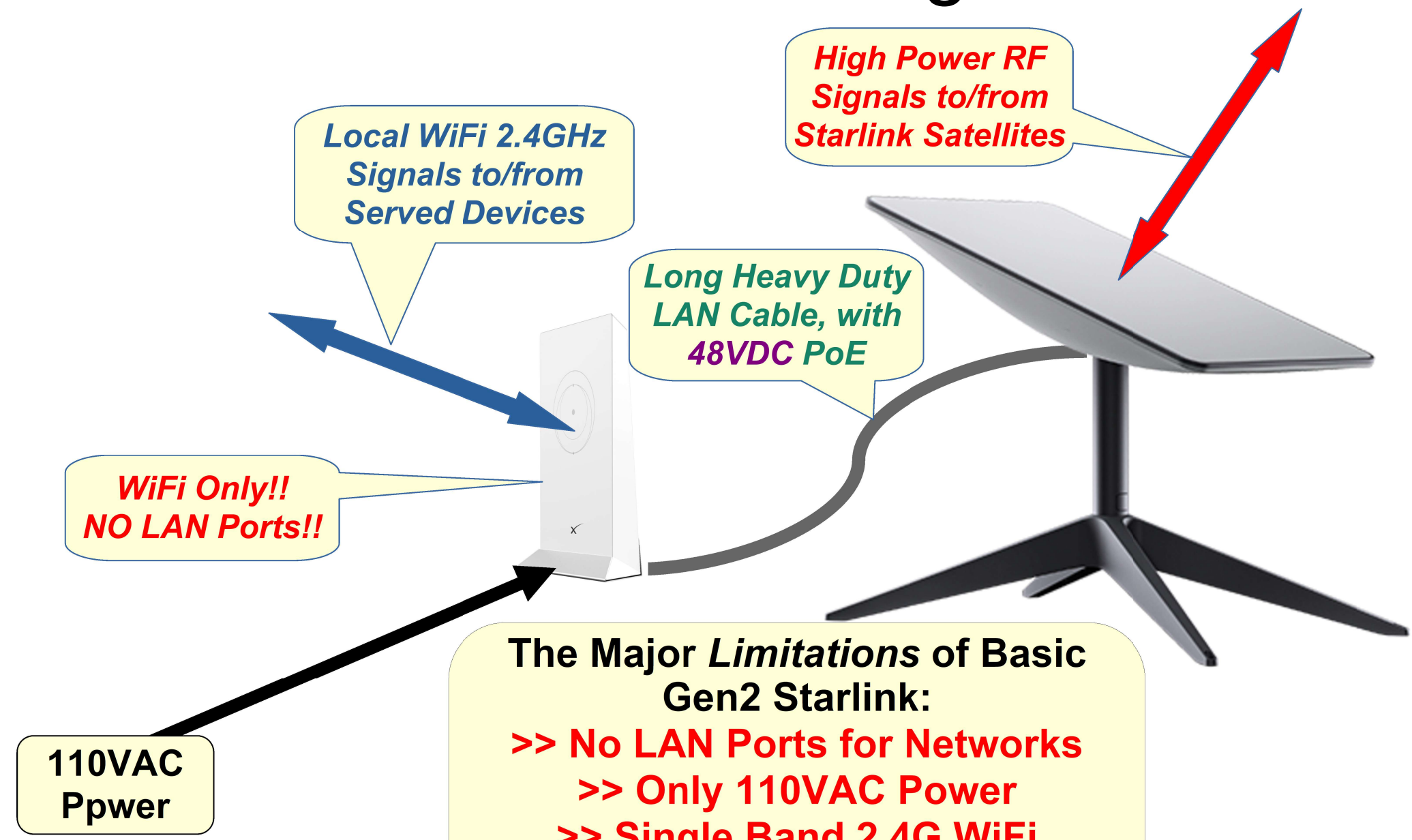
Typical Starlink Terminal



Starlink Gen 2 WiFi Router & Ethernet Adapter



Basic Starlink Configuration



The Major *Limitations* of Basic Gen2 Starlink:

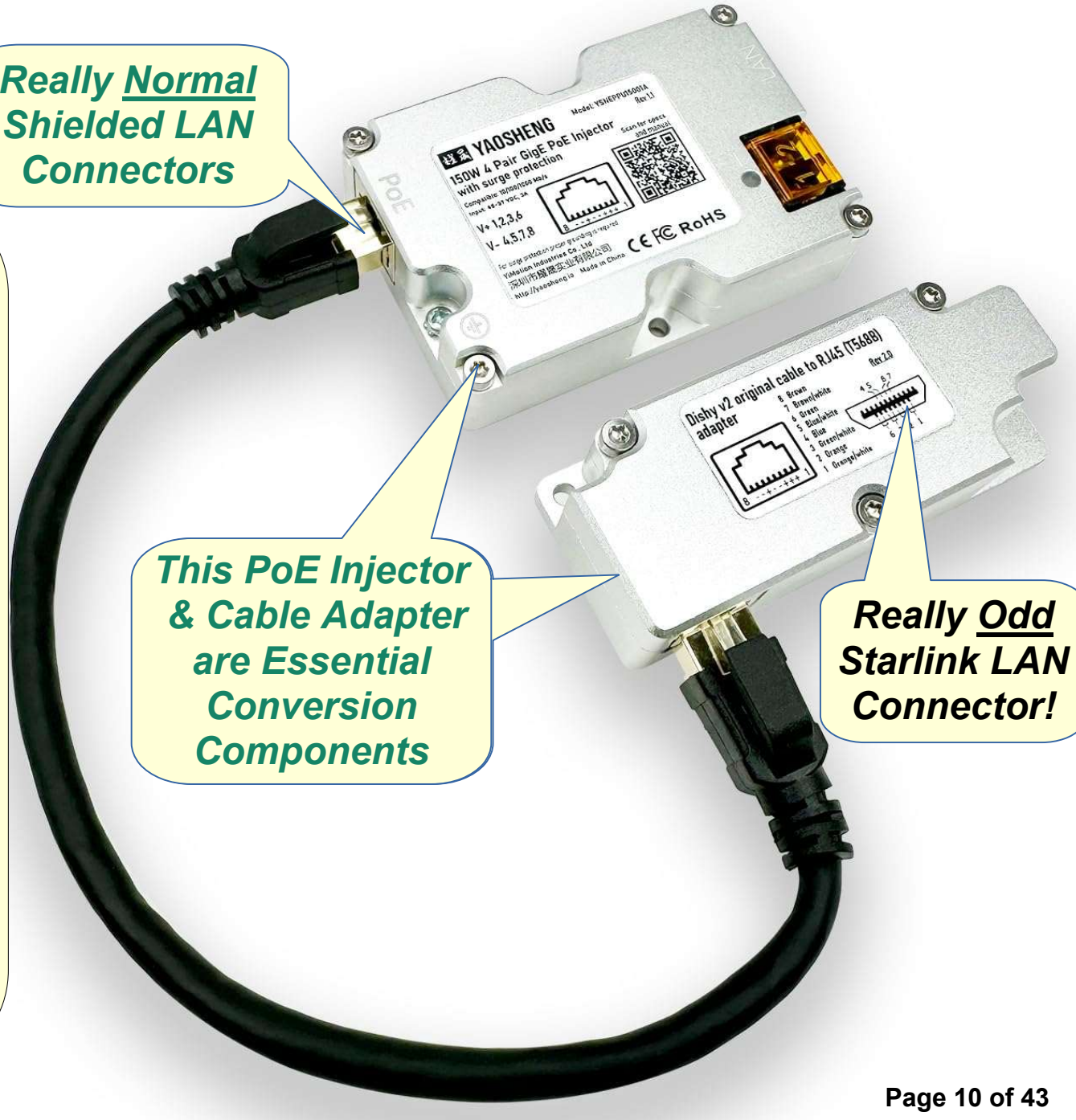
>> No LAN Ports for Networks
>> Only 110VAC Power
>> Single Band 2.4G WiFi
>> No Phone Interfaces
>> No MESH Interface

Phase *1*

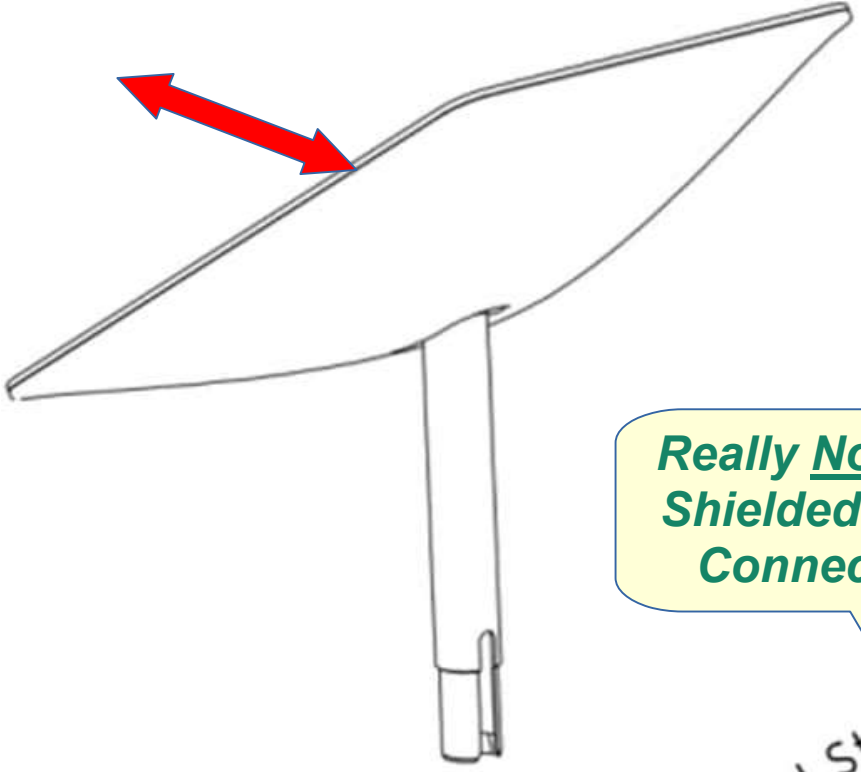
- Convert to Dual Power
  - Add 12VDC (nominal 11-16VDC inputs)
    - 48VDC PoE – 11-16VDC input
    - 24VDC PoE – 10-14?VDC input
    - 12VDC devices – nominal “12”VDC (always vague?)
    - 5V USB – 10-32VDC input
  - Keep 110VAC (Original Starlink WiFi outer)
    - Reverts to Original Limited WiFi Only Services
    - Option – Add Ethernet Adapter for Local LAN
  - Option – Add 110VAC / 12VDC Power Supply
    - 13.8VDC 30A – 110VAC input
    - Max 25A continuous (Peak Load << 15A??)
    - Both PowerPole and Binding Post Outputs
    - Automatic Cooling Fan

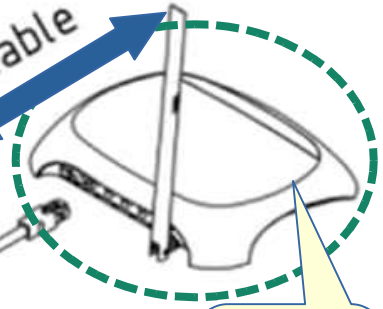
PoE Injector & Cable Adapter

I always seek pragmatic & effective solutions for Emergency Incidents, Events and Other Operations.
These Two MAGIC BULLETS were my Inspiration to Develop a Rapidly Deployable Starlink System!!



Starlink 48VDC PoE Injector Circuit





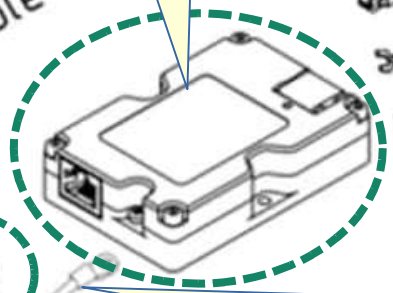
Regular Ethernet cable

Modified Star k cable

Really Normal Shielded LAN Connector

NEW PoE Injector

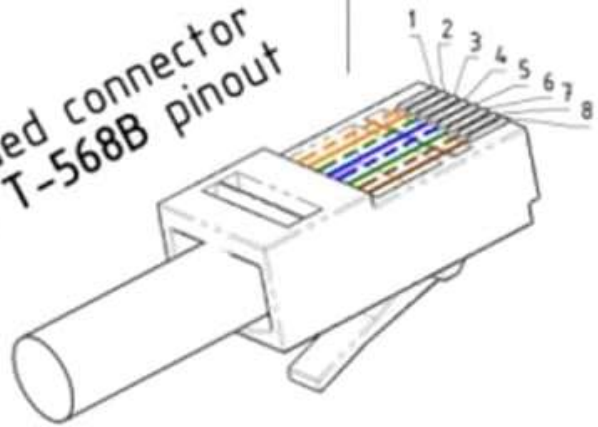
NEW WiFi Router



Really Odd Starlink LAN Connector!

Great Safety Option!!

Modifying the Special Starlink Cable is Both Challenging & Hazardous!!



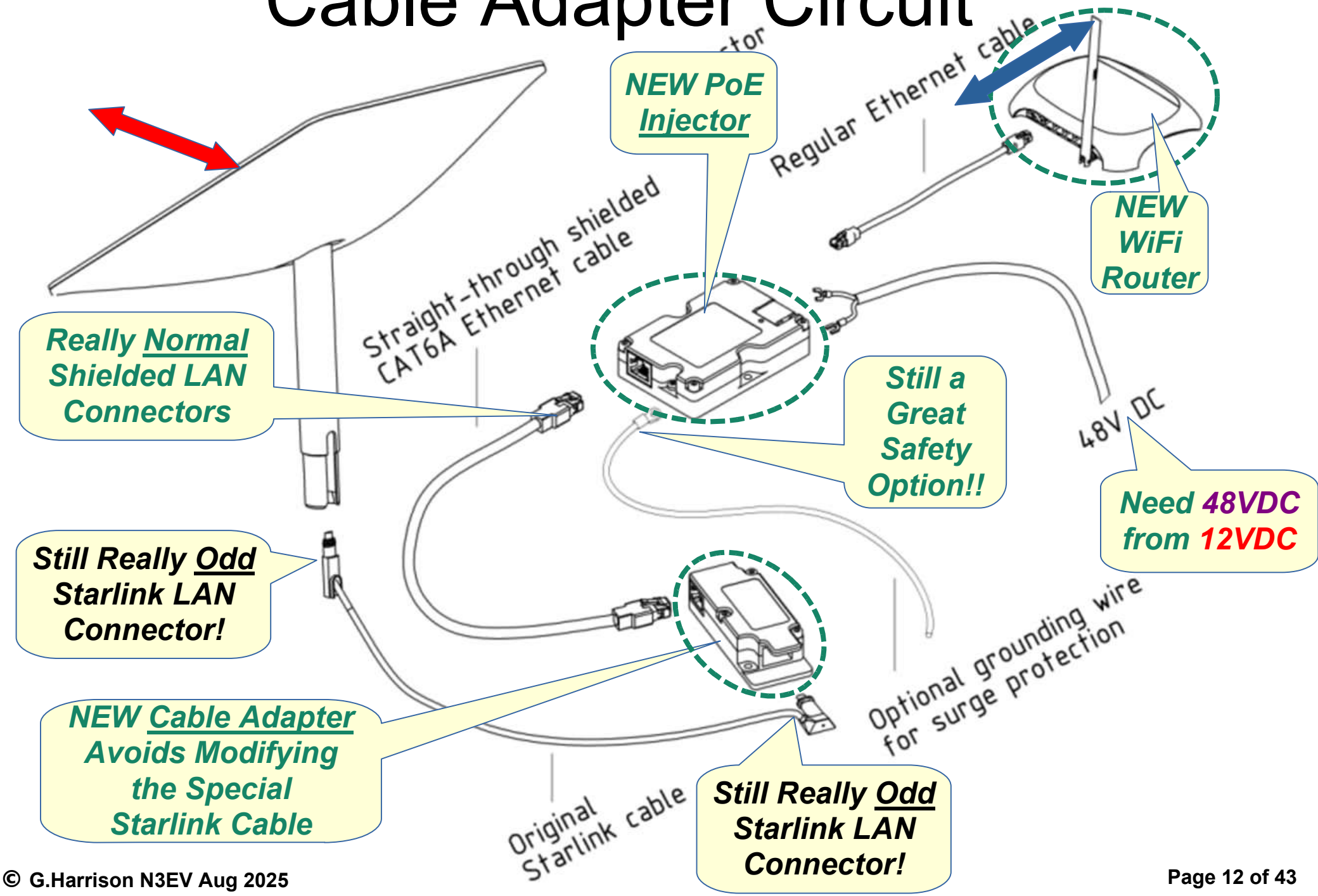
Shielded connector with T-568B pinout

Optional grounding wire for surge protection

48V DC

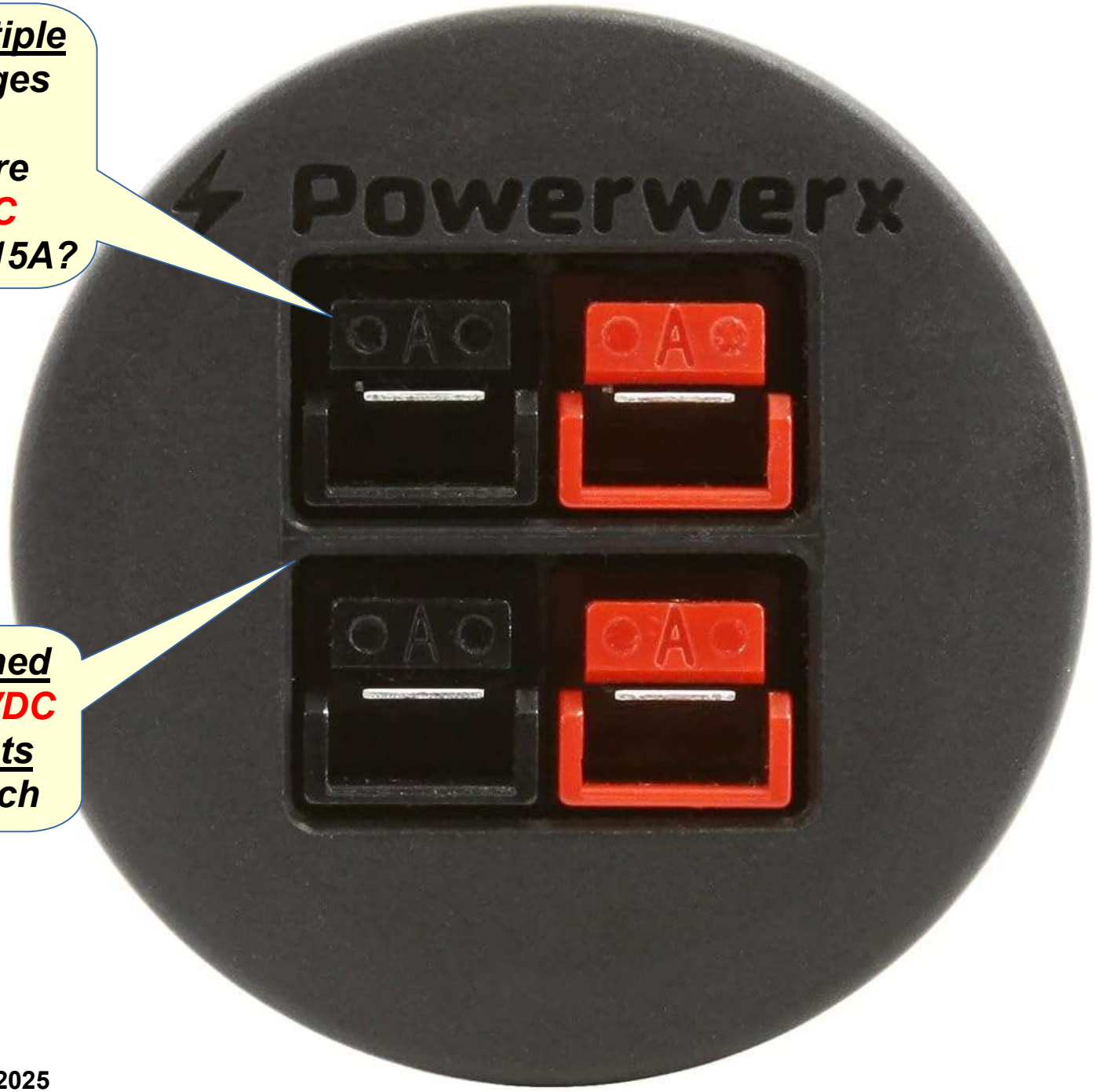
Need 48VDC from 12VDC

Starlink 48VDC PoE Injector & Cable Adapter Circuit



PowerPole WP Dual Feedthru

We Need <u>Multiple</u> Power Voltages Internally, Starting Here With 12VDC Peak Load <<15A?

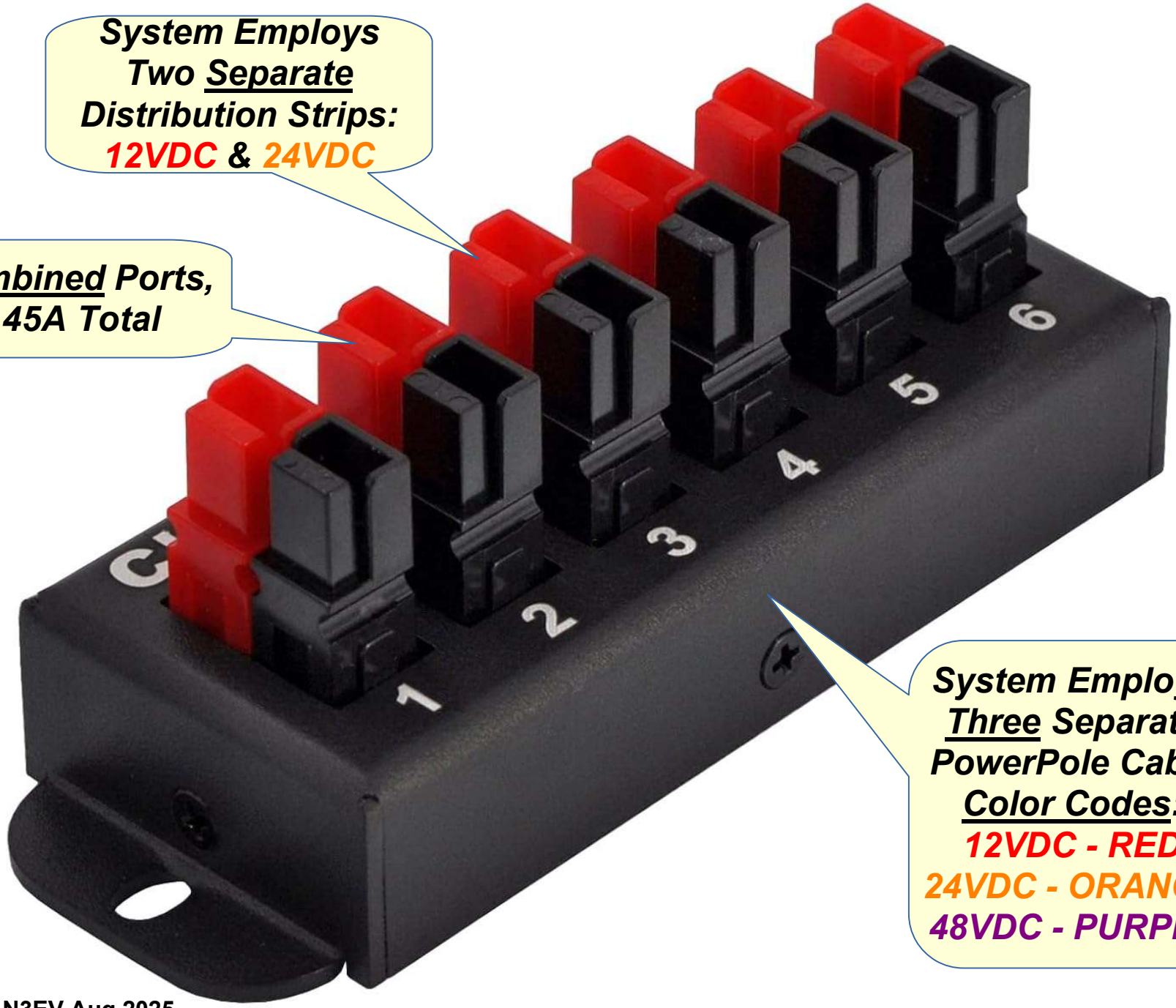


Two <u>Combined</u> External 12VDC Power <u>Inputs</u> Max 45A each

PowerPole 6 Point Distribution

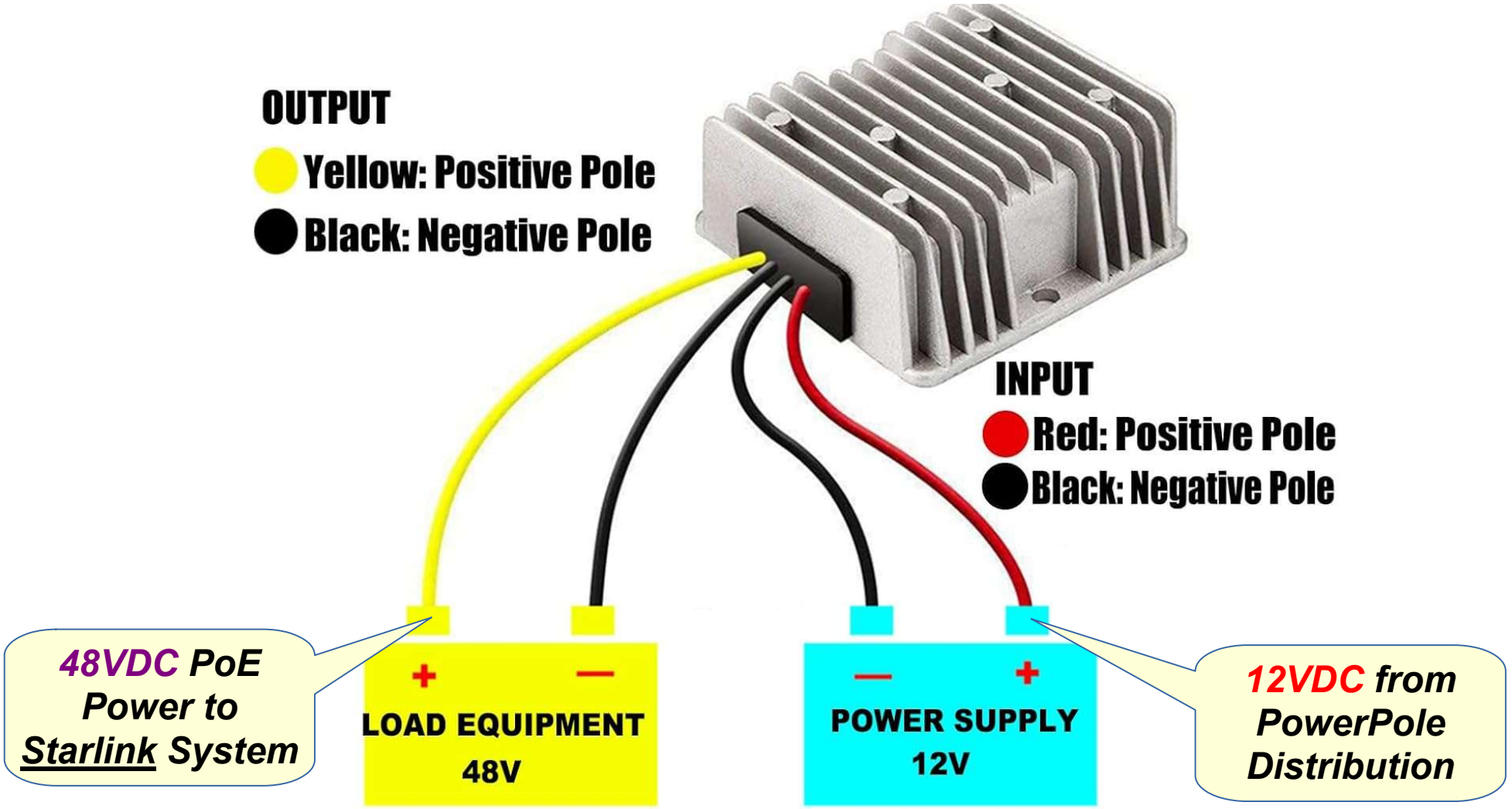
System Employs Two <u>Separate</u> Distribution Strips: 12VDC & 24VDC

Six <u>Combined</u> Ports, Max 45A Total



System Employs <u>Three</u> Separate PowerPole Cable <u>Color Codes</u>:
12VDC - RED
24VDC - ORANGE
48VDC - PURPLE

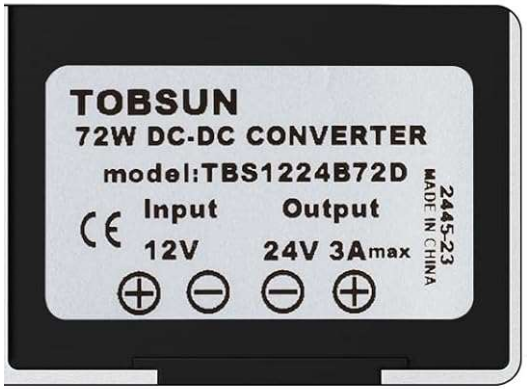
12VDC to 48VDC Converter

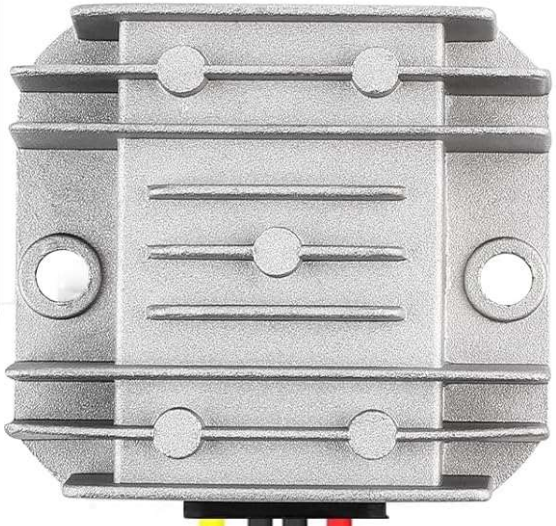


Notice

- The input voltage should not exceed the fluctuation range of the converter can withstand;
- The converter output power must be greater than output connection device required power;
- Positive and negative wires can't be reversed connection.

12VDC to 24VDC Converter





Output
Positive+
Negative-

Input
Positive+
Negative-

***24VDC* Power to *Data* Systems & *PoE* Devices**

***12VDC* from PowerPole Distribution**

+ −

Connect Output Device

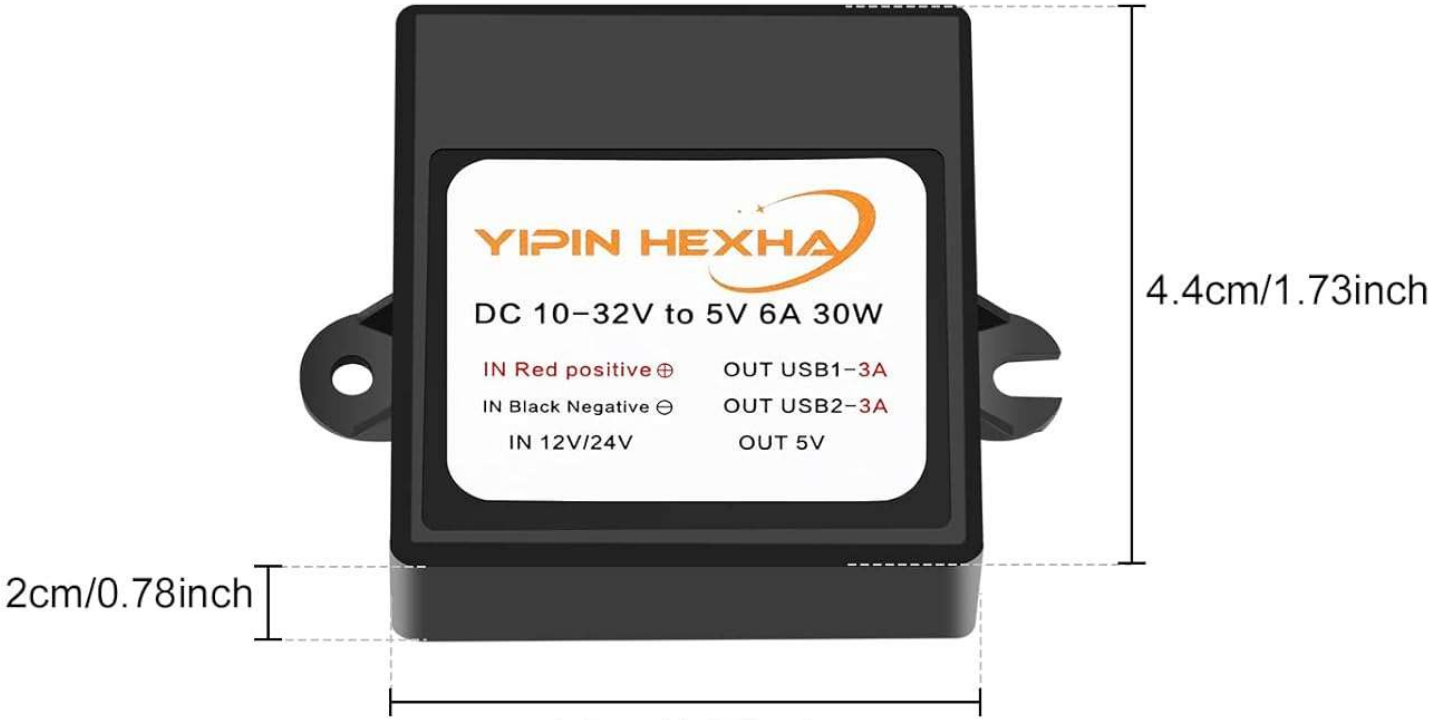
− +

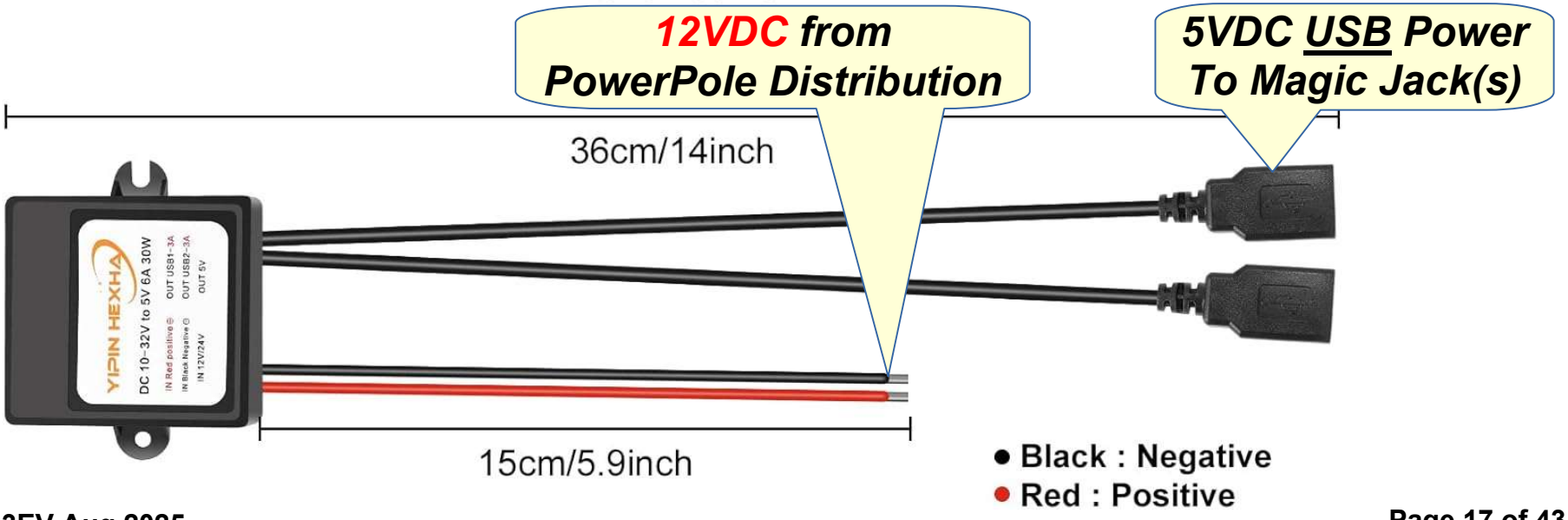
Connect Input Device

NOTICE

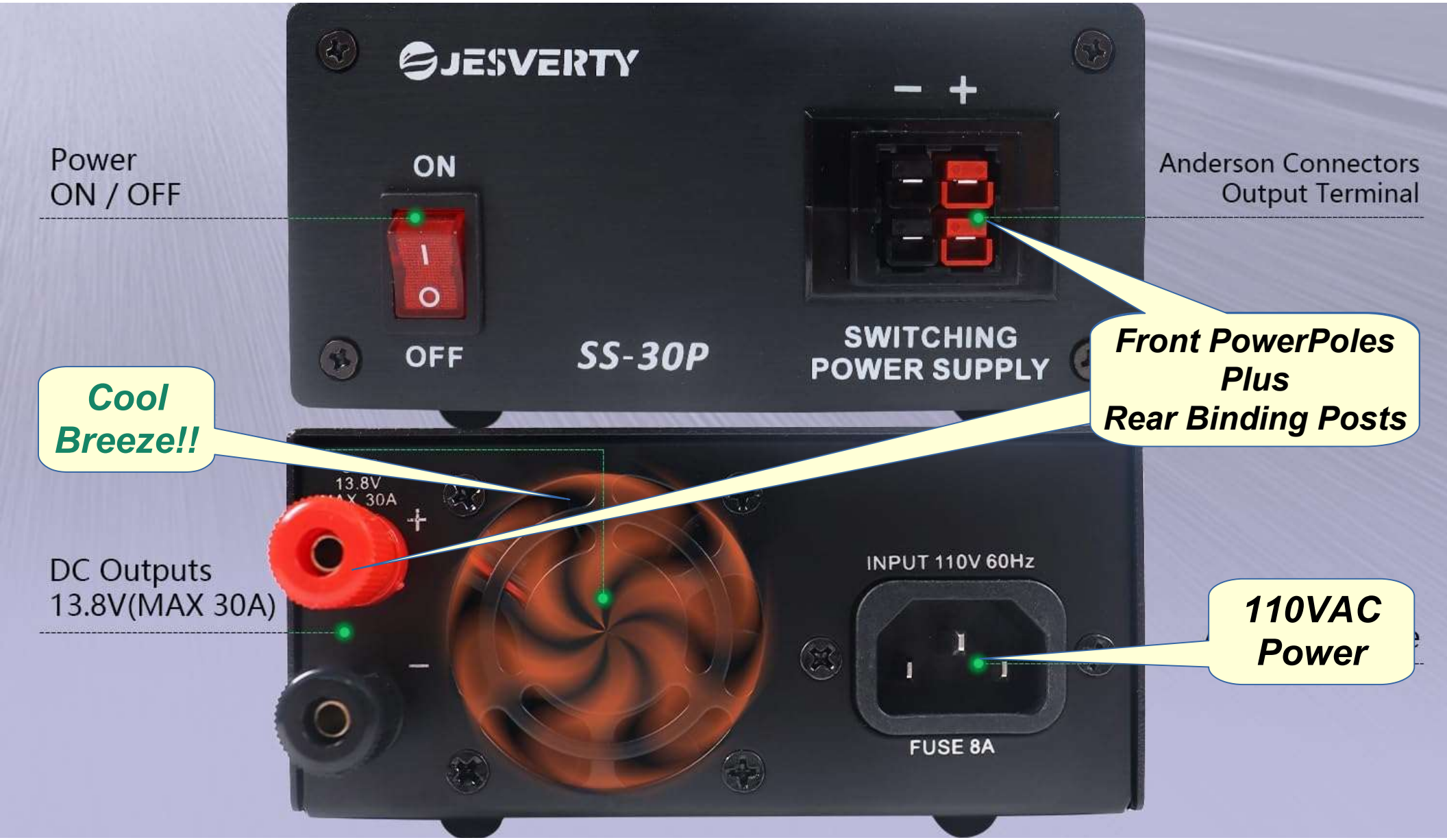
- The input voltage should not exceed the fluctuation range of the converter can withstand
- The converter output power must be greater than output connection device required power
- Positive and negative wires can't be reversed connection

12VDC to 5VDC USB Converter





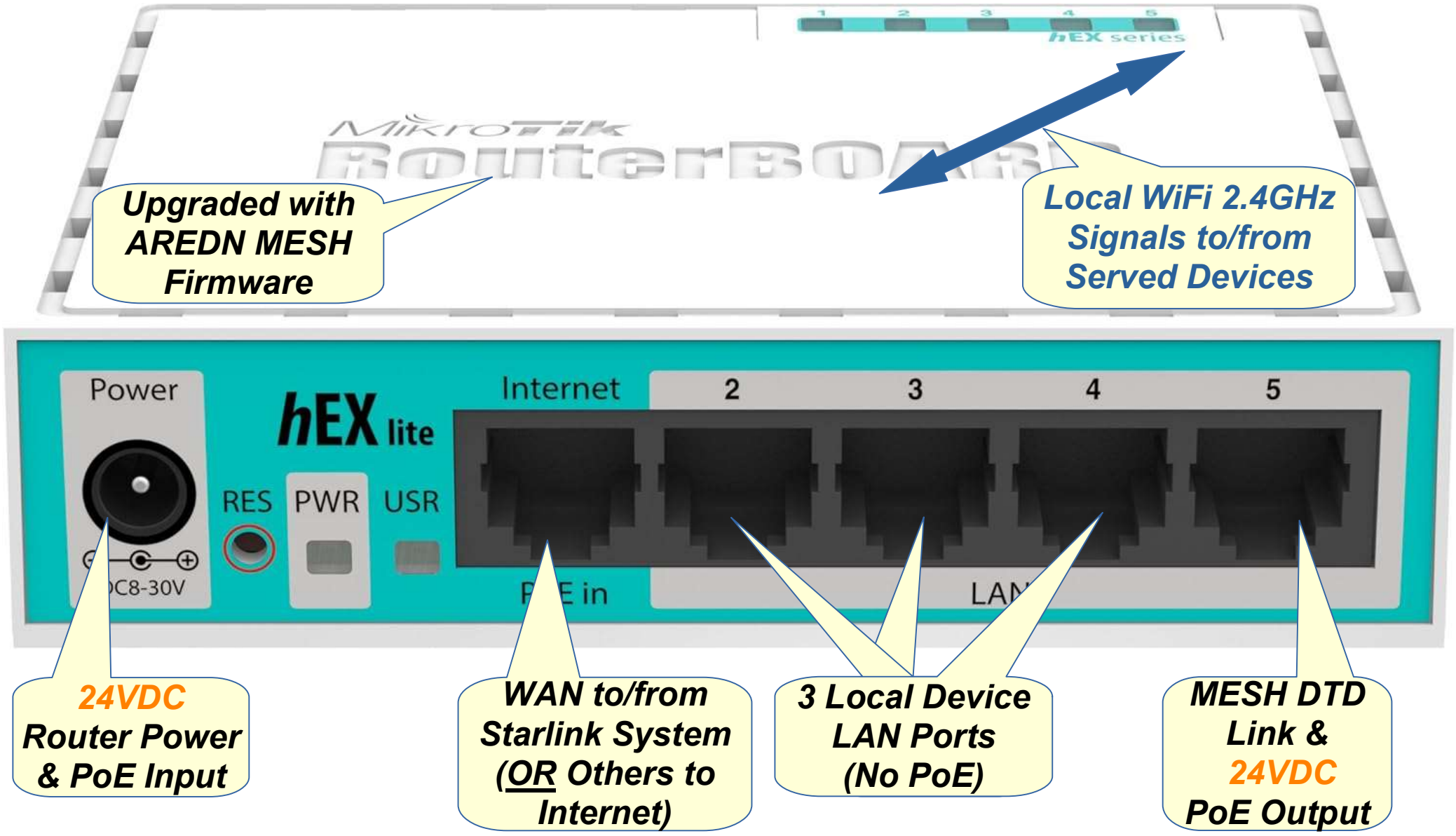
Optional 13.8VDC Power Supply



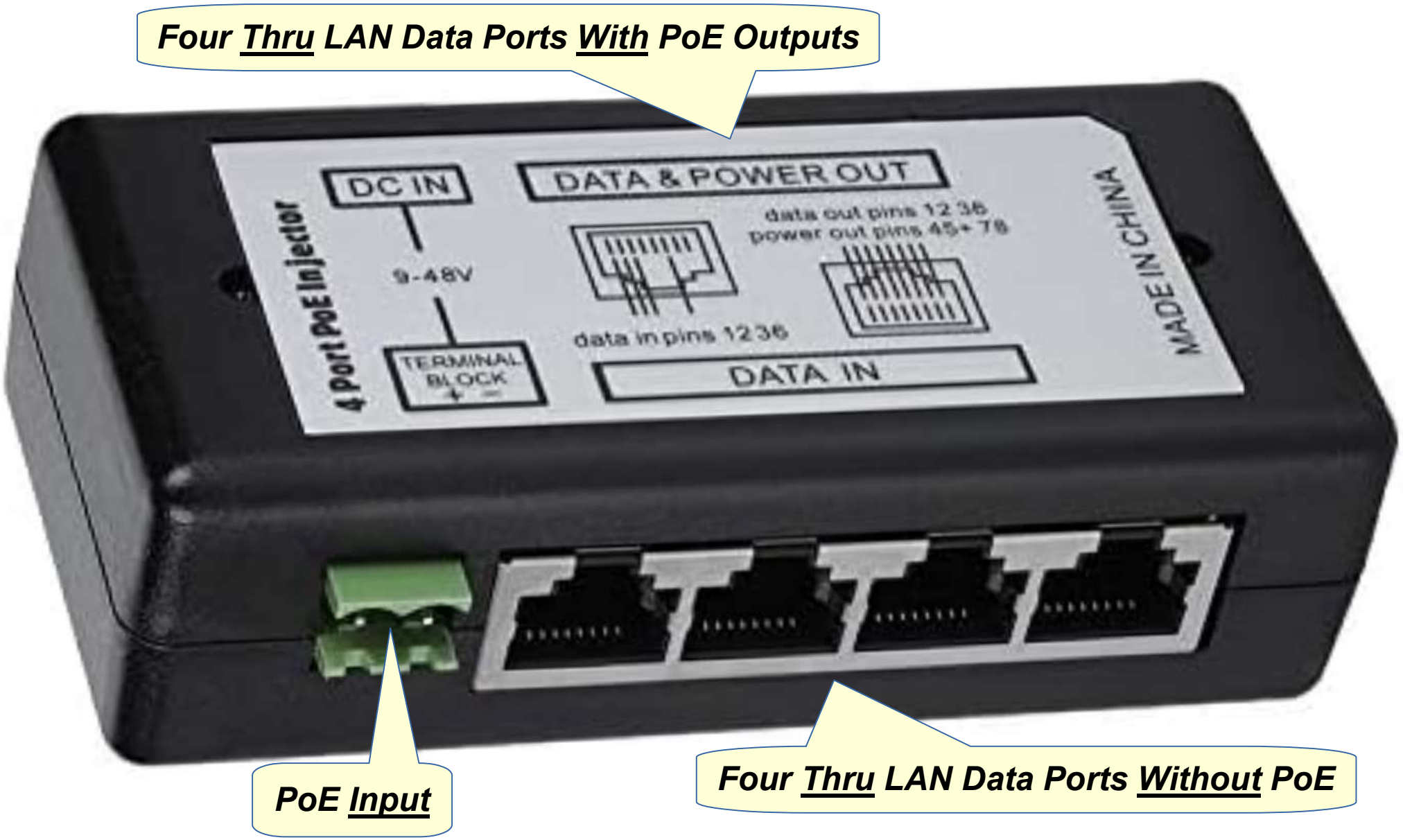
Phase *2*

- Upgrade WiFi Router
  - Replace Limited Starlink WiFi Only Router
    - Retain for Backup Uses
  - Incorporate Modern Flexible MikroTik Router
  - Improve WiFi Capabilities (Optional Dual Band?)
  - Provide multiple LAN Ports for Local Network
  - Provide 24VDC Passive PoE for VoIP Phones, etc
  - Augment Flexibility & Extend Connectivity with Integrated AREDN MESH Node DTD Interface
  - Enable Alternate WAN via Other Internet Access

MikroTik WiFi Router with MESH



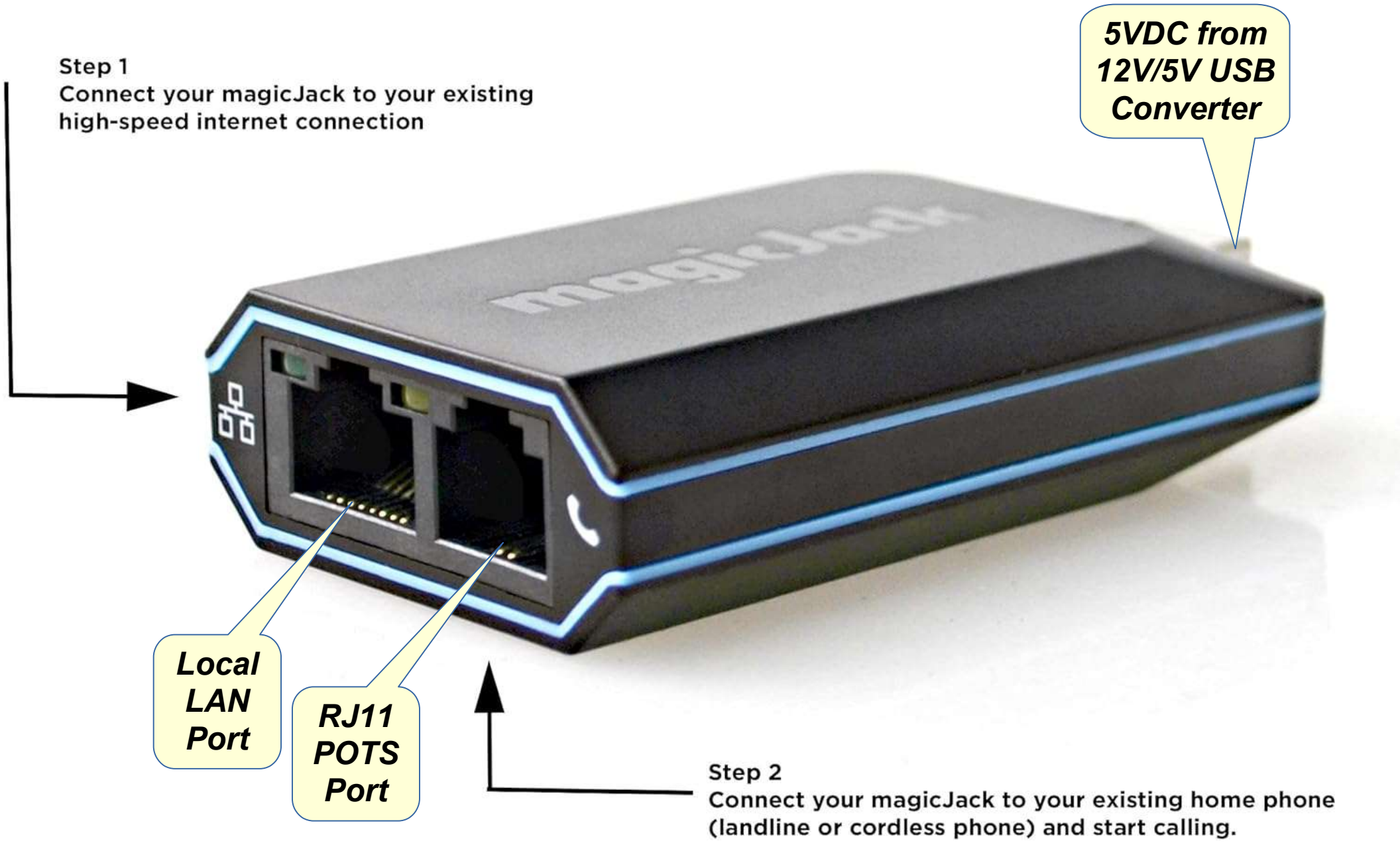
4 Port PoE Passive Injector



Phase *3*

- Add Multiple Telephone Capabilities
  - Conventional Landline Phone or FAX Interface
    - POTS to PSTN & Planet
    - Analog 600 Ohm Loop Start & Touch Tone
    - Employs Magic Jack Module(s) & RJ11 Port(s)
  - Modern VoIP Networked Phone Interfaces
    - VoIP to PSTN (& Many Other VoIP Systems)
    - Digital Data Device Emulates POTS Form & Functions
    - Provides RJ45 LAN & PoE Port, OR...
    - RJ45 LAN Port (No PoE, & separate Power Supply)

Magic Jack (VoIP) POTS Interface



Magic Jack (VoIP) POTS Circuit (Using USB Power)

Phase *4*

- Environment & Transport
  - Package in Weatherproof Housing
  - Add Weatherproof Port Connectors
  - Upgrade Cables
    - Long, Heavy Duty & Shielded
    - With Weatherproof Connectors
  - Pack System in Handy Transport Case
  - Optional Additions:
    - Antenna Mounting Adapters
    - POTS & VoIP Telephones
    - AREDN MESH Node
    - Spare LAN & Other Cables
    - AC Extension Cord and Power Strip
    - Large Portable 12VDC Battery, & Charger
    - Car 12VDC Power Cable
  - Inventory List & Handy Instructions?

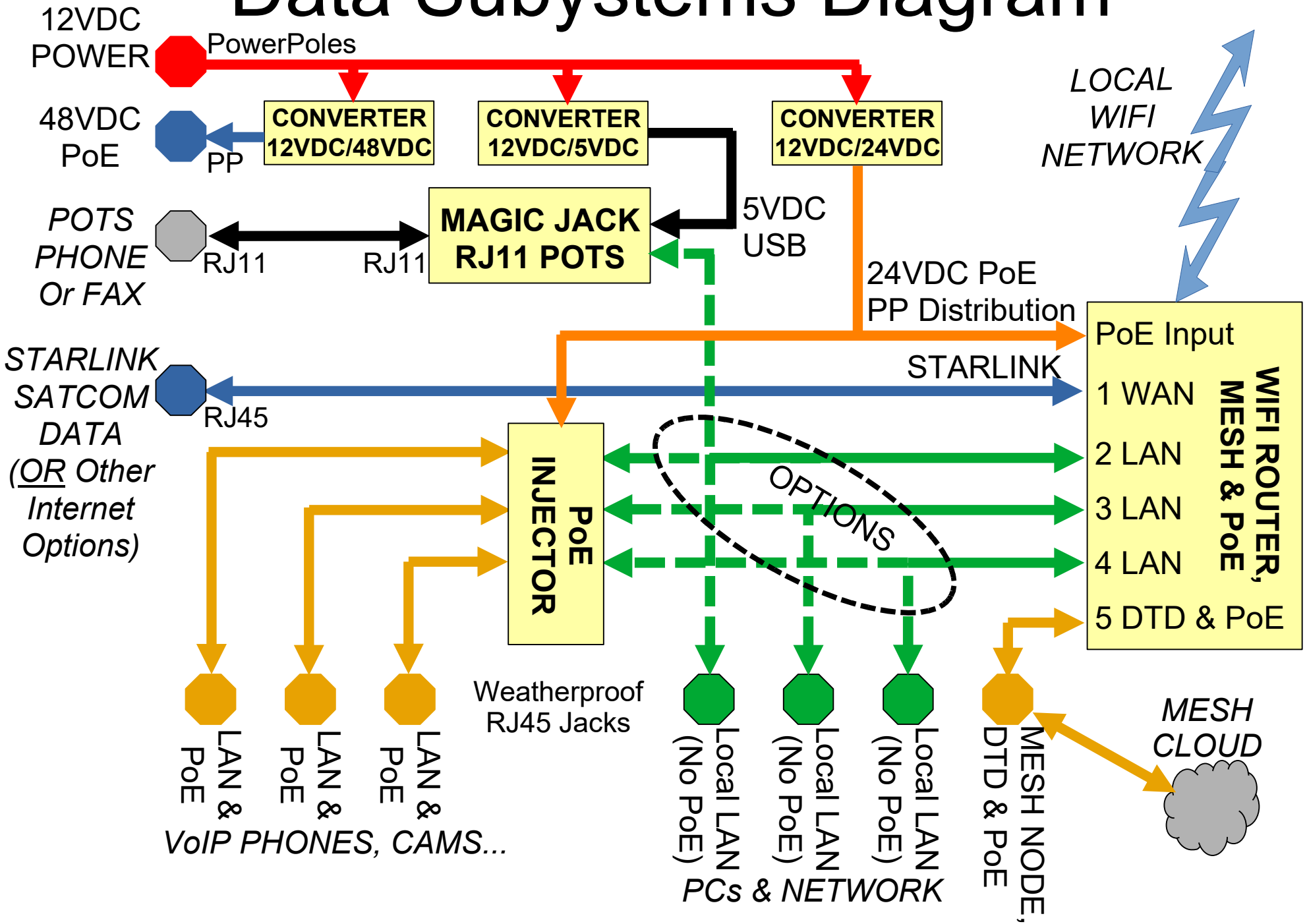
Weatherproof LAN Bulkhead Kit

Waterproof LAN Connector

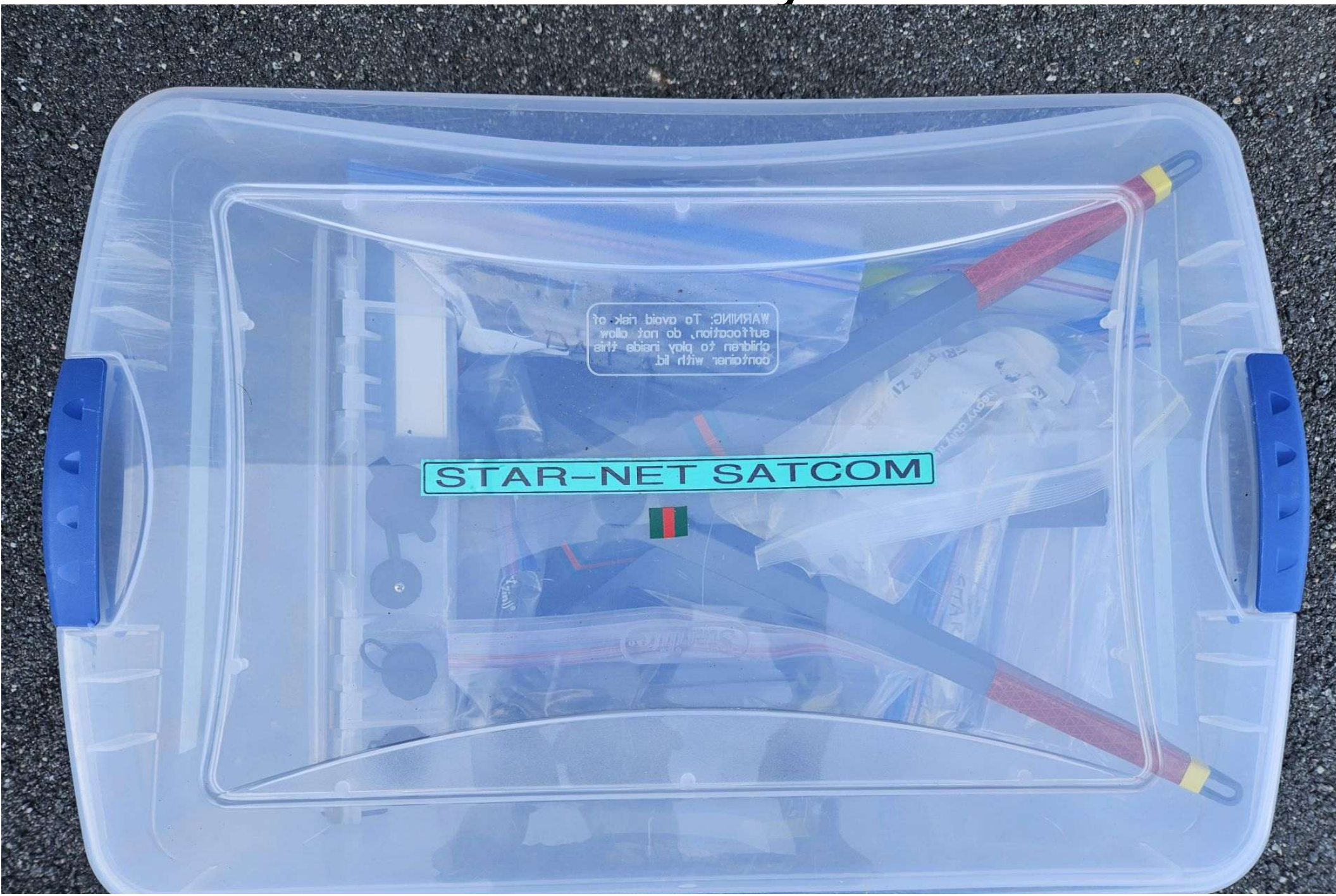
Waterproof LAN Connector Kit

These RJ45 waterproof connectors can accommodate Ethernet cables as large as CAT6 CMX rated, down to standard CAT5.

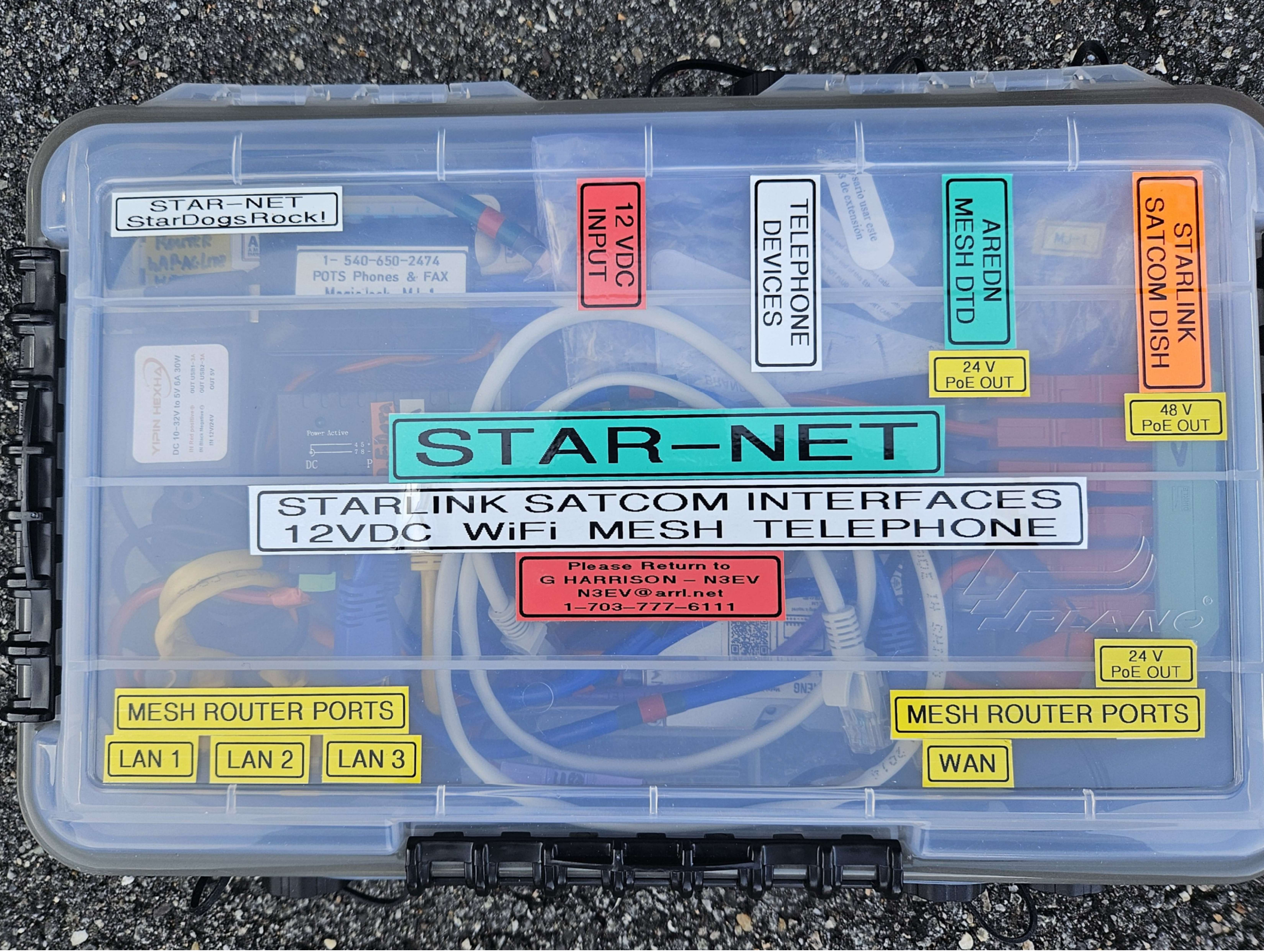
Data Subsystems Diagram

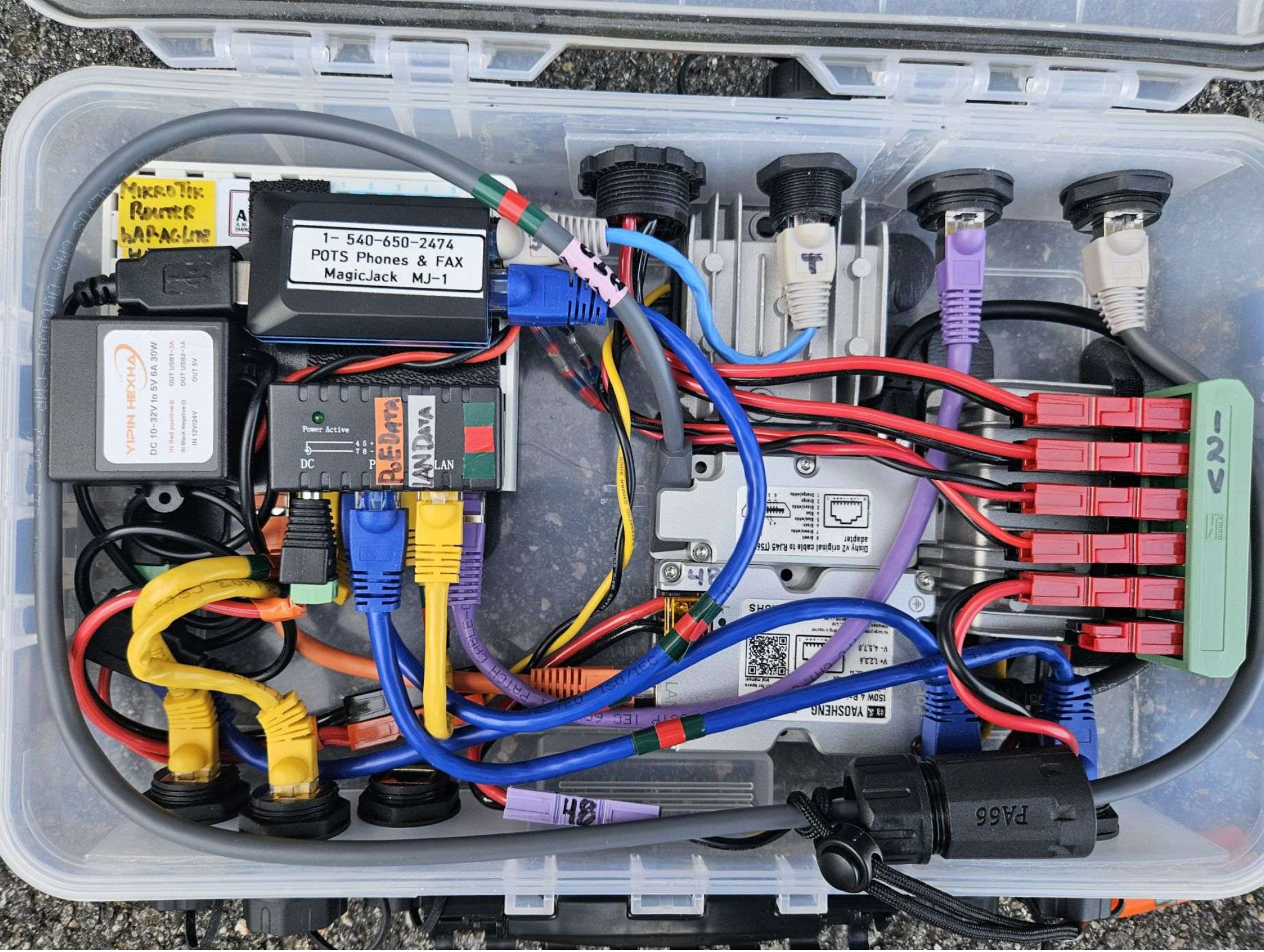


STAR-Net System



DATA
Smart Zip


STAR–NET
StarDogsRock!
1- 540-650-2474
POTS Phones & FAX
12 VDC
INPUT
TELEPHONE
DEVICES
AREDN
MESH DTD
24 V
PoE OUT
STARLINK
SATCOM DISH
48 V
PoE OUT
STAR–NET
STARLINK SATCOM INTERFACES
12VDC WiFi MESH TELEPHONE
Please Return to
G HARRISON – N3EV
N3EV@arrl.net
1–703–777–6111
24 V
PoE OUT
MESH ROUTER PORTS
LAN 1
LAN 2
LAN 3
MESH ROUTER PORTS
WAN


MIKROTIK
ROUTER
1- 540-650-2474
POTS Phones & FAX
MagicJack MJ-1
YIPIN HEXHA
DC 10-32V to 5V 6A 30W
Power Active
DC
LAN
PA66

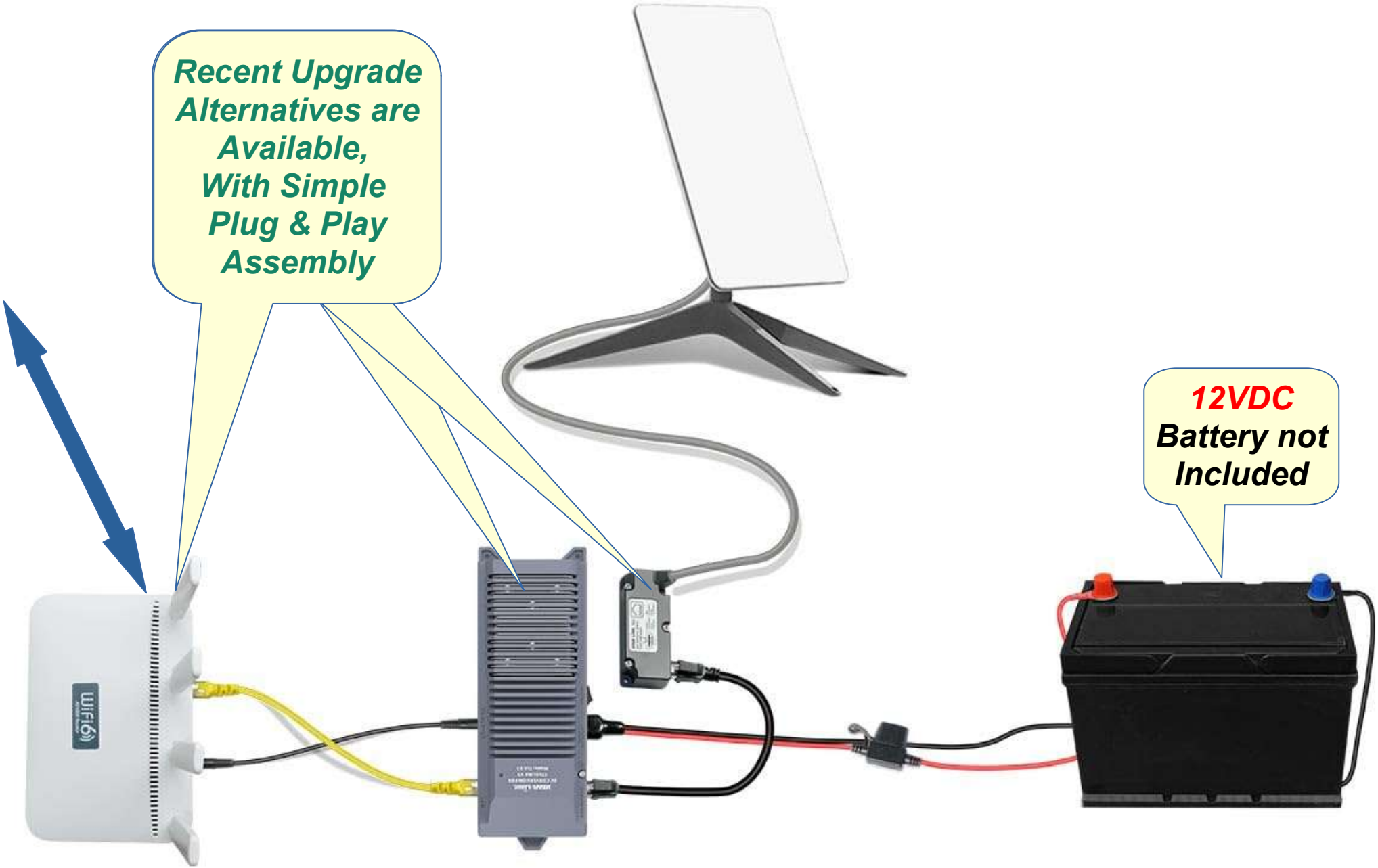

DISH
Ziploc
ANTENNA
DATA
CABLE
40 SOFT
(ROUTER TO DISH
STAR-NET
540-861-1425
HHUS 12425
PASSIVE
PoE or
54VDC 2A PS
PA66
PA66
LAN ADAPTER
STARLINK
LAN
ADAPTER


540-861-1425
HHUS 12425
PASSIVE
PoE or
5VDC 2A PS
STAR-NET
StarDaggsRock!
12 VDC
INPUT
TELEPHONE
DEVICES
AREDN
MESH DTD
24 V
PoE OUT
STARLINK
SATCOM DISH
48 V
PoE OUT
STAR-NET
STARLINK SATCOM INTERFACES
12VDC WiFi MESH TELEPHONE
Please Return to
G HARRISON - N3EV
N3EV@arrl.net
1-703-777-6111
24 V
PoE OUT
MESH ROUTER PORTS
WAN
MESH ROUTER PORTS
LAN 1
LAN 2
LAN 3
12V SW B
30A MAX
12V HDTH
40A MAX
SWITCH B
ON OFF OFF
BATTERY BOX
BB-1 Gene
WARNING!!!
14.4V 40AH
LiFe Battery
12V SW A
15A MAX
12V HDTH
30A MAX
SWITCH A
ON OFF

What Should *You* Do Today??

- IF *You* want to build a Rapidly Deployable Starlink System Today….
- Pick *todays* “Best” Starlink terminal to fit *Your Mission*
  - 2G terminals still good performance at very modest prices
  - 3G terminals have equal or better performance, are smaller & lighter, but are more expensive
  - Mini is a bit slower, but excellent for man-pack & remote operations
  - Shop for Sales, Discounts, Refurbished and Used for best deals!
- Most Starlink versions now have 12VDC kits, vs DIY
- Now many available accessories avoid custom engineering
- Optional weatherproofing is simple & inexpensive
- Other good options are WiFi routers, MESH connectivity, phone adapters (VoIP or POTS), long cables, etc.
- New flexible & economical Plans available (stay tuned!!)

Power Gen 2 Starlink 12/24VDC Kit



Power Gen 2 Starlink 12/24VDC Kit

Plastic Housing **EL3 V2 SET**

Basic 12/24VDC Conversion Kit = $160

Includes WiFi Router & Cables (No Battery)

XTAR-Link EL3 V2

RJ45 Adapter for Gen2 Dish

RJ45 Cable for Adapter

Power Cable A for EL3 V2

Power Cable for Router

Router WiFi 6

RJ45 Cable for Router

Additional AC Adapterfor Router

Power Gen 2 Starlink Use

News & Clues!!

- Significant Plan Changes!!
  - There are many Starlink Service Plans for Residences, Businesses, Mobile & Maritime, Aviation, and other continuous duty services, so check the Site.
  - The *Roam* Plan was $*10*/mo, with modest 10GB data when ON, with No Cost *Suspension* when OFF – Great for Intermittent Events
  - Now replaced by *Standby Mode* for $*5*/mo, with unlimited low rate data, and always ON – Still Good
  - IF using Roam Suspended, Users *must* switch by 13 Sep 2025, or their service will be *canceled!!!*
  - BUT the Starlink Plans can be turned ON or OFF almost anytime, *without charges*, and only a tiny delay
  - Soooo, pick your favorite and do it!
  - P.S.- I just tried switching & it was not smooth...

Equipment & Parts Clues

- Starlink SATCOM Systems
- https://starlink.com

- Starlink Gen 2 Pipe Adapter 2” - $27
- https://www.amazon.com/dp/B0D3GZDYWZ

- Weatherproof RJ45 Couplers - $4/ea
- https://www.amazon.com/ANMBEST-Shielded-Waterproof-Connector-Ethernet/dp/B0BY2KXW74

- Weatherproof RJ45 Bulkhead - $4
- https://www.amazon.com/dp/B07KSSV8LD

- Voltage Converter 12V/48V 288W - $30
- https://www.amazon.com/dp/B0B7WZGCM3

- Voltage Converter 12V/24V 72W - $14
- https://www.amazon.com/dp/B07XBWHR56

- Voltage Converter 12V/5V Dual USB - $13
- https://www.amazon.com/dp/B0BCP6WPBD

- Four Port Passive PoE Injector - $12
- https://www.amazon.com/dp/B07XCN5GHJ
-
- Power Supply, 13.8VDC 30A - $70
- https://www.amazon.com/dp/B0D1MY6BZ1
- .

- PowerPole WP Dual Bulkhead - $25
- https://www.amazon.com/dp/B097QDKJJ2

- PowerPole Distribution 6 point - $26
- https://www.amazon.com/dp/B07KQD9V3G

- High Power 150W PoE Injector - $40
- https://www.amazon.com/YAOSHENG-Passive-Injector-Protection-Developed/dp/B0BX74T2T5

- Starlink Cable Adapter to RJ45 - $23
- https://www.amazon.com/dp/B0BYJTHX4P

- WiFi Router & PoE & MESH FW - $40
- https://www.amazon.com/Mikrotik-RouterBOARD-lite-ports-router/dp/B00ZPTW8T2

- Magic Jack POTS Phone Interface - $45
- https://www.magicjack.com/

- Starlink Gen 2 DC Converter Kit - $160
- https://www.amazon.com/XTAR-Link-EL3-Starlink-Consumption-V2/dp/B0DJVF3ZW2

- Satellite Phone Store (Lots of Options!)
- https://satellitephonestore.com/

References & Credits

- SpaceX Starlink – Lots of cool gear & plans.
- https://starlink.com
-
- Amazon Shopping! Excessive means to disappear your family funds!
- https://amazon.com
-
- Photos: N3EV, and likely other suspects!
-
- Please send your great photos and hot ideas to: Gene Harrison - N3EV@arrl.net
-
- Hint!! IF you want to build your own system, Please feel free to contact the Author for pragmatic plotting & scheming!
- .

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Questions?
Discussion?
Good Ideas?

Gene Harrison

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