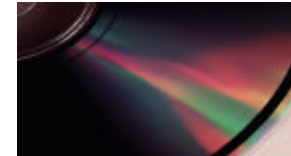




**BROADBAND**



# **NEC Article 830: Practical Applications**

Presentation to the  
**Protection Engineers Group**  
of the  
**Alliance for Telecommunications**  
**Industry Solutions**

Las Vegas, NV  
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**Gary Donaldson**  
Director, HFC Design & OSS  
AT&T Broadband, Englewood, CO  
[gdonaldson@broadband.att.com](mailto:gdonaldson@broadband.att.com)



# AT&T Broadband's business plan

## *Full-service suite of broadband product offerings:*

- **Video:** Analog & digital, including VOD
- **High-Speed Data (HSD):** DOCSIS-compliant cable modems
- **Telephony:** Primary line (implying E-911 responsibilities) circuit-switched today; voice over internet protocol (VoIP) in near future



# Primary Line Telephony Service

## *Key Issues:*

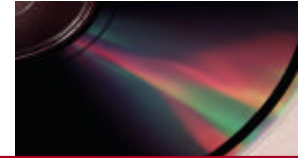
- Should Network Interface Units (NIUs) be powered from network, or locally-power at customer premise?
  - NEC 830 compliance issues with installations
  - Cost & complication to provision network for powering through the service drop
  - Craft training & safety
  - Operational issues with NIU access & reliability
- How to deal with “high power” installations which are not covered by NEC 830?
  - Multi-Dwelling Units (MDUs)
  - Commercial & campus installations



# Primary Line Telephony Service

## *Why power NIUs from the network?*

- **RELIABILITY:** Industry standards require 99.99% network reliability, equivalent to ~53 minutes of annual down-time
- **NIU ACCESS:** Practical considerations require that premise-powered NIUs are installed internally, making them relatively inaccessible
- **NETWORK MONITORING:** The premise power supplies must be closely monitored to determine battery condition
- **CUSTOMER INTERFERENCE:** Customers inadvertently disconnect the NIU power supply from the AC source
- **OUTSIDE PLANT:** In hybrid fiber-coax networks, active equipment requires reliable powering regardless of NIUs' power needs; Powering through the drop is not a big stretch, but...

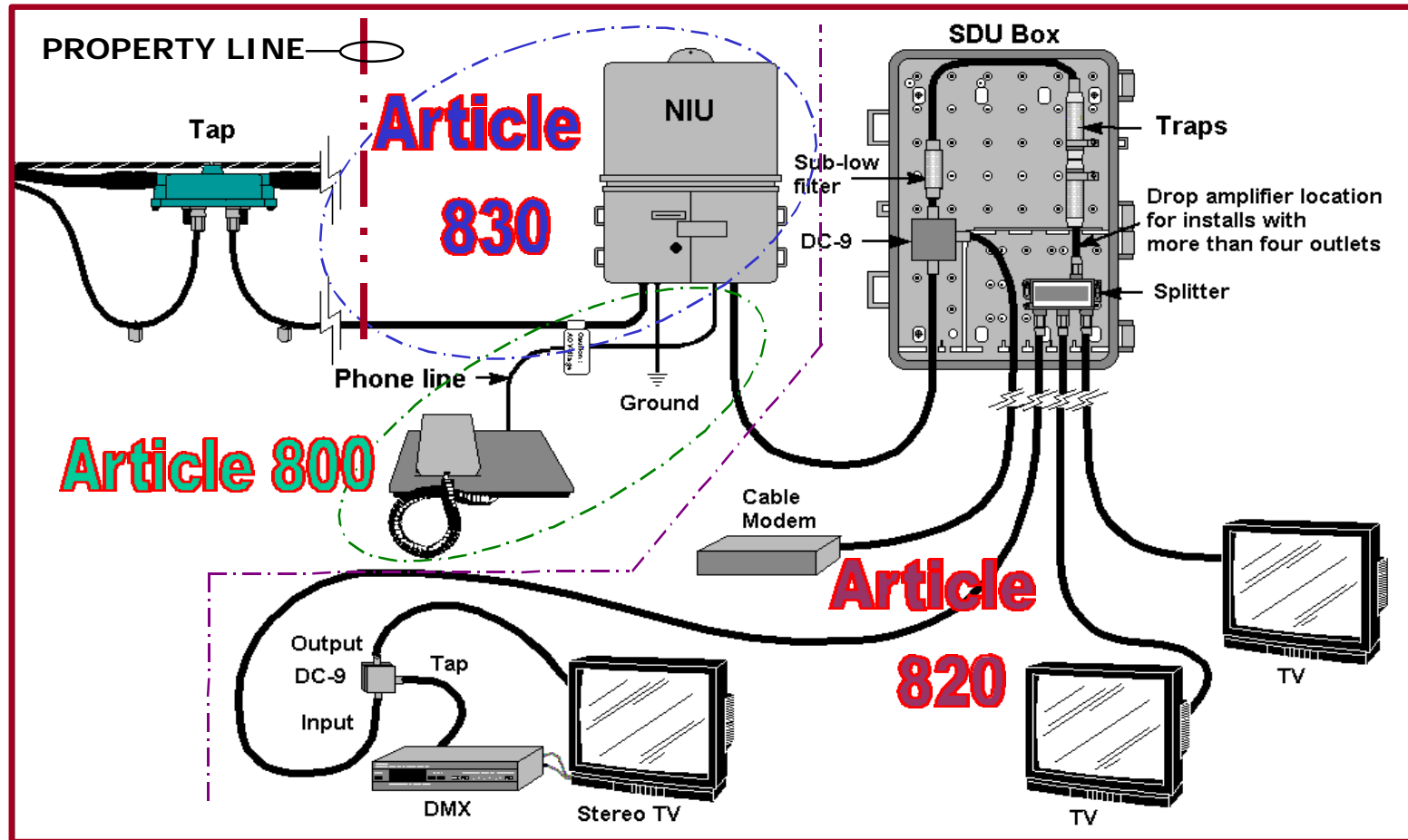


## **AT&T Broadband's Emphasis Regarding NEC Compliance in Home Installations**

- Ensure compliance with low-power circuit provisions of §830-4, obviating some costly cover & protection requirements through use of a listed fault protection device
- Comply with NRTL (UL<sup>®</sup>) listing of power-passing network components per §830-5
- Comply with cable listing, marking, voltage & flame-spread requirements of §830-5
- Comply with Primary Electrical Protection requirements of §830-30
- Comply with more stringent grounding conductor size requirements of §830-40(a)(3)

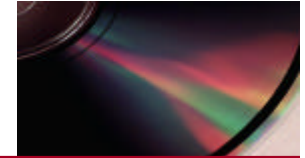


## Generic illustration of a Network Interface Unit installation showing derived circuits for voice, video and high-speed data





# Safety Issues with 60 Hz AC



60 Hz Current	Physiological Phenomenon	Feeling or Lethal Incidence
< 1 mA	None	Imperceptible
1 mA	Perception threshold	
1 – 3 mA		Mild sensation
3 – 10 mA		Painful sensation
10 mA	Paralysis threshold in arms	Cannot release hand grip; If no grip, may be thrown clear
30 mA	Respiratory paralysis	Stoppage of breathing (frequently fatal)
75 mA	Fibrillation threshold (0.5%)	Heart action discoordinated
250 mA	Fibrillation threshold (99%) (<5 seconds exposure)	
4 A	Heart paralysis	Heart stops for duration of current passage
>5 A	Tissue burning	Not fatal unless vital organs are burned

Powering home terminal equipment from the broadband network will expose craft personnel (installers) — and inadvertently some members of the public — to network power which had previously been isolated from access.

Source: *Meeting the Requirements of Article 830 of the 1999 NEC*; Chamberlain & Sniezko, 1999



Key special provisions for network-powered broadband equipment installations per Article 830:

- Power is limited to 100 VA per §830-4
  - *Controlled by Positive Temperature Coefficient (PTC) current-limiting device installed in multitap at curb*
- Stringent clearance, cover and protection requirements
  - *Specific requirements for aerial & underground installations specified in §830-10 & §830-11 defining clearances, ground cover and mechanical protection of power-bearing cables*
- Enhanced ratings for power-bearing broadband cables
  - *Newly-defined cable types under §830-5 for low- and medium-power broadband applications (voltage & flame-spread ratings)*
- More stringent grounding requirements
  - *Procedures unmodified, but conductor size determined by ampacity of both shield and protected conductors per §830-40*



# Broadband Cable Ampacities



***From §820-40(a)(3): "The grounding conductor...shall have a current-carrying capacity approximately equal to that of the outer conductor of the coaxial cable."***

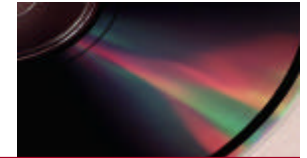
***From §830-40(a)(3): "The grounding conductor...shall have a current-carrying capacity approximately equal to that of the grounded metallic member(s) and protected conductor(s) of the network-powered broadband communications cable."***

Cable Type, Broadband Coaxial Drop Cables	Conductor Ampacity in Amperes at 20°C (68° F)		
	Outer Conductor (Article 820 std)	Inner Conductor	Total (Article 830 std)
RG-59, 67% & Tri-shield	21.5	7.5	29.0
RG-6, 60% & Tri-shield	22.5	9.5	32.0
RG-6, Quad-shield	31.0	9.5	40.5
RG-11, Standard	32.5	17.5	50.0
RG-11, Quad-shield	42.5	17.5	60.0

Source: Data table from CommScope, Inc., 2000



# Fault Protection Device



The Fault Protection Device is defined under §830-2 as device to protect personnel from electrical shock, and which functions under fault conditions, such as an open or short circuit

- Applies only to low-power circuits (<100 V, <100 VA)
- Must be listed as suitable for the purpose
- Obviates mechanical protection provisions of §830-10(i)(4) and §830-11(c)

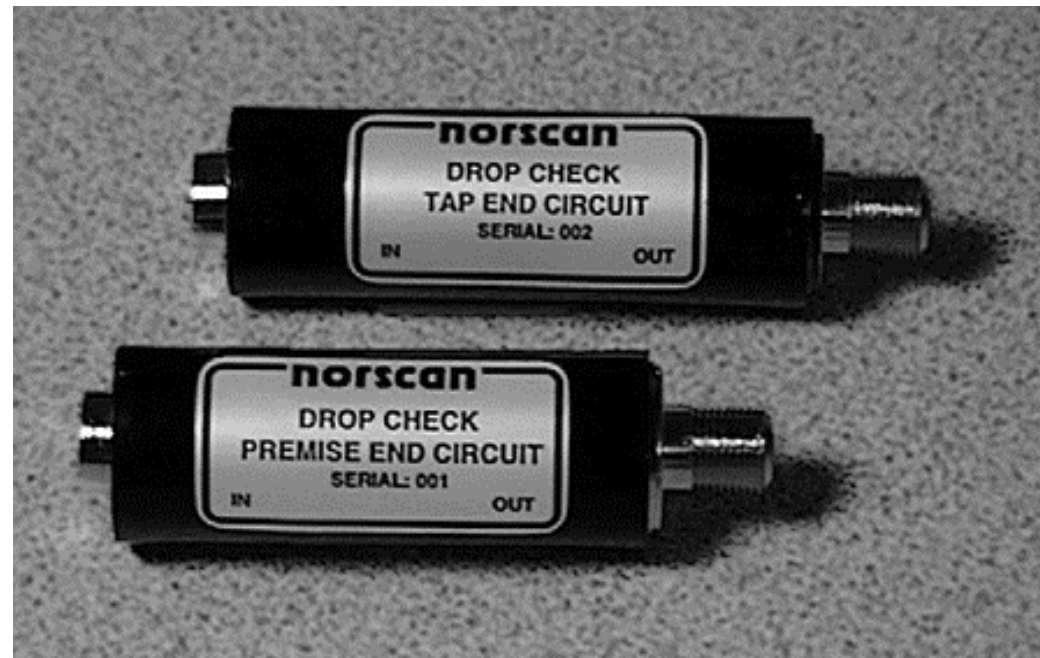


Photo courtesy Norscan, Inc.

- Practical matters: Must have low RF insertion loss, low RF return loss, flat RF response, and operate reliably under a reactive load



**Issue: NEC Article 830 addresses low- and medium-power broadband installations (not to exceed 100 VA), but what about the inevitable high-power applications?**

- **Possible applications:**
  - MDU, campus & commercial property installations
- **NEC Jurisdiction per §90-2 Scope:**
  - **Covered [§90-2(a)(1)]:** Installations within or on public and private buildings and other premises such as yards
  - **Not Covered [§90-2(b)(4)]:** Installations of communications equipment under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations



## ***High-power installation options:***

- **Install cable and equipment in a manner consistent with the communications utility exclusivity provisions of §90.2(b)(4)**
  - *CLEC issue: Can a CLEC be legitimately defined as a “communications utility”?*
- **Operate under NEC Article 820, and the energy limitations of §820-4**
  - *60 volts maximum with no specific power limits except that the current is delivered from a “transformer or other device that has energy-limiting characteristics”*



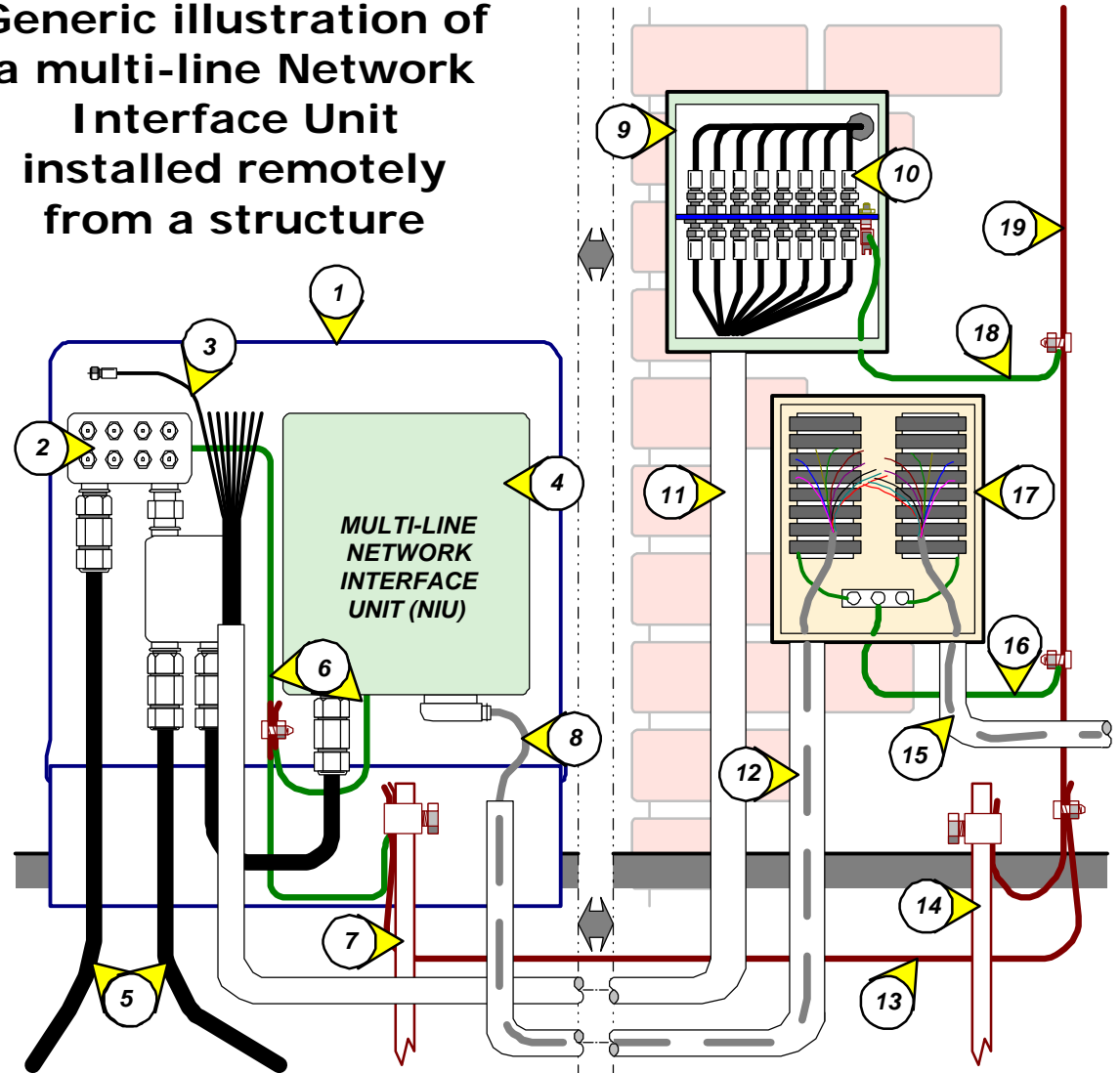
# Multi-line NIU: Remote



**Legend:**

- 1. Broadband Pedestal
- 2. Broadband Multitap
- 3. Video Coax Service Drops
- 4. Broadband Network Interface Unit (NIU)
- 5. Broadband Coax Distribution
- 6. Coax & NIU Grounding Conductors
- 7. Broadband Grounding Electrode- 8. CLEC Multi-pair Telephone Service Cable
- 9. CATV Inside Wire X-Connect Box
- 10. CATV Inside Wire Coaxial Cable
- 11. Conduit, Video Service Wire (Sch.40)
- 12. Conduit, Phone Service Wire (Sch.40)
- 13. Bonding Jumper, #6 AWG (<6 ft length)
- 14. Structure Grounding Electrode
- 15. Conduit, ILEC Phone Service (Sch.40)
- 16. Cross-connect Box Bonding Jumper
- 17. Telephone Inside Wire X-Connect Box
- 18. Cross-Connect Box Bonding Jumper
- 19. Structure Grounding Conductor

**Generic illustration of a multi-line Network Interface Unit installed remotely from a structure**







***Prerequisites: Operation at high voltage (>60 volts) is permissible under the NEC if:***

- The broadband installation is outside the scope of the NEC as defined under §90-2(a)
- The broadband installation meets the communications utility exclusivity provisions of §90-2(b)(4)
- The broadband installation, if within the jurisdiction of the NEC, does not exceed the power limitations of §830-4 (*in which case the other provisions of Article 830 apply*).

***Options: In cases where it is impractical to comply with the above rules, the broadband operator may:***

- Operate the plant equipment under the guidelines of Article 820, and locally-power the NIU terminal equipment
- Decline to offer any broadband services



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# End of Presentation

*Thank you for your interest*