12 GHz
The New Frontier
Exploring 4K Cable Technology

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Product Line Manager – Entertainment
Choices for 4K 12 GHz Infrastructure

- Fiber Optic Cable
- Premise/data cable
- Coaxial Cable
Fiber Optic Cable

• Single mode
  – Unlimited bandwidth
  – Unlimited distance
  – Multimode
    ▪ Single mode price approaching multimode

• Conversion: electrons to photons
  – Fiber is cheap, conversion is not

• Fiber will win when….
  – Fiber amplifiers, splitters, optical circuitry
Video and IP – Twisted Pairs or Fiber

- Grass Valley is promoting video over IP.
- In installations of 16 cameras or more.
- TICO compression….a gentle 4:1
- Takes 12 GHz down to 3 GHz
- On a 10GbaseT data cable
  - Three 12 GHz TICO signals
  - 1 GHz left over – audio, control, metadata
Copper Twisted-Pair Data Cable

- Category 6a, “augmented” Category 6
  - 10GbaseT
  - 10 gigahertz bandwidth, 10 gigabits data rate
  - 100Ω 100m (328 ft.)
A New Kind of Category 6a Cable – 10GXS
A New Kind of Category 6a Connector – REVConnect
SFP and Copper/Glass Data Cables

• Can change instantly between twisted pairs and fiber
Belden 4794R – first of many 12 GHz 4K single-link coax
20 Years of Improvements

• Center conductor
  - Silver-coated copper

• Dielectric
  - New high performance polyethylene

• Shield
  - Foil-Braid-Foil
  - Foil bonded to core, foil bonded to jacket
  - Highest shield effectiveness we have ever made
  - Special braiding machines – 95% coverage tinned copper
NEW: Belden 4855R

• The 4K version of Belden 1855A
• Diameter 4.03mm, 0.159 inches
  – Same size, same connectors
• Short distance
• Inter-rack wiring
• High density
• 4855P coming soon!
Belden 4855R – Return Loss

Frequency - MHz

Return Loss (dB)

SMPTE Limit (ST 2082-1:2015)

Belden Limit
NEW: Belden 4505R

- The 4K version of Belden 1505A
- Diameter 5.92mm, 0.233 inches
  - Same size, same connectors
- Medium distance
- Inter-rack wiring
- Flexibility vs Performance
Belden 4505R – Return Loss

![Graph showing Belden Limit and SMPTE Limit (ST 2082-1:2015) for return loss vs frequency.](image)

- Belden Limit
- SMPTE Limit (ST 2082-1:2015)

Frequency - MHz

Return Loss (dB)
NEW: Belden 4694R

- The 4K version of Belden 1694A
- Diameter 6.96mm, 0.274 inches
  - Same size, same connectors
- Long distance
- Most popular size
- 4694P coming soon!
Belden 4694R – Return Loss

Return Loss (dB)

Frequency - MHz

SMPTE Limit (ST 2082-1:2015)

Belden Limit
Belden 4794R

- The 4K version of Belden 1794A
- Diameter 8.13mm, 0.320 inches
  - Same size, same connectors
- 98 metres at 4K
- High performance, long distance
- Improved performance since last year
Belden 4794R – Return Loss

![Graph showing return loss vs frequency for Belden 4794R and SMPTE limits.]

- **Belden Limit**
- **SMPTE Limit (ST 2082-1:2015)**

**Return Loss (dB)**

**Frequency - MHz**
COMING SOON : Belden 4731R

- The 4K version of Belden 7731A
- Diameter 10.2 mm, 0.400 inches
  - Same size, same connectors
- Longest distance – 117 metres (384 feet)
- Next stop fiber optic cable
- 4731P coming soon!
- For the entire list….

http://info.belden.com/ecos/video-distance-chart
<table>
<thead>
<tr>
<th>Formula:</th>
<th>-30 dB @ ½ clock</th>
<th>-20 dB @ ½ clock</th>
<th>-20 dB @ ½ clock</th>
<th>-40 dB @ ½ clock</th>
<th>-40 dB @ ½ clock</th>
<th>-40 dB @ ½ clock</th>
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</thead>
<tbody>
<tr>
<td>Data Rate:</td>
<td>270 Mb/s</td>
<td>1.5 Gb/s</td>
<td>3.0 Gb/s</td>
<td>3.0 Gbps</td>
<td>6 Gb/s</td>
<td>12 Gb/s</td>
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<tr>
<td>SMPTE Std:</td>
<td>ST-259M</td>
<td>ST-292M</td>
<td>ST-424M</td>
<td>ST-425</td>
<td>2081-1</td>
<td>2082-1</td>
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<tr>
<td>Application:</td>
<td>SD-SDI</td>
<td>HD-SDI</td>
<td>3G-SDI</td>
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<td>6 GHz 4K</td>
<td>12 GHz 4K</td>
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<tr>
<td>Cable Part #</td>
<td>Ft.</td>
<td>m</td>
<td>Ft.</td>
<td>m</td>
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<td>137</td>
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## Dimensions and Tolerances – Belden 4794R

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<tr>
<th></th>
<th>mm</th>
<th>Tolerance +/-</th>
<th>Inches</th>
<th>Tolerance +/-</th>
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<tbody>
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<td>Dielectric Diameter</td>
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<td>.005</td>
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<td>Inner Shield Tape Diameter</td>
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<td>Braid Diameter</td>
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<td>0.635</td>
<td>.262</td>
<td>.0025</td>
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<tr>
<td>Jacket Diameter</td>
<td>8.13</td>
<td>0.127</td>
<td>.320</td>
<td>.005</td>
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</tbody>
</table>
Belden 4794R – Attenuation (Compared to 1794A)
Connectors

• 75 Ω BNC for digital video
  – 4.5 GHz: Existing cable & connectors
  – 6 GHz: Marked cable & connectors !!
  – 12 GHz New cable, one connector
    ▪ 1-piece and 3-piece
## 12 GHz BNC Connectors

### 1-Piece Compression

<table>
<thead>
<tr>
<th>BNC Part #</th>
<th>Cable</th>
<th>Compression Tool</th>
<th>Strip Tool</th>
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<tbody>
<tr>
<td>4855RBUHD1</td>
<td>Mini RG-59</td>
<td>CPLCRBC-BR</td>
<td>PS59/6/RGB</td>
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<tr>
<td>4505RBUHD1</td>
<td>RG-59</td>
<td>CPLCRBC-BR</td>
<td>PSA59/6</td>
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<tr>
<td>4694RBUHD1</td>
<td>RG-6</td>
<td>CPLCRBC-BR</td>
<td>PSA59/6</td>
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<tr>
<td>4794RBUHD1</td>
<td>Series 7</td>
<td>CPLCRBC1794</td>
<td>PS-11</td>
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</table>

### 3-Piece Crimp

<table>
<thead>
<tr>
<th>BNC Part #</th>
<th>Cable</th>
<th>Crimp Tool</th>
<th>Strip Tool</th>
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<tbody>
<tr>
<td>4855RBUHD3</td>
<td>Mini RG-59</td>
<td>BB3PHCT</td>
<td>BB3PST</td>
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<tr>
<td>4505RBUHD3</td>
<td>RG-59</td>
<td>BB3PHCT</td>
<td>BB3PST</td>
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<td>4694RBUHD3</td>
<td>RG-6</td>
<td>BB3PHCT</td>
<td>BB3PST</td>
</tr>
<tr>
<td>4794RBUHD3*</td>
<td>Series 7</td>
<td>Kings KTH-1000</td>
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<tr>
<td>4731RBUHD3*</td>
<td>RG-11</td>
<td>Kings KTH-1000</td>
<td></td>
</tr>
</tbody>
</table>
SFP and Coax

- Embrionix
  - Single/Dual 12 GHz input
  - Single/Dual 12 GHz output
  - Mini-BNC Belden 4855R
  - Standard BNC.
What is Available and NOT Available

• Current Colors
  – Black, Red, Orange, Yellow, Green, Blue, Violet,
  – Any other color: special order 5,000 feet.

• One more size coming….
  – Smaller than 4855R, bigger than 179DT

• Other applications being considered…. 
  – Stranded (flexible)
  – Outdoor/Direct Burial
  – Fire Ratings (LSOH, Plenum) in progress