

## RETURN PATH HEADEND SIGNAL ORGANIZATION

### BACKGROUND

In order to improve the service quality, e.g. the upload data speed, CATV service providers have to decrease the subscriber number of each optical segments. This can be done by increasing the number of segments - in other words by using more return path transmitters (or complete nodes) on the field and more return path receivers at the headend station. However it seems to be sufficient to serve the new receiver outputs by new CMTS ports, the problem can be in many cases more difficult, because the devices providing the additional services (element management, VoD, measurements etc.) must be connected to all the receivers or at least to a group of receivers. In case of headend rack cabinets working since many years can occur the situation, that free space is strongly limited, so the solution has to be as small as possible, further it has to dissipate the lowest energy in order to minimize the additional heating and the OPEX as well.

### THE COMTECH SOLUTION

Comtech has developed a whole product family called HRF-R, which allows to match the signal levels between the output of the optical receiver and the inputs of each return path RF devices (CMTS, monitoring gateway etc.), provides combined ports for low data speed services and enough individual, uncombined outputs for high data speed services and measurements. 3 main types are available, 1 for serving 4 optical segments (HRF-OR4), 1 for serving 8 optical segments (HRF-OR8) and 1 for serving 4 coaxial segments (HRF-RR4). Serving a higher number of segments is also possible by cascading the devices - a special further unit (HRF-C16) can combine the output signals of 16 pieces of same or different elements of the solution providing the same optimal level relations at it's output as an individual HRF device. Each device of the family (including also the HRF-C16 extension combiner) needs only 1 U height in the cabinet using less space than the conventional solutions, and complies the DOCSIS 3.1 requirements from the bandwidth and from the isolation side as well.

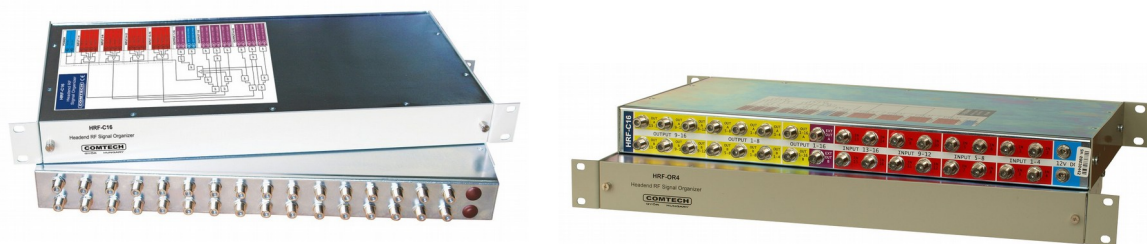


Figure 1

## SERVING 4 OPTICAL SEGMENTS

An HRF-OR4 device can handle 4 return path optical segments by itself. Each input has to be connected to an output of a return path optical receiver. The individual signals of the optical receivers will appear on 4 outputs per input port, with a relative level of -24 dB - this attenuation is needed between an average receiver output and an average CMTS/CCAP input in order to avoid overload. These individual ports forward the signal to the CMTS/CCAP, to the spectrum analyzer to a local video receiver (in case of security cameras or remote local TV studios) and can act as free testpoints too (figure 2).

The device has 2 combined outputs with the same relative levels of -24 dB for monitoring gateways (HMTS) with 2 different frequency upstream carriers.

The 1 U housing provides enough space for an additional 2x2 combiner too. This makes possible to combine 2 HRF-OR4 devices without external devices. To achieve the ideal -24 dB relative level at both of the 2x2 combiner outputs, the device has a high level (-17,5 dB) output, this has to be connected to the combiner. If more than 2 devices have to be combined, the another high level (-14 dB) output must be used, this provides the level needed by the HRF-C16 device, which can be combine 16 pieces of HRF-R devices with relative output level of -24 dB related to the receiver output.

The HRF-OR4 is a fully passive device, so it draws no powering costs and additional heating.

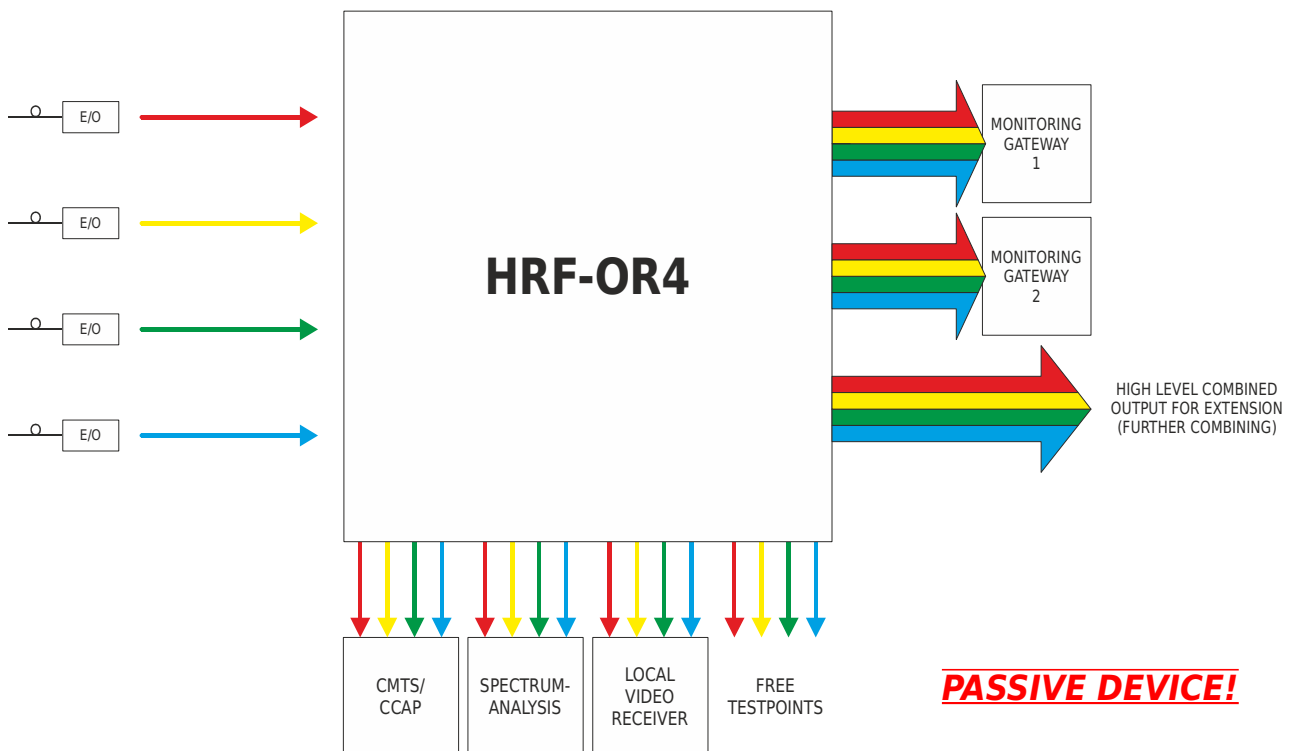


Figure 2

## SERVING 8 OPTICAL SEGMENTS

Serving 8 optical segments is possible by using the HRF-OR8 device of Comtech. The work of this unit is very similar to the work of HRF-OR4, and it provides the same ideal level relations as the HRF-OR4.

The difference (beside the number of input ports) is that HRF-OR8 allows to frame clusters from 4 ports. The individual outputs (the number of them is 2 in case of this type) and the combined outputs are also available. This is useful, if service provider would like to reuse the same monitoring carrier frequency in 2 groups of segments. The combined outputs can be used in this case for serving telemetry receivers or PPV processors (figure 3).

The further combining of combined signals arriving from 16 HRF-OR8 (or other) devices by an HRF-C16 is possible in this case too, the HRF-OR8 provides a high level output (relative level of -14 dB) for this purpose.

The HRF-OR8 is a fully passive device, so it draws no powering costs and additional heating.

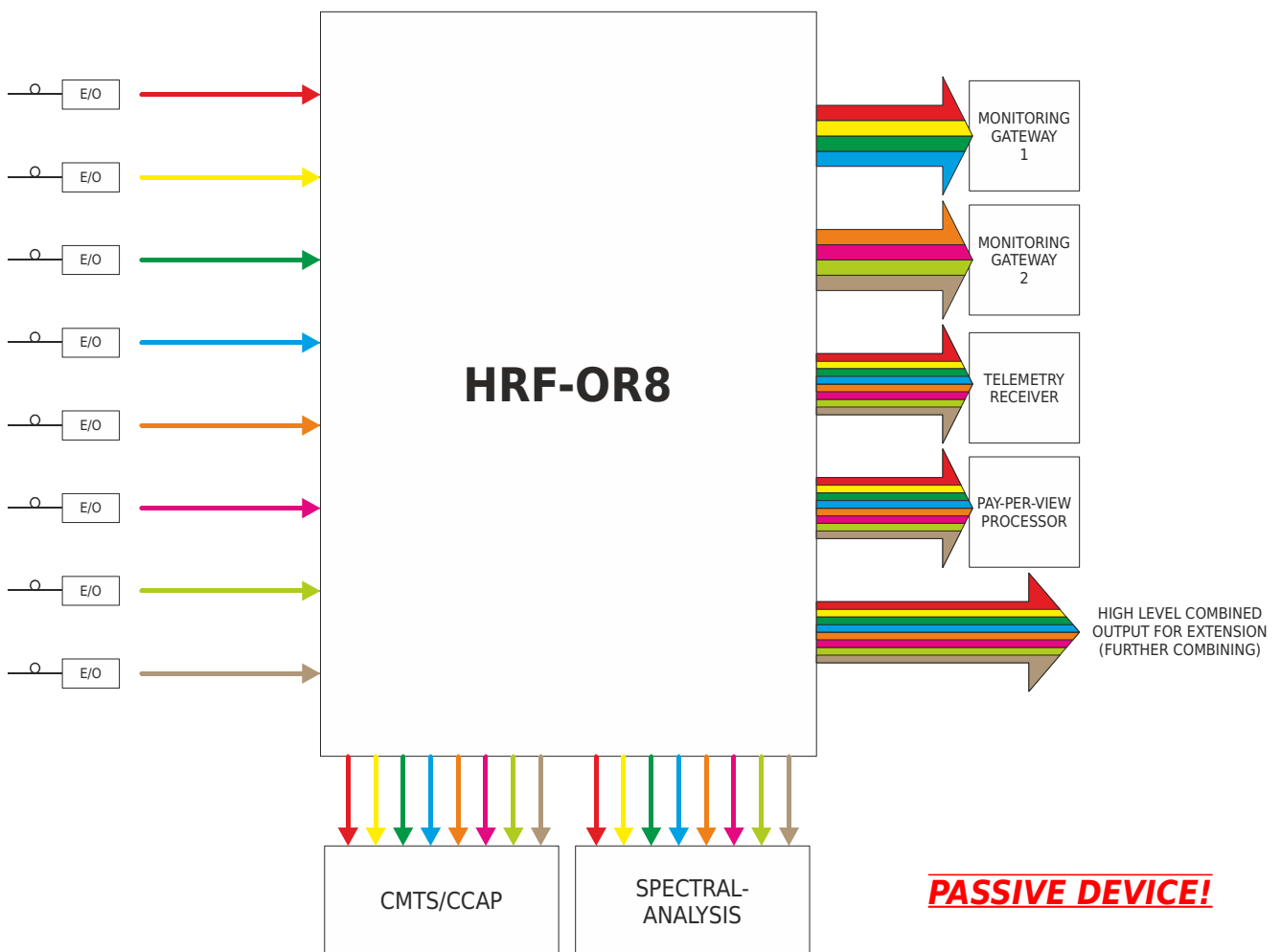


Figure 3

## SERVING 4 COAXIAL SEGMENTS

Serving coaxial segments is a little bit more difficult, than serving optical segments, because in this case the forward path and the return path is not divided into 2 different media (like 2 optical fibres at least at the output of the WWDM filter). To solve this problem, the HRF-RR4 contains 4 pieces of diplex filters (splitting frequency depends on the customer's decision). Regarding to this the device has 4 bidirectional ports for launching the coaxial stretches towards the first amplifier. To all the ports belongs an individual forward path input, these inputs drive the signal of the forward path signal organizers to the outside plant.

The work of the return path section is similar to the work of the HRF-OR4, there are 4 individual outputs of -24 dB per bidirectional port, 2 combined outputs with the same ideal relative level, a high level output for the HRF-C16 external combiner and a medium level output for driving the built-in 2x2 combiner if needed (figure 4).

The HRF-RR4 ensures the optimal signal levels by using amplifier stages. The total power consumption is 1 W.

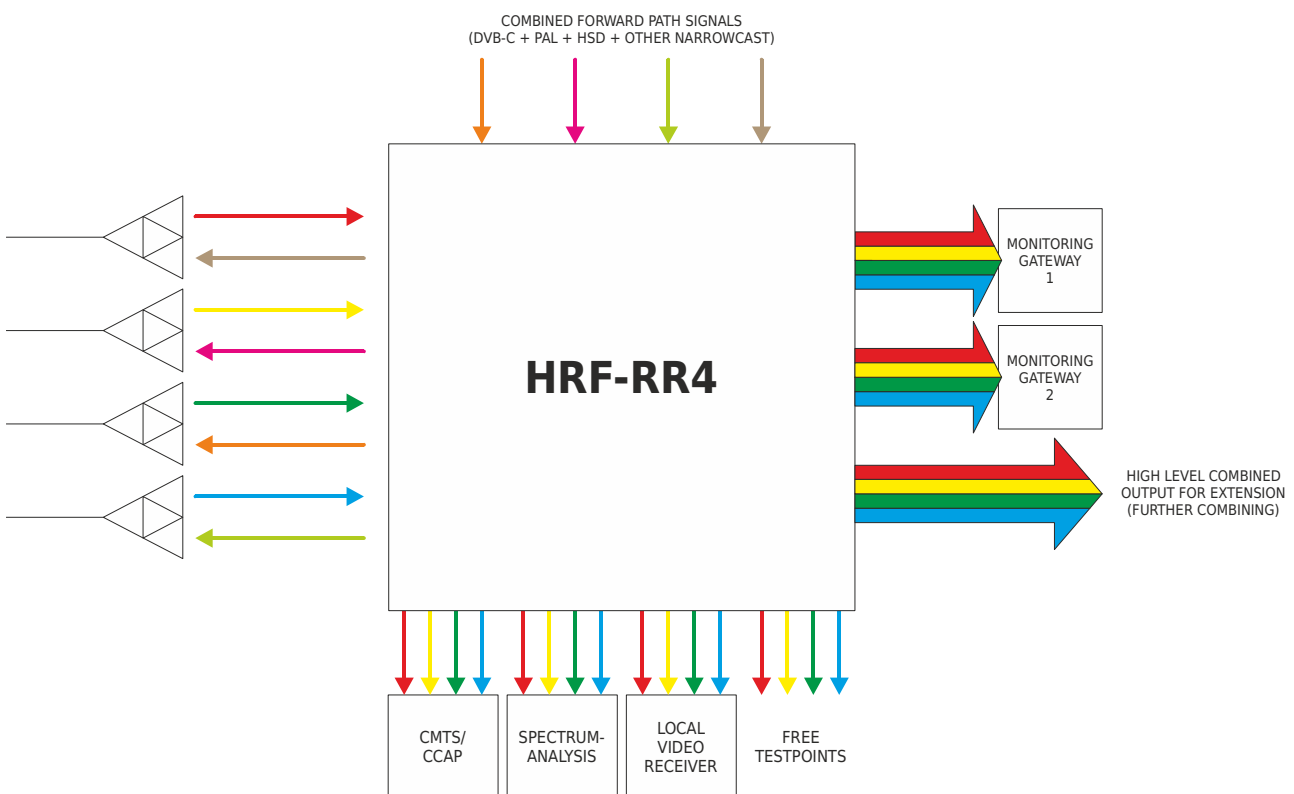


Figure 4.

## SERVING SEGMENTS UP TO A NUMBER OF 512

As mentioned in the previous sections, all the main elements have a high leveled extension port, which can be connected to the HRF-C16 extension device. This unit not only combines all the signals arriving to the 16 inputs, but realizes also partial combining for groups of 4 inputs (16 or 32 segments) and for groups of 8 inputs (32 or 64 segments depending on the type of the connected main element).

In case of using 16 pieces of HRF-OR8 and a single HRF-C16 128 optical segments can be handled on 17 U height in the cabinet. In order to achieve the same capabilities for 512 segments as in case of the HRF-D forward path solution, also HRF-C16 has an extension port, which can be connected to a 4-way splitter. At the output of this device appears the same ideal signal level as on the main outputs of the HRF-C16. The space requirement of this constellation is 68 U + a 4-way splitter. The modular construction of the system (i. e. the same input-output level relations) allows very high flexibility by handling mixed systems of strongly and slightly segmented areas as well as optical and coaxial segment groups (see the example on figure 5).

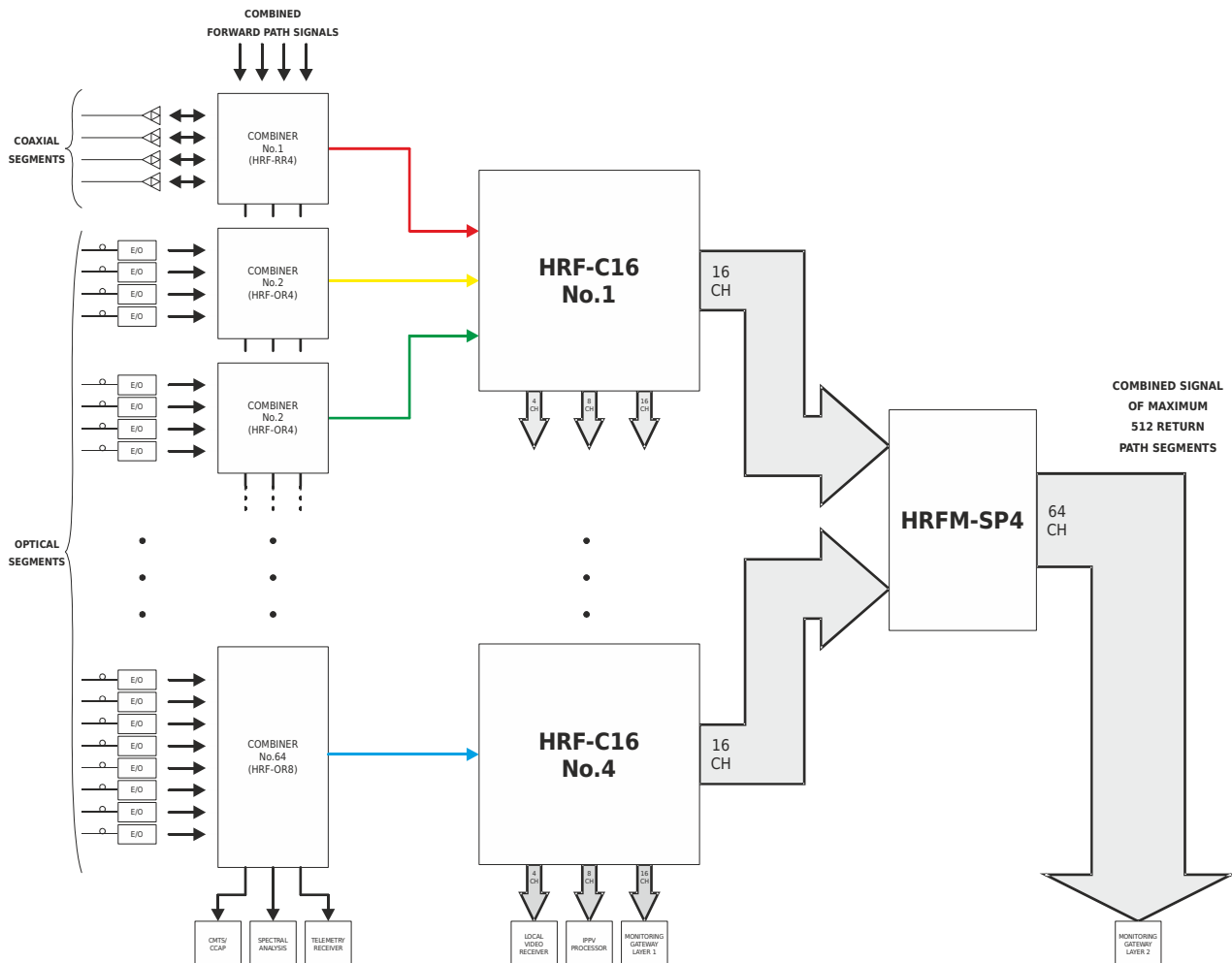


Figure 5.

The HRF-C16 provides the ideal signal levels by using active gain stages. The total power consumption is 4 W.

## **USER DEFINED UNITS**

On customer request Comtech gladly modifies the existing units in order to pass the solution to a given network. A really good example for this is the OR8-T type. At this device modified signal level relations (-20 dB instead of -24 dB) are used, further the device contains testpoints for all the inputs. Regarding to the needs, the input and output ports are placed on different sides of the housing.

## **USE, ALIGNMENT**

The elements of the product family have a construction, that is able to receive signal levels, which are in the output level range of the return path optical receivers. If this condition is fulfilled, the output will automatically provide levels, which are expected at the input of the RF headend devices, so the devices do not need alignment.

## **KEY BENEFITS OF OUR SOLUTION**

- **Very low space requirements** (1 U for 8 segments, 17 U for 128 segments, 68 U + SP4 for 512 segments)
- **Flexible use** (high number of various devices can be connected to an arbitrary number of segments)
- **No or only a little external cabling is needed**
- **No alignment is needed**
- **Flexible mechanics** (front and rear plate are interchangeable by adequate montage of mounting handles)