













Fig. 6. Electrical spectrums after 20.1 km at: (a) 1344 nm and (b) 1547 nm. Constellations after 20.1 km: (c) 1344 nm and (d) 1547 nm.

## 5. Conclusions

We have demonstrated, for the first time, the successful use of ultra-low power 480 Mbit/s, MB-OFDM UWB signals to directly modulate low-cost, commercially-available, VCSELs in CWDM bi-directional radio-over-fiber transmission application. With drive signal levels in the range  $-60$  dBm to  $-32$  dBm, the results reported here show that virtual direct off-air modulation of current-generation, long-wavelength VCSELs is possible. In all cases, even up to 20.1 km reach in a 1344/1547 nm CWDM PON, EVMs of at least  $-18.3$  dB were measured, compared to the baseline standard requirement of  $-17$  dB. Considering the ultra-low power and cost aspects of the prototype networks demonstrated here, opportunities for embedded system approaches become available. Large scale deployment is then possible and this will be the subject of further investigation.

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