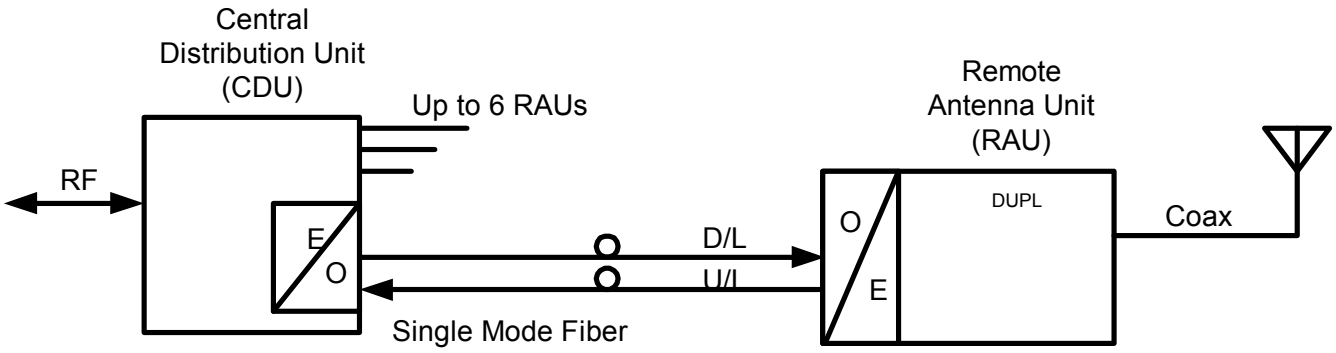
InCell™ Theory of Operation

Since no two indoor coverage requirements are the same, in-building RF coverage solutions may involve one or a combination of RF coverage methods. Andrew can provide several solutions to optimize the indoor RF coverage for a wide range of indoor applications. The InCell™ Fiber Optic DAS complements other Andrew in-building RF coverage methods such as passive and active leaky feeder RF distribution networks using Radiax cable, passive distributed antenna systems and active distributed antenna systems. In-building wireless systems are typically connected to an off-air donor antenna and repeater or to a BTS system located within the building.

The InCell™ DAS uses low loss single mode fiber optic cables to distribute the uplink and downlink signals throughout buildings or between multiple buildings.

The InCell system uses direct analog modulation of the RF signal onto the optical signal through a laser diode. The modulated optical signal from the laser travels over the fiber optic cable to a photo diode, which converts the optical signal back to an electrical signal. There is no frequency conversion (mixing the signal up and down to an IF frequency). Because of the direct RF to optical conversion, the InCell system is technology transparent, easily passing analog, TDMA, CDMA and 3G type signals.



- 1 system -- up to 6 antennas
- 1 main hub x 6 antennas = 6 antennas
- D/L + U/L: Direct RF to optical to RF conversion
- Typically only 1 antenna per RAU
- No long coax cables needed—resulting in improved coverage area

Figure 1-3. High Level InCell™ Block Diagram

Downlink Signal Flow

The downlink signal is the signal that is transmitted from the base station and received by the mobile phone. In the InCell™ Fiber Optic Distributed Antenna System, the CDU receives the downlink RF signal from a base station, converts the signal into six identical optical signals and distributes the optical signals to ERAUs that are located throughout a building. The ERAU receives the optical downlink signal and converts it back to an RF signal, which is then broadcast to mobile phones located within the building.

If the InCell system is connected directly to indoor base station equipment, the downlink is supplied to the CDU via a coax cable to the base station. If the InCell system uses an off-air antenna and repeater to interface to an external base station, the RF downlink signal is transmitted through the air, received by an off-air donor antenna and amplified using a bi-directional amplifier prior to entering the CDU.

The wireless downlink signal is received through the Type N connector on the rear panel of the CDU and is split into six identical RF signals, one for each port of the CDU. A laser diode at each CDU port converts the RF signal into an optical signal. The optical signal for each CDU port is transmitted through the D/L fiber optic bulkhead connector, through a single mode fiber optic cable to the D/L fiber optic bulkhead connector on the ERAU.

The ERAU converts the optical downlink signal back to an RF signal using a photodiode. The RF downlink signal is amplified, filtered and then passed through the ERAU Type N connector to a directional or omni antenna where it is transmitted to the mobile phone.

Uplink Signal Flow

The uplink signal is the signal that is transmitted from the mobile phone and received by the base station. In the InCell system, an indoor antenna receives the uplink RF signal from the mobile phone and passes the uplink signal to the ERAU through the Type N connector located on the rear panel of the ERAU. The ERAU amplifies and filters the uplink RF signal and then converts the RF signal into an optical signal using a laser diode. The optical signal passes through the U/L fiber optic bulkhead connector, through a single mode fiber optic cable to the U/L fiber optic bulkhead connector on the CDU.

The CDU converts the received optical uplink signal back to an RF signal with a photodiode. The uplink signals from each of the six remote antennas are received by the six CDU ports and are combined together to pass through the Type N RF connector on the back of the CDU and then up to the base station.