Troubleshooting Hints

These two tables provide guidance from the first indication of a fault, a poor Key Performance Indicator (KPI), to the BTS or Spectrum Master test, and finally, to the field replaceable unit.

### Key Performance Indicators vs. Test

<table>
<thead>
<tr>
<th>Ch. Power</th>
<th>Occ BW</th>
<th>Empty DL Slot Power</th>
<th>Slot PAR</th>
<th>EVM</th>
<th>Peak CDE</th>
<th>Freq. Error</th>
<th>Noise Floor</th>
<th>E/I</th>
<th>Tau Overlap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access failures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource Shortage</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>UL Interference (LER)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Call Drop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radio Link Timeout</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>UL Interference (LER)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>DL Interference (LER)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

### Test vs. BTS Field Replaceable Units

<table>
<thead>
<tr>
<th>Freq Ref</th>
<th>Ch Cards</th>
<th>Radios</th>
<th>MCPA</th>
<th>Antenna Return Loss</th>
<th>Antenna Down Tilt</th>
<th>Uplink Interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Power</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Occupied Band Width</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Empty DL Slot Power</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Slot Peak Average Radio</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Error Vector Magnitude</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Peak Code Domain Error</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Frequency Error</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
</tr>
<tr>
<td>Noise Floor</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
</tr>
<tr>
<td>Scrambling Code</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
</tr>
<tr>
<td>E/I</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
</tr>
<tr>
<td>Tau Scanner Overlap</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
</tr>
</tbody>
</table>

Tests may indicate the need to troubleshoot backhaul.

### Locating Over-the-Air Test Spots

To test a BTS Over-the-Air (OTA) it is necessary to find a location with good pilot dominance and low multipath. The BTS Master is ideal for this task. OTA testing requires a pilot dominance higher than 10 dB.

To find a good OTA test site, look for a place squarely in the sector, a block or two from the tower, and away from surfaces that may reflect radio waves. A directional antenna for the BTS Master will help to screen out unwanted signals.

In some urban areas, locating a good OTA site can be difficult. In these cases, it may be quicker to hook up to the BTS for testing.

### Multiple Sector Coverage Checks

**Sync Codes, Scrambling Codes, DwPTS Power & Pilot Dominance**

**Guidelines:**
- **Sync Codes:** 3 or fewer codes within 10 dB of the dominant code over 95% of the coverage area.
- **DwPTS OTA Power:** Higher than -88 dBm over 95% of the coverage area.
- **Pilot Dominance:** Higher than 10 dB for OTA EVM/signal quality testing.

**Consequences:**
- **Sync Codes:** Excessive sync codes produce too much co-channel interference, which leads to lower capacity, low data rate and excessive handoffs.
- **DwPTS OTA Power:** Low capacity, low data rates, excessive call drops and call blocking.
- **Pilot Dominance:** Helps locate a good spot for Over-the-Air signal quality testing.

**Common Faults:**
- **Sync Codes and DwPTS OTA Power:** Excessive or inadequate coverage can be caused by antenna down tilt errors, improper pilot power, and repeaters. DwPTS Over-the-Air power is also affected by building shadows and other obstructions.
These two OTA measurements for the six strongest sync codes serve as a troubleshooting tool for coverage issues. If further detail is needed, the strongest scrambling code can be identified on the code domain screen.

**Guidelines:**
- E₁/₆₅ should be higher than -2 dB over 95% of the coverage area.
- Tau should be lower than the distance to the three nearest base stations.

**Consequences:**
- E₁/₆₅ and Tau faults indicate excessive or inadequate coverage and lead to low capacity, low data rates, extended handoffs, and excessive call drops.
- Common Faults:
  - E₁/₆₅ and Tau faults are often caused by antenna down tilt issues, improper BTS power levels, and improper use of repeaters.

**Common Faults:**
- For Channel Power faults check the amplifier power settings, then look for large VSWR faults and damaged connectors. Channel cards and radio units may also need to be checked.
- For Occ BW issues, trace the fault through the signal path. Antennas, amplifiers, radios, and channel cards are all likely suspects.

**Consequences:**
- E₁/₆₅ and Tau faults can be caused by distortion in the channel cards, radios, power amplifier, or antenna system. Trace the fault through the signal chain to resolve.

**Peak CDE faults** are likely caused by channel cards or an amplifier with a high output or low supply voltage.

**Guidelines:**
- Frequency Error should be less than:
  - Wide Area BTS: +/- 0.05 ppm
  - Local area BTS: +/- 0.1 ppm

**Noise Floor** should be lower than -20 dB.

**Scrambling Code** should be as specified.

**Consequences:**
- High Frequency Error will cause calls to drop when mobiles travel at higher speed. In some cases, cell phones cannot hand off into, or out of the cell.

**Common Faults:**
- For Frequency Error, first check the reference frequency and the reference frequency distribution system. If a GPS frequency reference is used, check it as well. For a Noise Floor at a higher power level is the first indication of signal quality problems. Follow up with other checks, such as EVM, to narrow the problem down.

**Scrambling Code errors** can cause a very high dropped call rate on hand off.

**Common Faults:**
- For Frequency Error, first check the reference frequency and the reference frequency distribution system. If a GPS frequency reference is used, check it as well. For Noise Floor problems check for channel card cross talk, amplifier faults, and antenna issues. Also follow up with EVM and Peak CDE measurements.

**Scrambling Code errors** are likely caused by an error setting the scrambling code value.

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**Channel Power**
- sets cell size. A 1.5 dB change in power levels means approximately a 15% change in coverage area.
- Channel Power (RRC) and an in-service power measurement, DwPTS Power, are available on the Time Slot Power screen.
- Use the high accuracy power meter for the best accuracy (± 0.16 dB).

**Occ BW** (Occupied Bandwidth) is the RF spectrum that contains 99% of the RF Power.

**Guidelines:**
- Channel Power typically should be within +/- 1.0 dB of specification. This also applies to Channel Power RRC and DwPTS Power.
- Occ BW typically between 1.3 and 1.6 MHz.

**Consequences:**
- Channel Power errors will cause either co-channel interference or poor coverage at cell boundaries, leading to dropped calls, extended handoffs, low capacity, and blocked calls.
- Occ BW errors will cause interference with neighboring RF channels creating lower signal quality and reducing capacity.

**Common Faults:**
- For Channel Power faults check the amplifier power settings, then look for large VSWR faults and damaged connectors. Channel cards and radio units may also need to be checked.
- For Occ BW issues, trace the fault through the signal path. Antennas, amplifiers, radios, and channel cards are all likely suspects.

**Consequences:**
- EVM is the ratio of errors, or distortions, in the actual signal, compared to a perfect signal.

**Peak Code Domain Error** (Peak CDE) is the EVM of the worst code. It is used to spot the worst case distortion caused by either amplifier compression or channel card issues.

**Guidelines:**
- EVM should be 12.5 % or less when coupled to the transmitter's output.
- Peak CDE should be lower than -28 dB at a spreading factor of 16.

**Consequences:**
- EVM or Peak CDE faults will result in poor signal quality to all user equipment. In turn, this will result in extended hand off time, lower sector capacity, and lower data rates. These faults will create a higher than necessary dropped and blocked call rate.

**Common Faults:**
- EVM faults can be caused by distortion in the channel cards, radios, power amplifier, or antenna system. Trace the fault through the signal chain to resolve.

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**Time Slot Power**
- Empty downlink slots can be used to estimate interference, and also, self-interference of the transmitter during uplink time. Measuring the power of these slots provides an indication of how well the transmitter turns off.
- Slot PAR is the peak to average ratio of a slot. If it is too low, the amplifier is compressing (distorting) the signal.

**Guidelines:**
- Empty downlink slots should have less than -82 dBm of transmit power when measured at the base station.
- Slot PAR should typically be above 6 dB.

**Consequences:**
- Empty downlink slots with excess power will reduce the sensitivity of the receiver and the size of the sector. This will cause dropped and blocked calls.
- Slot PAR faults indicate signal quality issues. Follow up with EVM and Peak CDE measurements for further information.

**Common Faults:**
- Empty downlink slots with excessive power are caused by the Tx amplifier not turning off enough. Trace the fault through the signal path.
- Slot PAR faults can be caused by low supply voltage to the amplifier which restricts the amplifier headroom. Other likely causes are excess signal strength at the amplifier input, radio units, and channel cards.