Exhibit B. Detailed Description of the Measurement System

As illustrated in Figure 1, our MIMO-channel measurement system is composed of two parts: (1) the HP85301B antenna pattern measurement system, used to measure the channel frequency response, and (2) the actuator positioning system, which emulates an arrays at both ends of the link by moving the antennas to arbitrary pre-programmed locations. The actuator controller moves the antennas to a pair of specified positions, and then the channel is measured. This procedure is repeated until all the desired antenna positions have been sampled.

The details of the components are listed in Table 1. The last column of the table lists the maximum rated outputs of the components.

Each trial of the experiment is expected to take about 30 minutes. We plan to perform trials in many different locations within the buildings specified in Exhibit A.

Actuator Positioning System

Driven by three brushless motors, the actuators can translate the antenna through a volume of approximately 50cm × 50cm × 7cm. The 7cm in the Z-direction ensures that the angles of paths arriving at nearly all elevations can be identified. For convenience, a mobile platform is also prepared to move both actuator systems to various locations. The design of actuator and mobile platform systems are demonstrated in Figure 2 and 3, respectively. The antennas are mounted on plastic telescoping masts such that the receive antenna can be positioned at heights ranging from 4 to 5 feet from the floor and the transmit antenna can be positioned at heights ranging from 4.5 to 5.5 feet from the floor. A photograph of the system is shown in Figure 4.

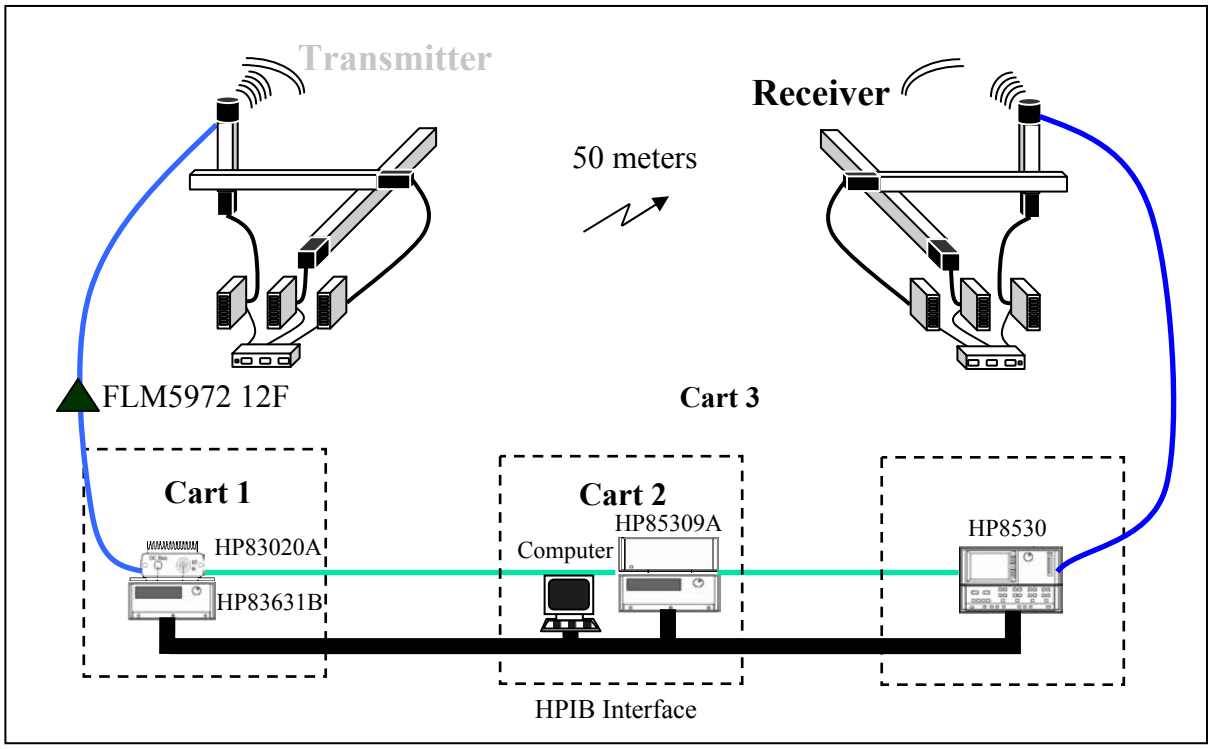

Figure 1. MIMO channel measurement system.

Table 1. HP85301B measurement system specifications

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Component	Equipment	Functions & Specs
Transmit source	HP83631B synthesized sweeper	Frequency range : 0.045 – 26.5GHz Max. output power : < 20 GHz, +13 dBm Resolution : 20-26.5 GHz, +10 dBm : 1 Hz
Amplifier	HP87422 power supply and HP83020A power amplifier	Frequency range : 2 –26.5 GHz Gain : 30 dB Max. output power : 30 dBm
Amplifier	Fujitsu FLM5972 12F post amplifier	Frequency range : 5.9 – 7.2 GHz Gain : 9.5 dB Max. output power : 41.5 dBm
LO source	HP83621B synthesized sweeper	Frequency range : 0.045 – 20GHz Max. output power : +13 dBm Resolution : 1 Hz
RF downconverter	HP85320A/B Mixers	Downconvert RF signal to IF band Sensitivity : -113 dBm Dynamic range : 89 dB
	HP85309A LO/IF distribution unit	1. Receive LO source and provide it to the mixers 2. Receive IF signals and send it to the microwave receiver
Microwave receiver	HP 8530A microwave receiver (HP85101C Display/Processor + HP85102R IF/Detector)	1. Synchronize and control the RF transmitter and the RF receiver 2. Receive and display the IF signal 3. Send the data to computer
Antenna (for Tx & Rx)	EM 6865 omni-directional wideband antenna	Type : Biconical Frequency range : 2-18 GHz Polarization : Vertical Gain : 2.6 dB at 5.5GHz 3.5 dB at 17.0 GHz Max. power : 5W VSWR : <2:1 Output impedance: : 50Ω Interface : Type “N” female Weight : 1 lbs

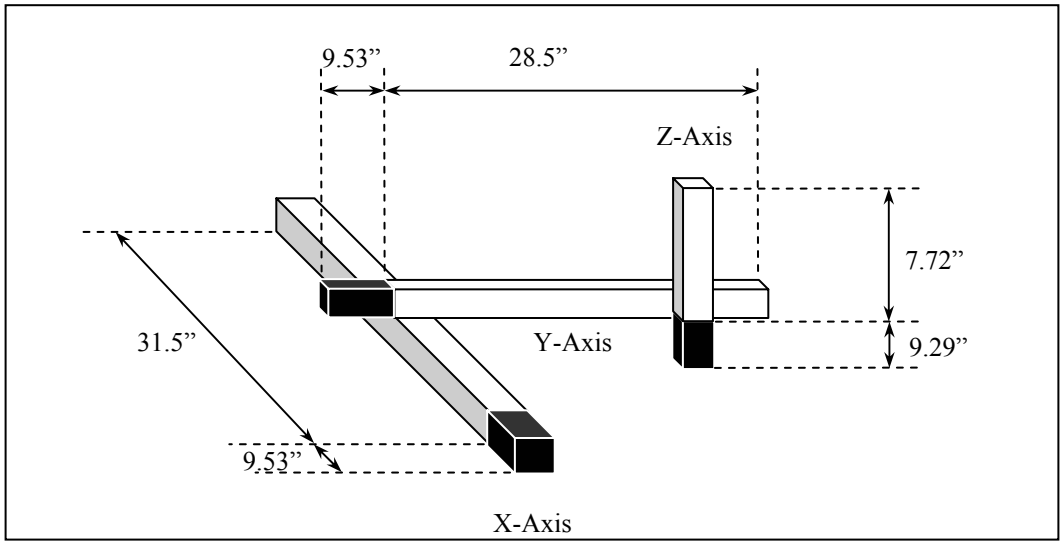

Figure 2. Three-dimensional actuator positioning system.

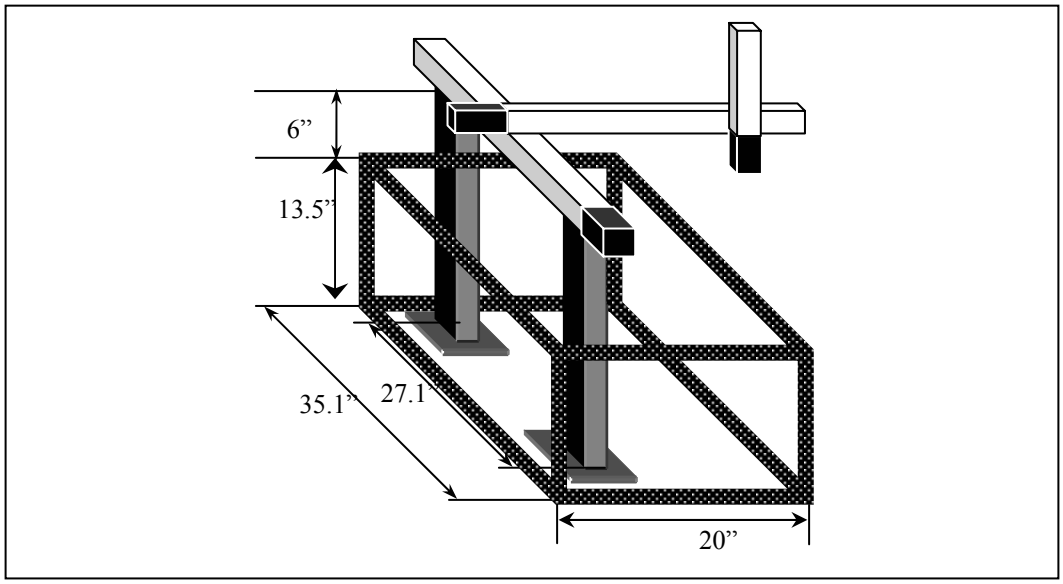

Figure 3. Mobile platform.

Figure 4. In the forground, the actuator system and the antenna on the telescoping mast. Behind the actuator system is a cart holding the HP8530A microwave receiver and other components.