Aircraft noise sources

A gas turbine engine is characterized by a unique noise spectrum which unequivocally results from its specific design. Basically, all components of the engine contribute to engine noise, i.e. fan, compressor, combustion chamber, turbine, exhaust section. The relative magnitude of different noise sources can vary not only from engine to engine, but also with operating conditions.

Typically for the plain turbojet engines of the past were a small cross-section, relatively small air mass flow rate, but a very high exhaust velocity (600 m/s and more). The dominant noise source was clearly the exhaust system and the mixing of the jet with the ambient air.

The low bypass-ratio turbofan engine of the sixties, with a bypass-ratio of about 1.5, featured a higher air mass flow intake rate, but a lower exhaust velocity of the propelling jet. This made possible somewhat lower jet noise, but at the same time the turbomachinery noise increased. Typical transport aircraft using such engines were the B-727, B-707, DC-9, DC-8.

High bypass-ratio engines (with bypass-ratios of up to eight) process most of the intake air stream by the fan, with only a small portion passing to the core engine. Exhaust velocities of 300 m/s of the fan flow, and 400 m/s of the core engine flow are low enough to place jet noise second to fan turbomachinery noise, which is now the dominant noise source.

Gas turbine engine noise can be divided into two general categories: *internally* generated noise, usually associated with the rotating machinery, and *externally* generated noise, or jet noise.

Primary sources for internally generated noise are fan, compressor, and turbine . In most high bypass-ratio engines, the fan is the the fan discharge duct. Compressor noise also propagates out of the inlet, whereas turbine noise exits through the exhaust nozzle of the core engine.