An axiomatic framework providing robust stability and performance bounds for a wide class of Estimation based Multiple Model Switched Adaptive Control (EMMSAC) algorithms is developed. The approach decouples development of both the atomic control designs and the estimation processes thus permitting the usage of standard controller design and optimization approaches for these components. The framework is shown to give tractable algorithms for MIMO LTI plants, and also for some classes of nonlinear systems (for example, an integrator with input saturation). The gain bounds obtained have the key feature that they are functions of the complexity of the underlying uncertainty as described by metric entropy measures. For certain important geometries, such as a compact parametric uncertainties, the gain bounds are independent of the number of plant models (above a certain threshold) which are utilized in the implementation. Design processes are described for achieving a suitable sampling of the plant uncertainty set to create a finite candidate plant model set (whose size is also determined by a metric entropy measure) which achieves a guaranteed robustness/performance.