Medulloblastoma is the most common malignant childhood brain tumor, consisting of four molecularly and clinically distinct subtypes. Recent work has advanced our understanding about the basic pathological processes, identifying unique mutations and anatomical locations that contribute to medulloblastoma subtype heterogeneity. Recognizing how subtype-specific genetic alterations dictate treatment response is critical to advancing treatments for all patients. The central nervous system (CNS) contains a unique vascular system that tightly regulates exchange between the blood and brain, termed the blood brain barrier (BBB). How brain tumors specify BBB properties in newly formed blood vessels, and if this dictates tumor behavior remains unanswered. Here we show that WNT-subtype medulloblastomas create a microenvironment that inhibits BBB formation, producing tumors with a highly permeable aberrant vascular network. We found human and mouse WNT-subtype tumors display increased vascularization and hemorrhaging, along with decreased expression of endothelial BBB associated genes. Fenestrated blood vessels, normally associated with peripheral organs, are highly enriched in WNT-subtype tumors, allowing unrestricted exchange of substances between blood and tumor. Canonical Wnt signaling is essential for normal CNS BBB formation and maintenance. WNT-subtype tumors express high levels of secreted Wnt antagonists, creating a microenvironment that is inhibitory to canonical Wnt signaling and BBB formation in neighboring endothelial cells. Differences in BBB status between WNT and SHH-subtype tumors result in differential in vivo treatment response and drug penetration, suggesting the abnormal vasculature might contribute to the excellent clinical prognosis associated with WNT-subtype patients. Our data offer insight into brain tumor-vascular BBB specification, and should benefit ongoing efforts to improve response, survival, and quality of life for all medulloblastoma patients.