Abstract: In this work we investigate an exact solution of Einstein's equations which is described by the Plebański–Demiański metric. This metric represents type D space-times and contains seven free parameters, including electric and magnetic charges and a cosmological constant. We study geometrical and physical properties of these space-times in the case when repeated principal null congruences have zero expansion. Therefore, first we study de Sitter universe and anti-de Sitter universe in the Plebański–Demiański coordinates, and we carefully analyze the corresponding parametrizations of (anti-)de Sitter hyperboloid in five-dimensional flat space-time, unknown so far, we draw the respective conformal diagrams, and we find transformations to various known forms. After that, we investigate the more general case of the B metrics with a cosmological constant, and we do a basic analysis of its geometrical properties. We summarize the article by Gott from 1974, where he interprets the BI metric as a part of space-time with a tachyon singularity, and we generalize his results for the case of non-zero cosmological constant. Finally, we analyze even more general cases of the Plebański–Demiański metric with more non-zero parameters. In particular, we study the electromagnetic field in the case of non-zero charges, and also a non-singular subcase of these metrics.