A synthesis of 3-methyl-3-hexanol from methanol and n-propanol is delineated in the following figure. Equation [5] of the figure outlines the synthesis, which is based on the retrosynthetic analysis of equations [1]-[4]. Equations [6] and [7] provide the ancillary steps necessary if one is to start with the two given alcohols. Left open here are the specific methods of oxidation, for which many variations are available, with only the proviso that any oxidation of a primary alcohol to an aldehyde must be mild enough so that (easily said, but not always so easily carried out in practice!) over-oxidation to the corresponding carboxylic acid does not take place. A moment's study will make clear that the approach outlined is not unique in detail; there are a number of similar routes, differing only in the order of bond-making and the exact choice of starting materials (for example, methanol, ethanol, and n-butanol; or ethanol and n-propanol).
retrosynthetic analysis:

[1] \[ \text{OH} \] \xrightarrow{\text{Grignard addition}} \text{CH}_3 \text{CH}_3 + \text{CH}_3\text{MgBr} \\

[2] \[ \text{O} \] \xrightarrow{\text{oxidation}} \text{CH}_3 \text{CH}_3 \text{OH} + \text{oxidizing agent} \\

[3] \[ \text{OH} \] \xrightarrow{\text{Grignard addition}} \text{CH}_3 \text{CH}_2 \text{H} + \text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr} \\

[4] \[ \text{O} \] \xrightarrow{\text{oxidation}} \text{CH}_3 \text{CH}_3 \text{OH} + \text{(mild)} \text{oxidizing agent} \\

synthesis, based on retrosynthetic analysis:

[5] \[ \text{OH} \] \xrightarrow{[\text{O}]} \text{CH}_3 \text{CH}_2 \text{H} \xrightarrow{\text{ether}} \text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr} \\

supplementary synthetic steps:

[6] \[ \text{CH}_3\text{OH} \xrightarrow{\text{conc} \text{HBr}} \text{CH}_3\text{Br} \xrightarrow{\text{ether}} \text{CH}_3\text{MgBr} \\

[7] \[ \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{conc} \text{HBr}} \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \xrightarrow{\text{ether}} \text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr} \\

retrosynthetic analysis and synthesis of (racemic) 3-methyl-3-hexanol from methanol and n-propanol

©2002 Claude E. Wintner