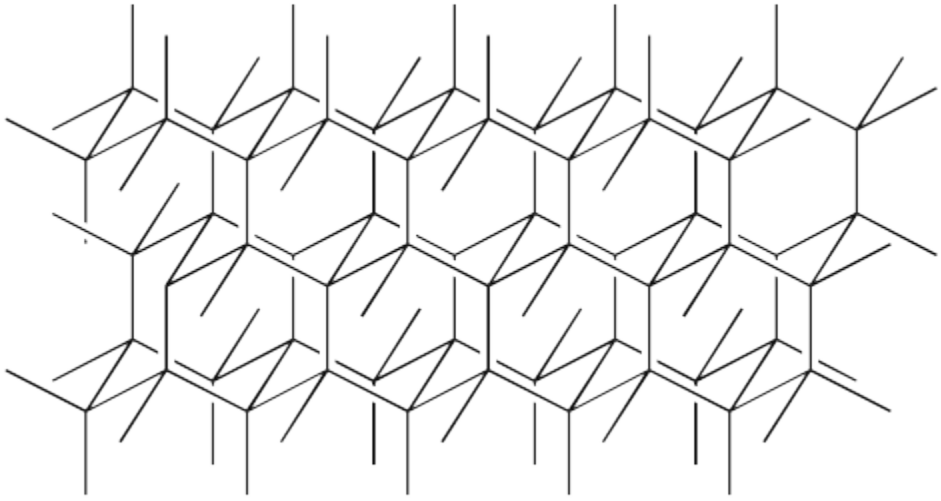
A NETWORK SOLID: DIAMOND

Some materials don't fall into any of the categories that we have seen so far. They are not metals, so they can't be described as lattices of identical ions surrounded by delocalized electrons. They are not ionic solids, so they can't be thought of as arrays of one type of ion with the counterions packed into the interstitial holes to balance the charge. They are not molecules, so we wouldn't draw them as discrete, self-contained collections of connected atoms.

Diamond, for example, is a network solid. Diamond is an allotrope of carbon -- it is one of several forms of elemental carbon found in nature. It looks something like this, on an atomic scale. The lines are bonds between the carbon atoms. Each carbon atom makes four bonds, one to each of four different neighbours.



Diamond is composed entirely of carbon atoms, but carbon is too electronegative to allow its electrons to completely delocalise into an electron sea, like metallic elements do. It forms a crystalline, solid structure, but it

doesn't dissolve even a tiny bit in water like ionic compounds would, because it has no ions to form ion-dipole interactions with the water molecules. It forms covalent bonds with its neighbouring atoms, sharing these electrons rather than exchanging them, but it forms an extended solid rather than individual units.

- Network solids are like molecules because they have covalent bonds connecting their atoms.
- Network solids are unlike molecules because they don't have a limited or specific size; their structures can extend "seemingly forever" on the atomic scale.

What do most people know about diamonds? They are very expensive, of course. They are very shiny. They are very, very hard. In fact, there is a scale used by minerologists to describe the hardness of materials called "Mohs scale of hardness". The scale was developed by German geologist Friedrich Mohs in the early 1800's. It simply places ten different minerals in order from softest to hardest and assigns each of them a number. Diamond is a 10, meaning it is the hardest material on the scale. Diamond is, in fact, the hardest naturally-ocurring substance in the world.

Table NW1.1. Mohs scale of hardness.

Mineral	Hardness
talc	1
gypsum	2
calcite	3
fluorite	4
apatite	5

orthoclase	6
quartz	7
topaz	8
corundum	9
diamond	10

Mohs scale is qualitative, not quantitative; each mineral in the scale is harder than the one before it. Mohs scale has been widely used by field geologists because of its simplicity. If you pick up a mineral and can scratch it with that diamond you keep in your toolbox, but the corundum doesn't leave a mark, then the hardness of the new sample is around 9.

Source : http://employees.csbsju.edu/cschaller/Principles%20Chem/network/NWdiamond.htm