

12 System-on-Chip Design (DJG)

- (a) SoC design involves dividing work between hardware and software as well as deciding the number of general-purpose and custom processors and co-processors to be used. What main factors influence these design decisions and the associated manual partition of envisaged workload over these resources? [5 marks]
- (b) A lossless compression algorithm converts fixed-size, 1 kByte blocks of data to a variable-sized block that is normally shorter. Suggest a suitable signature (argument and return types) for a software function that implements the algorithm. Draw a diagram showing the external wiring to the neighbouring SoC components for an appropriate, high-performance, hardware implementation. State any assumptions that guide your design approach. [6 marks]
- (c) A synchronous hardware module has separate input and output ports that each convey 32-bit words. Handshaking is required on both ports since it is unpredictable whether the module or its environment are ready to exchange data in either direction at any time. Give a diagram or RTL module definition for such a component and precisely describe the handshaking protocol in words. State the maximum throughput of your protocol. [5 marks]
- (d) Why might it be useful to have a formal specification of your protocol from part (c) during design and testing? What, if anything, might we infer about the number of words stored inside the module from the protocol? [4 marks]