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IRIS perspectives on the future of the SEED format

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The Standard for the Exchange Earthquake Data (SEED) was formally adopted by the International Federation of Digital Seismograph Networks (FDSN) in 1987. Since that time, SEED has served as the dominant standard for passive source seismological data, and has been adopted for use by a variety of other uniformly sampled time series data. The IRIS Data Management Center (DMC) was an early adopter and architect in addition to maintaining key software components of the SEED ecosystem. The SEED format, containing both time series data and related metadata, has been the primary archive and distribution format for the DMC for decades. After nearly 30 years, the SEED format is undergoing an evolution motivated by multiple factors, including the need for modern encoding, modern transmission and metadata expansion due to limitations. Within the last few years a new XML schema for expressing SEED metadata, called StationXML, was approved by the FDSN and is being adopted by multiple data centers and seismic software systems. The complete transition of users and centers to this new metadata format will take years. The DMC's strategy to promote this transition includes offering metadata in StationXML format, distributing a stand-alone program to convert between StationXML and SEED header format and accepting StationXML as the primary means of describing time series data. We will present the details of this strategy, known challenges, and current status. One key change needed in SEED is an expansion of the two-character network code to allow for identification of the increasing number geophysical networks in the world today. This change is relatively easy in the StationXML metadata, but requires a corresponding change in the fixed-length field format of SEED time series data known as miniSEED. Such an incompatible change in miniSEED affords the opportunity to make a number of other changes to miniSEED. The DMC has identified two classes of changes to miniSEED to be considered by the FDSN. The first is a set of relatively straight-forward improvements to address well known issues such as network code expansion, clear identification of byte order, record length, sample encoding and a microsecond time resolution field. The second is a set of enhancements to be explored such as additional encodings for compression of any data sample type, representations for fixed-point data samples and considerations for a minimal format (microSEED) to address efficiency and latency concerns. Details of the DMC's proposals and their implications will be presented. With the continued implementation of newly adopted changes by the FDSN and changes such as these being proposed we believe SEED will continue to serve the seismological community for many more years.