Bandwidth synthesis of VLBI data with clock-offsets different every channel

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A bandwidth synthesis processing is necessary to derive group delay, which is one of direct observables in a geodetic VLBI, with the precision as same as that obtained using the data observed with a wide bandwidth by combining a number of narrow bandwidth data. KOMB, that is bandwidth synthesis software developed by NICT, handles data that clock-offsets are the same for all channels and could not obtain a proper result when clock-offsets are different every channel. Recent VLBI samplers (K5/VSSP and K5/VSSP32) consist of a unit that has 4 channel inputs. Four units are usually used for a geodetic VLBI observation, so that clock-offset can differ by channel. Actually some observations were accidentally carried out under the condition that a unit data has a different clock-offset from other units. In order to rescue these data KOMB has been improved to include a function that corrects clock-offset difference among channels.

Correlation processing of geodetic VLBI data is performed by channel by using a priori delay and its derivatives up to the third order. A clock-offset is reflected in a priori delay. If clock-offsets are different every channel, an observed delay residual (observed minus a priori delay) will differ every channel. The correlation data of which delay residuals are different every channel are unable to be synthesized to obtain a precise delay residual. Therefore clock-offset differences should be corrected every channel before a synthesis. Clock-offset correction of a sampling period unit can be made on a time domain. A fractional part of offset, however, should be corrected on a frequency domain. A clock-offset difference also affects the phase of phase-calibration (PCAL) signal detected by a correlator. PCAL signals are injected into an LNA to compensate the phase-difference of local oscillators of each channel, and a phase referred to each 1 pulse per second signal is detected by a correlator. Hence PCAL phase should be corrected for a clock-offset difference. These functions to correct effects on both a residual delay and a PCAL phase caused by a clock-offset difference are installed into KOMB. VLBI data of which clock-offsets are different every unit were processed by using a revised KOMB, and good results were obtained.