Laboratory investigation on graphic presentation for relay function sequence

Dehui CHEN
dehui.ch@gmail.com
September 30, 2017
Outline

Motivation

Laboratory practices

Analysis
Motivation
Motivation

Substation automation system or sub-system, such as Protection and control system.

Individual IED is to be tested, maybe changed and instead by new one.
Motivation
typedef basic_istream<_Tr, _Myis> ios_base::iosstate; _st = ios_base::goodbit;
bool _Chg = false;
_X.erase();
const _Myis::sentry _Ok(I);
if (_Ok)
{
(const _Ctype& _Fac = _USE(_I.getloc(), _Ctype);
_TRY_IO_BEGIN
_A::size_type _N = 0 < _I.width() && _I.width() <= _X.max_size()
? _I.width() : _X.max_size();
_Tri::int_type _C = _I.rdbuf()->sgetc();
for (; 0 < --_N; _C = _I.rdbuf()->sgetc())
if (_Tri::eq_int_type(_Tri::eof(), _C))
{(_St = ios_base::eofbit; break;}
else if (_Fac.is(_Ctype::space,
_Tri::to_char_type(_C)))
break;
else
{(_X.append(_I, _Tri::to_char_type(_C));
_Chg = true;)
_CATCH_IO(_I);
}
_I.width(0);
if (!(_Chg)
  _St = ios_base::failbit;
if (_Ok)
(const _Ctype& _Fac = _USE(_I.getloc(), _Ctype);
_TRY_IO_END
_A::size_type _N = 0 < _I.width() && _I.width() <= _X.max_size()
? _I.width() : _X.max_size();
_Tri::int_type _C = _I.rdbuf()->sgetc();
for (; 0 < --_N; _C = _I.rdbuf()->sgetc())
if (_Tri::eq_int_type(_Tri::eof(), _C))
{(_St = ios_base::eofbit; break;}
else if (_Fac.is(_Ctype::space,
_Tri::to_char_type(_C)))
break;
else
{(_X.append(_I, _Tri::to_char_type(_C));
_Chg = true;)
_CATCH_IO(_I);
}
}

Model-Centered
Ideas for SDL marries relay function

- Application of IEC 61850 provides standardization for relay function, which is the basis for adopting Specification Description Language
- Relay function standardized can be looked as State Machine
- Signals exchanging between relay function component can be looked as transition between state within State Machine System
- MSC graphic is suitable for presenting exchange sequence between relay function component
Outline

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Laboratory Practice

Analysis
The meaning of PDIS, RPSB, PDIR, RREC and XCBR reference to 61850 and the function model are also constructed belongs to IEC 61850

The signal, such as SamVal, PowSwing[True], Start[Str], etc. are designed according to specification about data structure under SDL
SDL block system

- Two parts are to be considered, one is exchange with outside environment, the another is exchange within system.
- Embedded C program is used which can achieve relay function, and also the same program is reused in SDL system, ensuring consistence with real relay device.
Process system

- Process is the basic component in SDL system and also the behavior of SDL
- In the case, process is the entity or body of responding relay function
- DCL is the declaration for calling and using data and function in external C program
System integration

Light Integration

- OS task
- Process1
- Process2
- Generated Code
- Runtime Library
- SDT Kernel

Other OS task

RTOS

Tight Integration

- OS task
- Process1
- Generated Code
- Runtime Library

- OS task
- Process1
- Generated Code
- Runtime Library

RTOS
System integration

void main ( void )
{
    /* initializing all sequences used with SDL system */
    xmk_InitQueue ( void );
    /* initializing the kernel of SDL system*/
    xmk_InitSDL (void);
    /*start SDL system*/
    void xmk_RunSDL (void);
    /*shutdown the communication interface with main machine */
    void xmk_MicroTesterDeinit( void );
    /*initializing communication interface */
    void xmk_MicroTesterInit( void );
}

## Test environment

### Parameters and Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L_{MN}$</td>
<td>300km</td>
</tr>
<tr>
<td>$E_M$</td>
<td>500kV, 30 degree</td>
</tr>
<tr>
<td>$E_N$</td>
<td>500kV, 0 degree</td>
</tr>
<tr>
<td>$Z_{M1}$</td>
<td>1.2+j29.4 oh</td>
</tr>
<tr>
<td>$Z_{M0}$</td>
<td>0.5+j9.0 oh</td>
</tr>
<tr>
<td>$Z_{N1}$</td>
<td>0.6+j10.4 oh</td>
</tr>
<tr>
<td>$Z_{N0}$</td>
<td>0.1+j3.0 oh</td>
</tr>
<tr>
<td>$Z_{L1}$</td>
<td>0.027+j0.2783 oh</td>
</tr>
<tr>
<td>$Z_{L0}$</td>
<td>0.1948+j0.6494 oh</td>
</tr>
</tbody>
</table>
Case #1
Case #2
Case #3
Issues to be study furtherly

- The information included within exiting model
- The granularity that graphic presentation can achieve
- The coordination design between hardware and software for relay protection
- Trying to adopt TTCN to develop better use cases with high coverage
Thanks for your attention!

Dehui.ch@gmail.com