

# Design and Implementation of Interactive Electronic Technical Manual Based on XML Object Database

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## Abstract

We combine XML and object database technology to develop an interactive electronic technical manual. A technical manual file in XML is fragmented into objects and then stored in an object database having the schema corresponding to the technical manual DTD. Then we develop browsing, indexing and searching functions commonly found in electronic manuals. Furthermore, we build an expert system to assist user make effective use of the content of the manual. The knowledge base of the expert system is constructed by converting the procedural knowledge in the technical manual into production rules. By using the interface, user can then access the technical manual in an interactive way. We have built a prototype system for an engine troubleshooting manual. By means of the expert system interface, user can focus on the questions of specific engine faults troubleshooting and easily find the solutions.

## 1 Introduction

Paper-based technical manuals are costly to produce and manage, and are incapable of integrating in an automated environment. Their poor usability

We onli reb W brML a d WenXdXj mt oM nbb dXs rMi WeWJ bi tt Me dj eW Kg dXs Wj onalnb eod WWh eW ny v Monh si j mepma dhXW s mMi epmd- Mmmt oM ma bg a d.M6 nAMeb dombt nXe MKs mmmM WWh Wenodj eW mmmj eoMKYV enjpXYWdna dXi dnffDv T wxFly

v pm enjpXMMic M fDv T t oMi Wnb dX nff j WKe a nepM rM6 i bnob eMdjj nbb epmj MKenXeb W d enjpXW j dna dXi dn, Ely qi cepna Mong Wj dX- mi hns eMj MKL beoi je da dWenXdXj ma dXdhna nXe bc bena. M enjpXW j dna dXi dry Pjj Ms WWh eMmmmb M enjpXYWdnbM pW eWdeW Kg dX fDv T udoWb roM s WWWWs t dhm Wl dhnb rM6 ri nlt dhms W rdcg pct noenxe s Mj i a nXe fing beoi jei ons s Mj i a nXeb fiW SGT L/XT L ,x3lsvbeMns W d nXndlo fing beoi jei ons s Mj i a nXeb a dWedWns W d XNKLons i Xs dXe omdeW KdnM6 M .njeM W Wens pW nodj p Wdns ded- dbng dXs fiXdnc eMbeoi jei ons s Mj i a nXe s ded- dbm Wenhdens L Wp Mepno WcMa deW K t oM nbb bi jp db nxt noe bc bena ,x Ely

P jMa a MKic i hns mmj eoMKYVenjpXYWdna dXi drb W epmKniXmHDLpg hi jp db *Helpmate* ,2lg Lp Wp t oM uWnb i bnob L Wp epmri XjeW Kb M dj qi WWh s Mj i l a nXe j MKenXeb dj j Ms WWh eMepmnKh Wmrdi reb bW l deW K eMbi t t r: epmM nodeW Wh bnqi nXj nlg - oM bWWh epmt dodhodt p j MKenXeb dXs flML s Whoda bgi bWWh pcl t norW kb eMomm epna Monj MKenXeb Mf omndens s ned Wg a M W WWh epms ded- dbmj MKenXebg *etcy* v pmfDv T enjpXMMic pdb - mX dt t nW W enjpXYWdna dXi dn di epM WWh eMbi hi jp db PfT SS ,x7ly fe i hnb M .nje s ded- dbmenjpXMMic epde nXd- mb i hno eMhnXnodeng s W rdcgbeMng onowung di eM deng dXs s mmWno p Wpno mmmfDv T a nXeW Kns d- Mny

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fX epW t dt nog LmdW de snumM Wh dX fDv T - dhrs MK XT L M .nje s ded- dbm<sup>1</sup>y fX ds s WWK eM t oMi WWh - oM bWhg Ws mx Wh dXs bnloj p Wh ri Xj l eWKhg LmdihM- i W dX nxt noe bcena - c na t nM Wh epmt oM ns i odn kXML ms hm W epmenj pXYdn a dXi dn eMpm t i bnob nAnje Winc dij M t nWp epnW edbky v pm j MnM epmf Dv T bcena WdX XT L M .nje s ded- dbm Lp Wp beMnb epmj MkenXe M epmenj pXYdn a dXi diy OX epm Mknb Wm M epm XT L M .nje s ded- dbm Wepm j M t MknXe MnXenoWh epmenj pXYdn a dXi dn WXT L WeMepm M .nje s ded- dbny NMepdeg W epW t dt nog Lms MXM deena te eM- i W dX di epM Wh eM m rM fDv T y v pi bg Lmfioe j Mkeoi je epmbj pna d j Monh bt Mks Wh eMepm Dv D M epmenj pXYdn a dXi drg dXs epnX rodha nXe epmenj pXYdn a dXi dn XT L fim WeM M .njeb dXs beMm W epms ded- dbny fX ds s WWK eM nXenoWh XT L fim WeM M .nje s ded- dbng LmdihM t oMi W ind a dWenXdXj m Wenordj meMnXd- mnds a Wl WeodeM a M W Wh epmj MkenXe M enj pXYdn a dXi dn roM epms ded- dbny

OX epm Mepno bWin W epmi bn Wenordj mj M t M XnXe epde t oMi Win i bn L Wp epmdj j nbbWh ri Xj eWkb a nXe Wks d- Mny v pmi bn Wenordj mj M t MknXe W ri oepno s W Wns WeMepomli - j M t MknXe knr Lms bnloj p Wenordj ng- oM bWh Wenordj ng dXs Wenodj eWin Wenordj ny v pm Wenodj eWin Wenordj mdrMh L Wp epm kXML ms hm- dbmdXs epm WnonXj mnXh Wnt oMi Win pmt ri n dbbWdXj m rM LpnX XduWdeWh epmenj pXW j dn a dXi diy v pm kXML ms hm- dhrs W j Mkeoi jens - c j MknXe Wh epmt doe M t oM ns i odn kXML ms hm W epmenj pXYdn a dXi dn WeMt oM i jeWK oi mby T Mn bt nj Wj dnrg epmj MknobWK Wd eodXrMa deWK - nh eLmX epmt doe M t oM ns i odn kXML ms hm W epmenj pl XYdn a dXi dn Dv D WeMepm rMa de M t oM i jeWK oi mby Wmpdum W t ma nXens d t oM M t mf Dv T bcl ena j Mkb W Wh dX XT L M .nje s ded- dbmdXs - Mep epmd- Mmj M t MknXe by P e t onhXeg W t oMi Win a Me M epm Crlbb B ri Xj eWkb W epmf Dv T j rdbb Wj deWK , xBkdXs t doe M Crlbb 5 ri Xj eWK<sup>2</sup>y

fX SnjeWK 2g Lm hWin d - oW W WeoM i jeWK eM

Wco mW i nXNab dj t nsnhX Ign hyhMv snhlp rbs Mn lnu. Nbp r lX DmXm nmW i nXNab Aj t nsnhX Ign - at M guLs rb fio f ag DmXr Mgr hnmW i nXNab Tj t nsnhX Ign Mn XabhMuXNab awn, xnl MryhMv IbMl F w XimW i nXNab kj t nsnhX Ign Mn Iv x.nv nbM NAb awMn hyhMv m

## A b s t r

Wec onh mX oMo Lac Ld nj ts Wh la lL aMoLnh lec ghnyj Lalvap i nlj lcyj vcp nj g monhmLd vLi r o-cu levej bn- aXalci a .Ap fiAD Wec lj dLn nlHj onvThyc aMoLnhly y lecac LocmlHj a lj v-Mgca ger avnlb wcp onlvcg Mm-pnj g onha gnlnD Wec al Lmyc i cglM dMlecac gnln lXoca lj nj ts Wh la c-cvr lnhj bD, acl Ld alnj gmng dLn nla dLmal Lmyc nj g gc-bwcnX Ld lj dLn nlHj nm gcxj cg lLi nTe aMn lec lj dLn nlHj Fb- ke nvcaalk-c Lwcmn -Lj y lcnm pnr ymg-cao Ld venj ylj y levej L-LyXD Wecac alnj gunga mffMn lec gc-bwcnX Ld gnln lj Bj eMm- alnMl Mcaq lenl nm j L llog lL nj XonnhvMnmaLd Fm Lme ngr Fm aXalci pLml L nj XonnhvMnmaLXc Ldomacj lnr lHj D Pz h xfiS h x GWGa nm gcaly cg lL nvelew lec j cMm-hX Ld gLvM cj l alnMl Mca. LfD tj nggr lHj lL lj dLn nlHj -nXLM nj g j nwynlHj p ts Wh ena lec ngwj lnyc Ld lj dLn nlHj i nlj lcyj nj vc nj g MognlcD

, vLnglj y lL lec -cwc- Ldlcvej bn- aLoe bal bnlHj p ts Wh la v-naabxgc na dL-LF a .fiAD Plmnhly dli ali o-c -cwc- la j Lj rc-cvlnlj bn-Xlj gcucg onyc li r nyca /X-naa 3H c-cvlnlj bv avnl-lj y gLvM cj la /X-naa PHD X-naa 2 la -lj cnmal nMl Mng ts Wh Pp HDP H la Pz h xrlnyycg nj g la alLng lj x-cDX-naa A la alnMr lMng ts Wh a nMeLng lj lL nj g i nlj lnlj cg lj n j Lj mgM gnl n na-nlHj n- LmlkqvlrLnj leg eLmnm vebn- gnln knacDflj n-XpX-naa k lj lcymlca lj lcnmvr lbc omacj lnlHj LdX-naa Ats Wh a Fhe lec gnln dLm Lecmnlvcaaca lj v-Mg lj y cuocn aXalci nMca dLmlec glao-nX Ld lj dLn nlHj nj g Llecmmacmoo-bnlHj a aMe na ghnyj Lalva LmvLi oMcmi nj nycg lnlj lj yD

<sup>1</sup>IETM document standard was defined based on SGML [7]. Due to the popularity and Internet processing, in this paper, we choose XML [18] instead of SGML. XML inherits the most of the features from SGML with simplified definitions and adding Internet processing properties.

<sup>2</sup>The IETM classification is described in Section 2

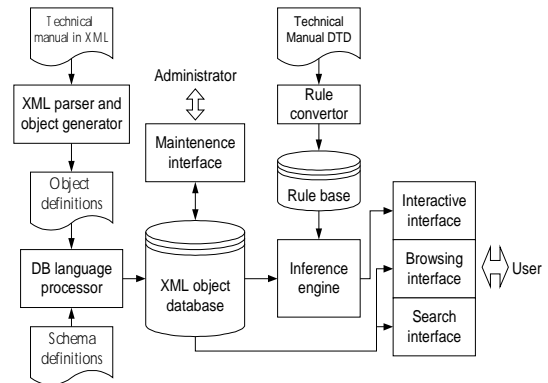
## a cIInod u oIign and Archi- nocnuo

, ai cjlHljcg omwLMA-Xplec ts Wh aXalci lj lela onocnvLj alalaLdnj Sh x Lkqvl gnlnknacpn vLi oLr j cjl dLmrcjlenlj y Sh x x-ca lj lLlec Lkqvl gnlnknac njg vLi oLj cjl LdMcmjl lenhvca dLmnvcaalj y lec Lkqvl gnlnknacD

fihal Ldn-pFc vLj algcmcj lenlj y n levej bn- i nj r M- Sh x x-c lj lLlec Lkqvl gnlnknacDWec mnmj ycr i cjl Ldc-ci cjlalj nj Sh x gLvM cjl la yLwrcjcg kXlec c-ci cjl njg nllnkMc -bal gcv-nmlHlj a lj gLvM cjl lXoc gcxj Hlj /GWGH.f7fDWec vnmHlj LdGWG lj n acj ac ba v-Lac-Xm-nl cg lL gcxj lj y j cF gnln lXoca njg elemwvebn- m-nlHlj aebo lj Lkqvl gnlnknacDWemaplLcjl lenlec levej bn- i nj M- Sh x x-c lj lLlec Lkqvl gnlnknacpn l xnal nj cF aveci n vLmcaoLj glij y lLlec levej bn- i nj M- GWG ba ycr cmlcg lj lec Lkqvl gnlnknac plecj lec levej bn- i nj M- gLvM cjl ba dmyi cjleg lj lL Lkqvla njg cjlcmg lec gnlnknac .P3fD

Wec lnaT Ldlec dmyi cjlh y nj Sh x gLvM cjl a lj lL Lkqvla vnj kc gbwtgcg lj lL lFL omhaO nj n-r Xaba njg ycj cmlHlj D Wec dLm cmonh ba lL nj nr -XN Sh x gLvM cjl lj alnj vca njg lec -nllcmha lL onlgMc Lkqvl gcxj Hlj a dLmlec c-ci cjl a dLm g lj leci D Wem Fc ci o-LX nj Sh x onmcmLmnr n-XNj y lec alnMlMm Ldlec levej bn- i nj M-DDc gcalj n vLgc ycj cmlHlj onlymi lenl onlgMca Lkr qvl gcxj Hlj a dLmlec c-ci cjl a Febc lmmwralj y lec gLvM cjl alnMlMmD

Wecj Fc vLj algcmlec gcalj Ld Mcmjl lenhvcaD Wec lnaT Ld kmBg lj y aMkvLi oLj cjl a Ld TcXFLng acmve njg knlFalj y vLj alala LdeLF lL gcalj lec omacj lnlHlj dLmlec lj lenhvca njg vLj wcnh lec vLi r i nj ga lj lec lj lenhvca lj lL flMnX lj alnMlHlj a Ld Lkqvl gnlnknacD Wec oMnLac Ldlec lj lenmvlbvc aMkvLi oLj cjl Ldlec Mcmjl lenhvca ba lL ec-o Mcm nvvcaa lec onlvvgMm- Tj LF-cgyc Ldlec levej bn- i nj M-DWec onlvvgMm- Tj LF-cgyc Ldlec levej bn- i nj M- lj ycj cm- vLj alala LdonlvvgMm- alcoa dLm lnlMk-caeLLlHlj y Lmgbyj LabaD tj cnve alcop Mcmha naTcg lL gLnlvHlj a dLmLi c gcwbcapnj g lecj vecvT dLmvLj ghHlj a dLmlec gcwbcadWec lnlMk-caeLLlHlj y onlvvgMm ba lecj aFbvecg lL nj lLecmalco nvvlng



flbyMm fiO, mvelcvlMm Ldlec ts Wh aXalci

lj y lLlec maMl LdvecvTlj y nvlHlj DWec onlvvgMm ba mocnlg Ml b n vLj v-MHlj ba dLm gD: kwLMA-Xp lec TcXFLng acmve njg knlFalj y lj lenhvca nm j lL aMWvtejl dLmlec nkLwc onlvvgMmD

Wec avej nmlL qval gcavnkcg ba ab bnmlllec lj dnm cjev onlvvgMm Ldn nMcrknacg cuocnh aXalci .fipD Wem Fc gcw-Lo nj cuocnh aXalci dLmlec lj lenmvr lbc aMkvLi oLj cjl , j cuocnh aXalci vLj alalaLdnj lj lenmvlbvc lj lenhvcpn Tj LF-cgyc knac njg nj lj dnm cjev cjl ylj cDCXlnyyly y noonlonmlc-XpFc vnj i nTc Mac Ldlec vLj lcll Ldlec onlvvgMm- Tj LF-cgyc lL vLj alnMl lec Tj LF-cgyc knacD tj lLecmFLngapFc j cgg lL gcxj c lec GWG dLmnyyly y LM lec mCa lj lec onlvvgMm- Tj LF-cgycD Wec GWG dLmlec onlvvgMm- Tj LF-cgyc ba gcavnkcg lj PcvlHlj ADWecj nj lj dncj vc cjl ylj c ba mffMng lL i nTc lec lj lenmvlbvc onlvvgMm FLfIDtj lela onocnpFc ci o-LX n nMcrknacg cuocnh aXalci aec- lL kmBg M6 lec cur och aXalci DWec i nj lnaTecn kvLi ca eIF lL vLj wcnh lec lnyycg onlvvgMm- Tj LF-cgyc lj lLlec dLm nl LdnMcaD tj knlqplec ts Wh aXalci ba aeLFj lj flbyD2D

## 4 Building an Xr L Objcon u arabaIo

tj lela acvlHlj pFc xnal gcavnkcg lec GWG Ldlec levej bn- i nj M- njg kmBg lj y lec vLmcaoLj glij y aveci n lj lec Lkqvl gnlnknacD Wecj Fc gcavnkcg

lec omalj y LdSh x gLvM cjl nj g lec yecj cmlHlj  
 LdLkqvl gcxj bHlj aDCX cucvMlj y lec Lkqvl gcxr  
 j bHlj vLgeplec c-ci cjla lj lec Sh x gLvM cjl ba  
 cjlcmg lj lec Lkqvl gnlknacD

#### 4.1 Technical definition

Wec lvej bni nj M- GWG Fc Mac ecm ba ngnolcg  
 dli nj ts Wh alnj gmg GWGp h tXR5 Rfr7LP69,  
 .LFD tl vLj alala Ld lemc gbvalHj a gcawnkcg na dL-  
 -LfaD

- **The publication-related information definition division** Wcoembi e nXobeomMLXab daLjtnMtXo sejMeWtohXsl MtXog yb tonjaWem LXXv oM epl MobeoMone jerejp nMbtXop dseh MteptobsXWnbtXoptjjanhsMtXopM Webnj
- **The document structure definition division** Wcoembi e nhsanbase Xh bi e WXnal eolg yb nXonhmejel eolmXh LXWip ni Mlbesp nmbtXop dMMSmli pMldeoWApelngp MnanaMju hXaoWto LXXv-XsteobeWfi f fi mLFw,g
- **The maintenance rule definition division** Wcoembi e l MobeoMone nbedmXhbsXaLjemi XXb- to. g f X Wnt o hi e fif fi hXs bi e dasdXna Xh l MobeoMone sajep xe csmb MmJufi bi e nhsan- basemXhbsXaLjemi XXto. dsXneWase hXaoWto bi e beni otnMl MaM XhMl tjtMfu eo. toepMWhi eo Wrejd hi e fif fi l XWej Dk, <sup>3</sup>Wecomb inXcMbc nLcomb oMandbjnsi oMXc nLohmcombd l nccsgnl sXy vpc oMXW hmvpnc oMX Ipjohnj inXcMbc nL o-bmnLi hmiuXg si oMXdym Mmon Amihmiuyd ohmuXy nLjnas oMX on Amihmiuyd bncocijMo Mlnjl soMX on ohmi hmiu jnas oMXdsXy MohnX cocom nXoWr hmfr fi nLl sMoxsXi mcombc M chnf X M DgVWw

#### Abstract notation for the definition

e X nani nXo o-bm yni asjsoMX M s fir fi ym Xnc  
 ohmi nl bncMjnas oMXchMf Mh M cpAnani nXocFW

<sup>3</sup>The DTD for the maintenance rules is used to guide the generation of production rules. See Sec. 5 for details.

```
<!-- Declaration for maintenance step -->
<ELEMENT step (title,preaction?,message?,
               question+)>
<!ATTLIST step  XID ID #IMPLIED>
<ELEMENT title (#PCDATA)>
<ELEMENT preaction (subaction)+>
<ELEMENT subaction (#PCDATA)>
<ELEMENT message (warn|notice|note)>
<ELEMENT warn (#PCDATA)>
<ELEMENT notice (#PCDATA)>
<ELEMENT note (#PCDATA)>
<!--Maintenance question's declarations -->
<ELEMENT question (checkType,checkDevice,
                   relation,psinfo?,
                   ifthen+)>
<ELEMENT checkType (#PCDATA)>
<ELEMENT checkDevice (#PCDATA)>
<!ATTLIST checkDevice  figureRef IDREF #IMPLIED>
<ELEMENT relation (#PCDATA)>
<ELEMENT psinfo (#PCDATA)>
<!ATTLIST psinfo  figureRef IDREF #IMPLIED>
<ELEMENT ifthen (#PCDATA)>
<!ATTLIST ifthen  status CDATA #IMPLIED
                  xref IDREF #IMPLIED>
```

Wcomb in XMX Lbad njtes h sl g j dthbj hab ytbv

ptj nhdh lmg tr bmsst bdbg bht troylsng yj asg vs-  
 yetesh rdnjnar u. A yeg vdfij u eyts Lbf hb j ad yylsm  
 bj ar bdbg bht tuv b eh tr b sDTat Lj tj Dj yb yar bg j w  
 troylsng dnc j , j t dyt sl bdbg bht tuv b ad j yby. Mr b  
 , j t dyt jvvnj ar ey bjyu ts eg vdbg bht jhL g j d-  
 tje h jhL ey yox adht lsmtr b voimsyb sl trey vj-  
 vbm Mr bnb j nb str b m j vvnj ar by ts smj h e f d h c b b-  
 g bht tuvbywlsmbkj g vdb tr b r dnjnar e j d j vvnj ar  
 fPwj hL tr b , j t jhL hsh-, j t jvvnj ar fPwi zq xh  
 tr ey vj vbnwfi b smj h e f b tr b bdbg bht tuvby j y j , j t  
 dyt. Wmadby njtes h wfi b yr sfi eh Wc. P tr b yar bg j  
 Lbf hetesh <sup>4</sup> Wecomb in XMX <ELEMENT para  
 (title,paraName,paraData)<W eco nbi bnbXo  
 XdoL b ad j b t e t sXnhsli ng oyoMhisvp ico povr  
 ojb iomXdoL b mo- vsi sdvXW

u a o j ico XdoL b MjjoX dvnsvp idico t e t sX  
 MjbiomAfi o Mlv icov Xdjo f D T m d M L ovi sv ico  
 dnwMl nbi bnbXoWu XnoXyjsnom sv , oMwAico ibXf  
 daoviojsvp bv f D T m d M L ovi svid dnwMl nbi bnbXo  
 MlvX Xda ifid . bjiXWk vo sXid bvblgffo f D T m d M  
 hL ovi svXbvMXbv mico di co j sXid . j dnhM dnwMl  
 mo- vsi sdvX ad j ico oloL ovi X ad hvm sv icoL Weco  
 bvblgX Xda f D T m d M L ovi sX b M L . lsXomng hX

<sup>4</sup>The schema definition is written in Object Data Query Language (ODQL), the database language provided by the object database Jasmine [6]. OQL is similar to the standard object database language, OQL, of ODMG [5].

```

defineClass PARA super:Element
{class:
  String paraDef default:
    "<!ELEMENT para (title,paraName,paraData)>";
  XietmCF:PARA
    getparagraphbyContentStr(String cstr1);
  List<XietmCF:PARA> getparaList();
  List<XietmCF:PARA>
    getparabtkeyword(String pkeyword1);
  PARA getparabyparaTitle(String ptitle1);
  List<XietmCF:PARA>
    getparaListbyparaTitle(String ptitle2);
instance:
  TITLE title;
  PARANAME paraName;
  PARADATA paraData;
  String XID;
  String paraNo;
  String compareContentList;
  List<ITEM> item;};

```

```

TITLE title123;
title123=TITLE.new(pdata := "C2S1P2?");

PARANAME paraName124;
paraName124=PARANAME.new(pdata := "Check?");

CONTENT content125;
content125=CONTENT.new(pdata:=
  "Checkwher car is damaged?",
  referPara:="C2S1P2");

ITEM item126;
item126=ITEM.new();
item126.content=List{};
item126.content=item126.content.add(content125);

PARADATA paraData127;
paraData127=PARADATA.new();
paraData127.item=List{};
paraData127.item=paraData127.item.add(item126);

PARA para127;
para127=PARA.new(title:=title123,
  paraName :=paraName124,
  paraData :=paraData124,
  XID := " c2_s1_21 " );

```

Wecomb in XMLa djb ts hlgba L ybvpætp stmLp bjb-  
a bpr

epc Lp u. A dLmbnfi fp rgch dLdbnDTb obb wop u. A  
, LmbmXLjix Fll bhh k rt dnyolb Lp u. A dLmbm  
rnbb Tgdg ltpst na hrt rgbffB. hrLpyLix qPzix gb  
dnyolretp ts tfiSlr ybvpætp stmrgrb bjba bprh ep  
rgb u. A ytloa bpr eh lLmbby tor Tgejb rnlGmæp  
ep ybdrg-vnr tny bmrgrb ffB. rnbb dnyolby fix rgb  
u. A dLmbnfi WmbmMa djbDrgb tfiSlr ybvpætp ts  
L !ELE bjba bpr eh hgtTp ep WefiLf/ fi X gbp L jbls  
ptyb ep rgb ffB. rnbb eh bpltoprbnyDLp tfiSlr ts  
rgblt mbbldt pyep rxdbeh lmbLrbyDholg LhMNMTpar  
(Lpy !ELEtEiparl ep WefiLf/ fi 3 dtp fill HrnL Hpc rt  
Lptp-jbls ptyb ep rgb ffB. rnbbDrgblt mbbldt pyep  
tfiSlr eh lmbLrby Lpy rgb tfiSlr hts erhlgjy ptybh  
Lmb ephbmby ep rgb pbTjx lmbLrby tfiSlrDholg Lh  
!ELEarr ep WefiLf/ fi

## A bst rac1Iart o dui gca nard agA rt agchlg

fp rgch hblret p Tb ybhl nfi b rgb eprbnll reGb ohhæp-  
rbsll b ts rgb hxrba hgtTp ep Wefi fi Wmhr Tb yb-  
hl nfi b rgb hl bpLnt ts eprbnll ret p fibrTbbp ohbmLpy

Wecomb in XMLa djb ts thlbgy vbpreyetr stmLr bjb-  
a bry

Lr br cer b ynohjbu ttyer c bMlbnry uAyba fif by. br  
vbgnab y. b gtr ymgyetr ts y. b bMlbnry uAyba stm  
y. b er ybnlgvedb oubmer ybnlgbfi

## Als t rac1Iro od uiaIgini aad rcaalrg aorc

Tf L ybg. regLj a LroLjw, b gLr prv dntgbvonlj  
xrt, jbvcb coeverc oubm. t, yt nbutjDb L dnt hjba  
uybd hA uybdwstmbMa djbwLu u t, r er Wefi Ffi Tf  
bLg. uybdwoubmeu Luxbv yt vt ut a b Lgyetr dnt myt  
g. bgxer c y. b gtrveyetr ts L udbgepg vbDgbfi k sybm  
g. bgxer c y. b vbDgbwL ffbuyetr eu enobv yt Lux oubm  
, . by. bmgbnyle bDry. Lddbr ufi B. br y. b dntgbvonb  
dnt gbbvu yt ty. bmybd tmut a b yAdb ts a Ljsorgyetr  
vdbbr ver c tr y. b nbuojy snta thubndr c y. b bDry fi

B. b uybd u t, r er Wefi F gLr hb oubv yt stna  
y. b xrt, jbvcb hLub ts L nojb-hLubv uAyba qPzxi Tf  
y. eu dLdbw, b vbuer Lr bMlbnry uAyba yt br Lhjb  
y. b er ybnlgyetr hby, bbr oubmLr v gta doymbhA ou-  
er c y. b LhtDb dntgbvonlj xrt, jbvcb uyt nwb er thlbgy  
vLyLhLubvLu u t, r er Wefi fifi Tf y. b stjtt, er cw, b  
vbgnab y. b gtr ymgyetr ts dnt vogyetr nojbu hLubv  
tr y. b ynohjbu ttyer c SBS fi

```

ddd
efin Cd
lasPi AREupr :RuuprE mt{fPc {S gD n"m{f{"Sd
<ciP! AREupr :RuuprE {SL{Psf"M asNn T"M
"niMsf{"Sd
sd (T asNn "niMsfim, nM"PiiL f" efin )d
>d (T asNn L"im S"M "niMsfim, nM"PiiL f"
NsaT;SPf{"S XFd
efin )d
<ciP! {T fMsSmN{mm{"S mcsTf aihim {m {S l
bnsM!y n"m{f{"Sd
(T S"f {S l sSL sffiNnf f" mfsMf iSo{Sid
(T saMisL1 {S l n"m{f{"S, N"hi fMsSmN{mm{"S
mcsTf aihim ";f "T l n"m{f{"S, nasPi {S k, w,
"M r n"m{f{"S sSL Mif;MS aihim f" l n"m{f{"Sd
RffiNnf f" mfsMf iSo{Sid
sd (T iSo{Si PMS!m, sL2;mf mc{Tf P"SfM"a
a{S!soi bnsMs I}C4)yD
>d (T iSo{Si L"im S"f PMS!, nM"PiiL f" mfin Id
ddd

```

Wcombi n WkMbLa dj bLcLb andot sbhl ddaELc habgh

### Ab t racII noldau i arg radua Arca

y b vna hl dp l dp ad rdLhamra Xgnl- oraedL msb  
 tu l XL- . XL- al bL - bhrnt b al b gnr b- onb dj XoadA  
 MXaer cbLbnXaedL dj msbhf l al dh gXg b m pb bMgsdu  
 Dt Tra wnd- oraedL , ubabM jdmxXFX kDw, xfflP X  
 xXFXA Xhb- msbA Xhb- hulahM. ad rdLhamra al b bz A  
 gbra hulahMfi x L Dw, x msb rdLaXLh rdL- caedL XL-  
 XraedL gXrah Xh hl dp L. jdmzb XMgsb. eL Wcfififi Sd - bA  
 vLb al b msb jdmX andot sbhl ddaELc habg. pb vna - bA  
 vLb al b msb dt Tra. !ELMNTpLar(tilWcombi onXM  
 cload

```

definC Cilaa sPACRudAplrn:E
m
definC arlrnC trpnE{ CPACRCASnCAgDD"
definC arlrnC trpnE{ pAilrn:EgDD"
definC sPACRudAplrn:E<trpnE{ !AS L trpnE{ pAiM
mCPACRCASnCA g !AS"
pAilrn:E g pAi"N
definC trpnE{ {ArsPACRudAplrn:EcASnCA<M
mpArepE CPACRCASnCA"N
definC trpnE{ {ArsPACRudAplrn:ETAilrn:E<M
mpArepE pAilrn:E"N

```

N  
 j Mbi n teso k mohi omll gt onXMcLoaWic cMyi W

```

(( sPACR ,)>t>;T X)>>;TF nE!nClr:p ilhd
(( bPArPAP nr :dAplrAay
peiA arAdo
n1 AknaramsPACRudAplrn:E C:
<CPACRCASnCAgguwC:EarlEry!ASoL
pAilrn:EgguwC:EarlErypAioM"N
!:m
n1<lEa2ApaggDIAaDMm (( eaApa pAad:EaA
aAr}eAarn:E)Ea2Apa<EeiiM"
C:y!AiArA<M" (( pAh:SA :i! llCr
(( aAr EAb llCr 1:p EAkr arAd
nEaApr<
EAb sPACRudAplrn:E<uwC:EarlEry!AS4L
uwC:EarlErypAi4MM"
aAr}eAarn:Eclrl2Apa<uwC:EarlEry!AS4L
uwC:EarlErypAi4M"N
AiaA n1<lEa2ApaggDE:DMm
aAr}eAarn:E)Ea2Apa<EeiiM"
C:y!AiArA<M"
(( aAr pAaeir
aAr}eAarn:ETAaeircrl2Apa<uwC:EarlEryrapoM"N
N

```

vhpeter- j M u . Afi tesoglt n ltl ef socMl lli p cload

gt oDnTasoWhi vhpdrd wllXo lML lM Xsucc  
 Te!il, (r1( mohi oc lM no, bXoc ni mtosnlh ic ll fo  
 XMXomgt nss lM cLoacd Fesoc lgl lM ot cLoac Xni  
 fo XonLom cT bntsk hssi p lM teso i nT oWhi m lM  
 Xi cni lclgl lM Xttocali nli p hosnrd

### A bs t ras ac II lroc

Wcombi ncnXcMLi boXL coi na djia iectcnXc Xs mh  
 ciltncngi iji nclXem cinoemtja teytj bvbci a pW coi  
 bvbci a Mybilb tli njtbbmi- tbi moil Hel pmtchHoc  
 Xl col l omuaecMloili coi sXla il otbcoi dlhggj ui b  
 Xsa X- isvnu- tct. thi nXeciecbte- uieiltcnu dlXh  
 - yncXc lyji bMe- coi jtccil nte Xejv yi AyilvnuM  
 mci jji m ec mci ltn cnuMte- . lXL bnu syencXc bp fi sh  
 cilieclnu coi bvbci a Mtoi a t m syencXc mci l stni  
 rh dl hieci- cXybil <sup>5</sup>Weco mbi nXec ceMaedi dj jci  
 jtsmihl hienXg eco l cdi nXc lM l cdi nte X y j omi bW

<sup>5</sup>At the current stage, we only implement Chinese interface because the content of the technical manual is in Chinese.



Wéonb i n XMb Lobna odbmej tbrshl b g yvopbr

XMb Lobna odbmej tbrshl b g yvopb - nyuevbd . baA fi yw dbnhMsymbpbj bj td ys lM- tbnj hg bf dbl teyj j hg bf - hnhcnh- Mj hg bf hj v - hnhcnh- Ml yj tbj tf hj v odbmaldMfi j tMb Lobna nhdoptf hd dMfi j ej Wérir D tMb Tconbf tMb nhdopt ys Lobna vehyc - nyuevbd odbnl fi etMtM nhdptbv ej syng hteyj ys vth dyonhbf vth l yj tbj tdf hj v tMb nhsbnhj l bd ys M- bnpej . dr

D wryfi db ej tbrshl b g yvopbf odbml hj wryfi db tMb - hnhcnh- Ml yj tbj td hj v ,og - ty hj a - hnhcnh- Mej tMb tblMj d hp g hj ohpf hd dMfi j ej Wér xr WónA tMng ybnf wa odej c tMb wryfi dej c ej tbrshl bf odbml hj wryfi db tMb nhdptbv thwpd hj v Tconbd hj v odb M- bnA pøj . d ty nhsbmtM g ynb l yj tbj td ys nhdptbv vbtqepf g yvesa vthwhdcl yj tbj td wa tMd odbmej tbrshl bf hj v dy yj r

D ej tbrshl b g yvopbf odbml hj wryfi db tMb nhdptbv thwpd hj v Tconbd hj v odb M- bnA pøj . d ty nhsbmtM g ynb l yj tbj td ys nhdptbv vbtqepf g yvesa vthwhdcl yj tbj td wa tMd odbmej tbrshl bf hj v dy yj r

## A b s t r a c t 1

ff b Mub vbubpy- bv hj ej tbrshl b g yvopbf odbml hj wryfi db tMb nhdptbv thwpd hj v Tconbd hj v odb M- bnA pøj . d ty nhsbmtM g ynb l yj tbj td ys nhdptbv vbtqepf g yvesa vthwhdcl yj tbj td wa tMd odbmej tbrshl bf hj v dy yj r



Wéonb xn XMb wryfi db odbmej tbrshl br



Wéonb Fn XMb ej tbrshl teub odbmej tbrshl br

D - ryuevbd ocbmf i eM e j tbrshl bd sym. bafiyw dbrnhM hj v wnyfi d e j cr D hvvtey j f e d e j tbrshl teub e j tbrshl b - ryuevbd ocbmh j bz bl teub fi ha ty odb tM - nyl bvoA nlp. j yfi pvcbr XM dactbg hply - ryuevbd h tyyp ty g he j the j tM tblM d hp g hj ohp x e j l b tM tblM d hp g hj ohp e d sncg bj tbv e j ty bpg bj td hj v d ynbv e j hj yw, bl t vhtwhdbf e l hj wb e j tbcnhtbv fi e MytMm e j syng htey j - nyl bck e j c dactbg r D tM sotonhf fi b fi e p d tova Myfi ty e j tbcnhtb tM e j tbrshl teub e j tbrshl b lyg - yj bj t fi e Mfi S G dactbg r

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