TranEd Version Two aids the study of complex signal designs

Paul Moore and Peter Cheng, JCT Consultancy Ltd.

This paper is intended to provide an overview of the new version of TranEd, the graphical editor for TRANSYT. This new version, as well as providing a range of graphical tools for editing and visualising TRANSYT models, incorporates a completely new set of tools to help with modelling complex signal junctions within TRANSYT. New analytical tools for analysing the network are also described, including a new network cycle time optimiser. Finally the issue of reporting and presentation of results is discussed together with a brief summary of some of the new reporting and printing features.

Although this paper is primarily to introduce the new version of TranEd it is also important to mention TRANSYT, which whilst being an independent product, is used by TranEd to carry out all calculations. Although the paper assumes that readers are generally familiar with TRANSYT, its underlying theory and use, a brief introduction is given below

TRANSYT

TRANSYT was originally written more than 30 years ago by the then Transport and Road Research Laboratory (since privatised as TRL Ltd). Over the years it has established itself as a highly popular and efficient model for calculating fixed time signal plans for networks of closely spaced traffic signal junctions. It's popularity stems partly from the fact that although it is usually of sufficient accuracy for assessing the performance of traffic signal schemes it also has quite low data requirements. This means that a number of scheme alternatives can be considered at an early stage in the design process without incurring large data collection costs. Additionally the fact that it has been used so extensively over such a long period has given it a high level of credibility within the traffic signals industry.

The main problem with TRANSYT was that data input and output was quite basic, initially being based on punched paper cards before moving to formatted text files. This meant that the process of building and analysing TRANSYT networks could be quite involved. This was the issue that TranEd was developed to address.

TRANED

Background

TranEd was originally developed in 1998 as a tool to complement TRANSYT by providing an improved method of preparing and analysing TRANSYT data. Some of the main features added were:

- A Windows based graphical editor for TRANSYT networks.
- Graphical display of link and node based input data.
- Error checking of input data on entry.
- Graphical depiction of traffic signal staging.
- Time-Distance diagrams.
- The ability to transparently run TRANSYT from within TranEd.
- Graphical analysis and display of TRANSYT results.

These features provided a significantly easier way to enter and analyse TRANSYT data and also helped to significantly reduce manual coding errors.

The main problem with TRANSYT historically was that data input and output was quite basic resulting in the process of building a TRANSYT model often being quite complex and time consuming. Despite more recent improvements to TRANSYT with the addition of a Windows based network editor it was felt that a need still existed for a TRANSYT editor which could provide additional help with

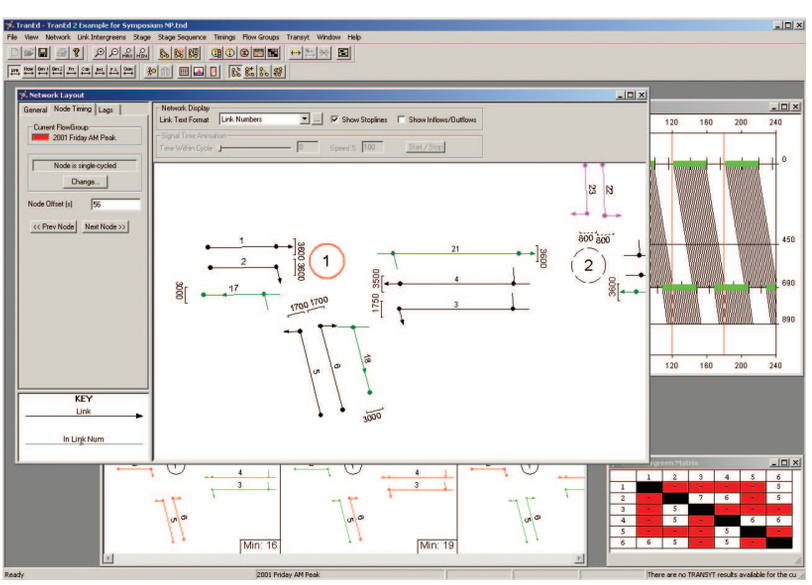
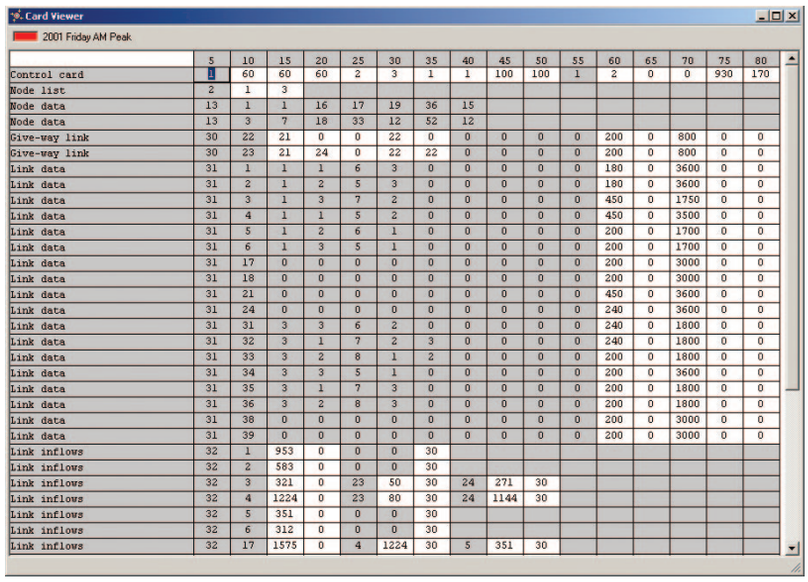


Figure 1: TranEd Version Two Main Window



	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
Control card	1	60	60	60	2	3	1	1	100	100	1	2	0	0	930	170
Node list	2	1	3													
Node data	13	1	1	16	17	19	36	15								
Node data	13	3	7	18	33	12	52	12								
Give-way link	30	22	21	0	0	22	0	0	0	0	0	200	0	800	0	0
Give-way link	30	23	21	24	0	22	22	0	0	0	0	200	0	800	0	0
Link data	31	1	1	1	6	3	0	0	0	0	0	180	0	3600	0	0
Link data	31	2	1	2	5	3	0	0	0	0	0	180	0	3600	0	0
Link data	31	3	1	3	7	2	0	0	0	0	0	450	0	1750	0	0
Link data	31	4	1	1	5	2	0	0	0	0	0	450	0	3500	0	0
Link data	31	5	1	2	6	1	0	0	0	0	0	200	0	1700	0	0
Link data	31	6	1	3	5	1	0	0	0	0	0	200	0	1700	0	0
Link data	31	17	0	0	0	0	0	0	0	0	0	200	0	3000	0	0
Link data	31	18	0	0	0	0	0	0	0	0	0	200	0	3000	0	0
Link data	31	21	0	0	0	0	0	0	0	0	0	450	0	3600	0	0
Link data	31	24	0	0	0	0	0	0	0	0	0	240	0	3600	0	0
Link data	31	31	3	3	6	2	0	0	0	0	0	240	0	1800	0	0
Link data	31	32	3	1	7	2	3	0	0	0	0	240	0	1800	0	0
Link data	31	33	3	2	8	1	2	0	0	0	0	200	0	1800	0	0
Link data	31	34	3	3	5	1	0	0	0	0	0	200	0	3600	0	0
Link data	31	35	3	1	7	3	0	0	0	0	0	200	0	1800	0	0
Link data	31	36	3	2	8	3	0	0	0	0	0	200	0	1800	0	0
Link data	31	38	0	0	0	0	0	0	0	0	0	200	0	3000	0	0
Link data	31	39	0	0	0	0	0	0	0	0	0	200	0	3000	0	0
Link inflows	32	1	953	0	0	0	30									
Link inflows	32	2	583	0	0	0	30									
Link inflows	32	3	321	0	23	50	30	24	271	30						
Link inflows	32	4	1224	0	23	80	30	24	1144	30						
Link inflows	32	5	351	0	0	0	30									
Link inflows	32	6	312	0	0	0	30									
Link inflows	32	17	1575	0	4	1224	30	5	351	30						

Figure 2: Card View showing TRANSYT card coding.

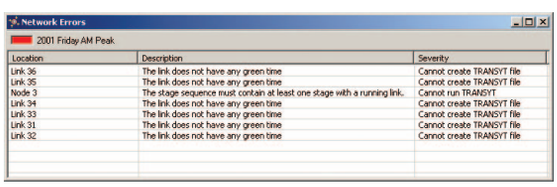


Figure 3: Error Management View

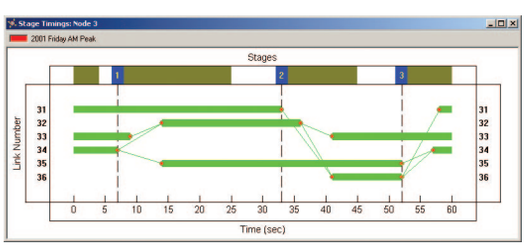


Figure 4: Stage Timings View showing when links run and how inter-greens and link delays influence this.

building more complex TRANSYT models. This is the need that TranEd has been developed to address.

The improvements made in Version Two can be broadly divided into three main areas, these being network data entry improvements, analysis tool improvements and reporting improvements. In particular:

- An improved data entry system for the TRANSYT network.
- Improved traffic signal data entry and manipulation, particularly for complex junctions.
- Improved tools for analysing the end results.
- Improved flexibility for reporting results.

These areas will now be described in turn.

NETWORK DATA ENTRY IMPROVEMENTS

User interface design

One of the key areas of improvement in TranEd has involved an in depth look at how data should be entered into the software to provide the correct blend of ease of use between beginners and advanced users. Often beginners find menus and popup dialog boxes useful in providing guidance whilst entering data. The same users having subsequently gained experience in using the software may then find the same features to be tedious getting in the way of rapid data entry. For example if in a network containing 50 TRANSYT links a decision is made to reduce all saturation flows by 10% it can be extremely tedious to have to double click on each link in turn with the mouse, before changing the saturation flow in the resulting popup dialog box. With TranEd 2 we have redesigned the basic user interface so that whilst still being a standard Windows style interface it attempts to provide an easy editing system for new users to learn whilst not getting in the way of more advanced users.

Figure 1 shows an overview of the main window of TranEd Version Two with some of its views including the enhanced network view with its new editing system.

Multiple traffic flow groups

Often when using TRANSYT for traffic assessments a large number of different traffic flow scenarios need to be taken into consideration, for example, the morning and evening peak, or with and without development options. TranEd V2 includes a new facility to allow a number of flow groups to be entered and modelled within the same file. This has the advantage of drastically reducing the number of files involved leading to easier data management and reduced possibility of errors by making a network change for one flow group but forgetting to do so in another flow groups TRANSYT file.

Card view

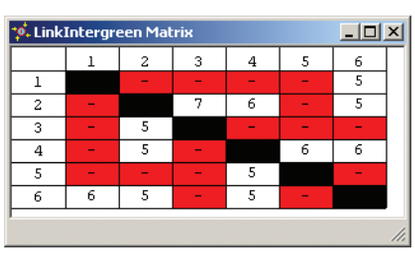
This new view is a novel idea suggested by users and relates to the concept described above of providing user interface features for advanced users as well as beginners. Figure 2 shows an example of this view, which is an interactive list of the 'cards' used by TRANSYT to code input data. Its purpose is to allow users who are very familiar with the old TRANSYT format to view how TranEd is converting the data to TRANSYT format to provide reassurance that it is doing so correctly. Advanced users can use the view as a way of quickly editing large amounts of data. Some fields that do not affect the overall data structure can be edited in a similar manner to a spreadsheet. This is very useful if for example a decision is taken to change all saturation flows from 1900 to 1800.

Error management view

This view stems from work being undertaken on the next version of LINSIG. Its purpose is to monitor the input data for errors, listing any errors found together with their severity. The intention is to provide early feedback on data input errors both helping to prevent errors not being spotted, and helping to pin-down the possible cause of any odd results. It is hoped that this view will help significantly in improving quality control of TRANSYT models produced using TranEd. An example of this view with some deliberate errors introduced is shown in Figure 3.

Traffic signal data entry

Modern microprocessor based traffic signal controllers offer a high degree of flexibility in designing traffic signal junctions. Concepts such as intergreens and phase delays can be used to enhance the performance of a junction by implementing a more efficient but often more complex signalling arrangement. Currently to model such designs in



	1	2	3	4	5	6
1		–	–	–	–	5
2	–		7	6	–	5
3	–	5		–	–	–
4	–	5	–		6	6
5	–	–	–	5		–
6	6	5	–	5	–	

Figure 5: Link Intergreen Matrix for a TRANSYT Node.

TRANSYT requires a large amount of manual signal data preparation and entry, in order to convert complex signal arrangements into the more simplistic representation used in TRANSYT. The complexity of this manual data processing can also lead to manual errors creeping into the data. To address this, a key objective of TranEd Version Two is to provide facilities for the user to input all data in a straightforward manner that corresponds with their knowledge and experience of traffic signals. The software will then transform this engineer-friendly input data into a form that TRANSYT can work with. The software will not however attempt to make any engineering decisions as part of this process, deferring these to the user. The result is that the software deals with all the straightforward but tedious detailed processing, whilst the human component (i.e. the engineer) makes the engineering decisions, such as link structure, that are best not left to a computer.

Interstage design

The lag based approach of constructing interstages used in TRANSYT and TranEd V1 has been replaced with a completely new model based on a simplified version of the phase-based model used in LINSIG. Use of the full phase based model from LINSIG was considered, however it was not chosen because feedback from users generally indicated many TRANSYT users did not require, or desire, the level of detail needed in LINSIG. Instead a simplified model was developed that introduces the concepts of link intergreens and link delays. These are analogous to phase intergreens and phase delays in LINSIG but relate to TRANSYT links rather than phases. This model allows users to directly enter and work with intergreen and link delay information in a similar manner to LINSIG. On running TRANSYT, TranEd processes the intergreens to derive the start and end lags necessary to replicate the designed interstage structures and implements these in TRANSYT. Backwards compatibility with the traditional TRANSYT approach is easy to implement – just ignore the new intergreens and use link delays alone!

Signal staging and sequencing

One objective of TranEd V2 was to allow easy experimentation with different stage sequences. This is achieved by again adopting a similar approach to LINSIG. Stages are defined for each node in the Stage View, an example of which is shown in Figure 6. This allows links to be included or excluded by double clicking on the link in question. Full error checking is included which prevents links with conflicting intergreens from running in the same stage. Stages can be easily renumbered and inserted using drag and drop.

In many cases however it is undesirable to renumber stages just to try a different sequence. The Stage Sequence view, shown in Figure 7, is therefore provided to allow stage sequences to be built up from the stages defined in the stage view. This allows stages sequences eg 1-4-3-2 to be run without any renumbering of stages avoiding confusion. Different stage sequences can be run simply by dragging the stages into a different order. TranEd deals with all the recalculation of start and end lags required to implement this new stage sequence.

ANALYSIS TOOL IMPROVEMENTS

When building a TRANSYT model it is never as straightforward as: Input Data; Run Model; Report results; there is always a considerable amount of iteration and refinement often on a number of different loops. One objective of TranEd V2 is to include or improve a number of tools to help with quickly analysing results in a number of different ways to help speed up convergence of this iteration to a final result or proposal. A key requirement with this type of facility is ease of use. Analysis tools need to be easy to access and must quickly present data in easy to understand, often graphical, formats. This allows quick tests of different ideas for changes to the model to be quickly examined and retained or rejected.

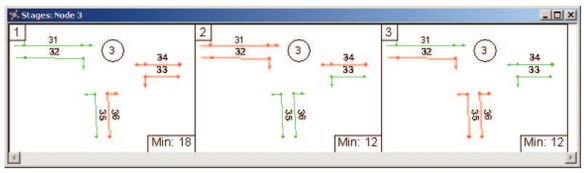


Figure 6: Stage View showing which links run in which stages

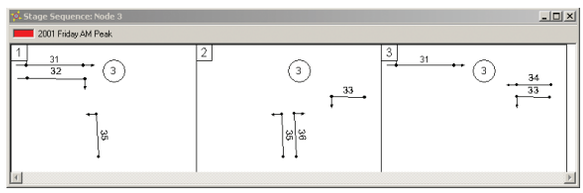


Figure 7: Stage Sequence View showing the current stage order

Cycle time analysis

Cycle time analysis was not able to be included in TranEd V1 and users had to fall back on using the CYOP feature of TRANSYT. To remedy this, a completely new facility has been introduced into TranEd V2 which provides a fully graphical cycle time analysis tool similar to the cycle time analysis view in LINSIG. This works in a fundamentally different manner than CYOP in that it builds up a performance profile over a range of different cycle times by running multiple TRANSYTs in the background each with a different cycle time and combination of double cycled nodes. This provides a much more robust estimate of performance than CYOP which made approximations to reduce the computing power required. The results of the TRANSYT runs are analysed and presented graphically as shown in Figure 8. This tool can also investigate the feasibility of double cycling selected nodes by automatically testing the effect on the model of double cycling different combinations of nodes and presenting the effects graphically.

Signal sequence visualisation

With the complex signal scenarios that can be easily built using TranEd it is often useful to have a quick overview as

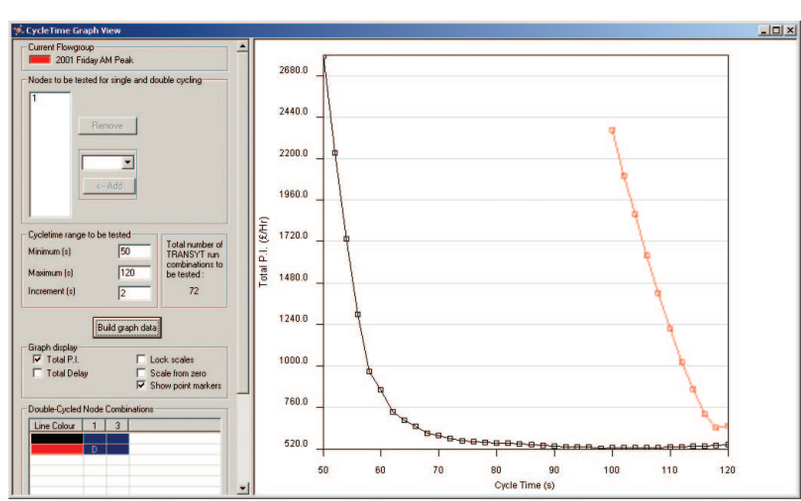


Figure 8: Cycle Time Optimisation View

to exactly how the signalling is operating. This is achieved in TranEd V2 using the new animation mode. This mode allows the links in the network diagram to be coloured based on whether they are running or not. It is then possible to step through the signal sequence, either manually or in real time, observing how TRANSYT links start and stop. This provides a different way of checking what is running when and can also be useful in demonstrating a TRANSYT model.

Graphical TRANSYT link graphs

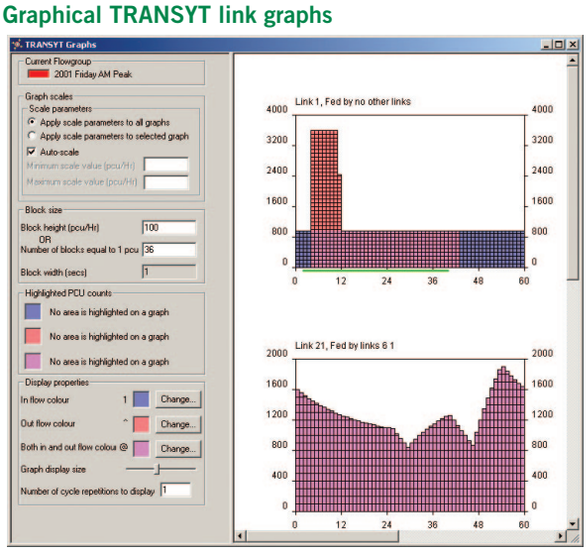


Figure 9: Graphs View showing TRANSYT flow profiles

The link graphs (card 35 for the initiated) provided by TRANSYT are vital for a full understanding of how different links in the network are performing. This was another feature that was unable to be included in TranEd V1 and the graphs provided by TRANSYT had to be used as a fallback. Although the graphs were easy to use for the initiated they often appeared daunting to the new user. They were actually constructed using text characters, which meant they were difficult to incorporate neatly into reports. TranEd V2 introduces another new view, the Graphs View shown in Figure 9, which provides a facility to format the graphs with full colour and also provides a number of other tools to analyse the flow profiles, and importantly to make them more accessible to new users. It is also now possible to easily include the graphs as fully graphical figures in reports.

REPORTING IMPROVEMENTS

It was originally anticipated that TranEd V1 would be used primarily as a tool for constructing and analysing TRANSYT networks rather than as a reporting tool. From user requests it has become increasingly apparent however that flexible reporting is an important area where improvements would be welcome. A number of reporting improvements have therefore been implemented in TranEd V2.

Rich text report generator

A new report generator has been added to TranEd based on the 'rich text' word processor format that can be read by most modern word processors such as Word and WordPerfect. This new format allow the reports to include features such as tables, different fonts, colour and embedded graphics of TranEd Views and to be generally richer in content (hence the name!) An added benefit is that once imported into Word the reports can be edited allowing them to be rearranged to fit a company standard format, or for individual tables or graphics to be cannibalised for use in other documents.

Drag and drop graphics

Although the new report generator is ideal for situations where a number of tables and figures are required, sometimes a single figure needs to be inserted quickly into an external document. A drag and drop facility has therefore been developed where TranEd views can be dragged from TranEd and dropped directly into another compatible document (generally any mainstream office type document such as Microsoft Word or Excel).

Network annotation

TranEd V2 allows text labels to be inserted onto the network at any point. These can be at any size, colour and orientation.

Large format printing support

As larger format printing devices (eg A1 to A3 sized) become more affordable it becomes more feasible to be able to plot large detailed TRANSYT network diagrams onto larger sheets. TranEd therefore incorporates a new printing system, which supports both printing the network diagram directly onto either a single large sheet or by using a system of viewports onto a number of pages. Title blocks can also be included showing information regarding the print. The viewport setup can be saved allowing reprinting after changes at any point.

Export to other graphics packages

Although the new printing system provides new capabilities for printing it is recognised that it is not feasible to provide every possible alternative format for printing in a program such as TranEd. Network diagrams and other views, can therefore be exported to DXF format in TranEd V2. This format is a standard drawing exchange format that is widely supported by CAD packages such as AutoCAD. The external graphics software can then be used to further annotate the views or even to combine views, for example, by inserting stage diagrams into a network diagram adjacent to each node.

SUMMARY

This paper has described some of the new facilities provided in Version Two of TranEd, the third party graphical editor for TRANSYT. The software has been completely rewritten to provide a new high-productivity interface for TRANSYT with a strong emphasis on providing tools to facilitate the modelling of complex signalling designs encountered when using modern microprocessor-based signal controllers. The need for high-quality reporting has also being recognised with a number of new graphical and text-based reporting mechanisms. It is hoped that the software will be of significant benefit to signal engineers needing to use a network model but who wish to work with complex signal designs for the junctions under study.

The Authors: You can contact Paul Moore and Peter Cheng at JCT Consultancy Ltd by phone on +44 (0) 1522 754681 or by email at pm@jctconsultancy.co.uk