Network Capacity Based Route Discovery Algorithm

*Note: Sub-titles are not captured in Xplore and should not be used

1st Klement Streit
dept. name of organization (of Aff.)
name of organization (of Aff.)
City, Country
email address

2nd Nils Roddey
dept. name of organization (of Aff.)
name of organization (of Aff.)
City, Country
email address

3rd Gabi Dreo Rodosek
dept. name of organization (of Aff.)
name of organization (of Aff.)
City, Country
email address

***Abstract*—With the rapid growth of connectivity, the information exchange within and between groups increases continuously. The security of those communication channels is often insufficient to distribute confidential information. Consequently, to ensure trustworthiness, integrity and confidentiality, the data has to be encrypted accordingly. In order to realize secure communication in a MANET manner, the participants must share a group key to decrypt and encrypt their message exchange. This common secret must be distributed secure. The management of encrypted group communication in MANET is challenging task because the participants rely on limited hardware and bandwidth resources. Furthermore, the dynamic changing group composition generates additional overhead. Considering these challenging conditions, we introduce a central organized GKM concept which combines the rekeying and key distribution functionalities of existing protocols to reduce key computation and control message overhead. Findings of the evaluation proves its applicability ... Moreover, the introduced concept provides a wide range of applications...**

***Index Terms*—component, formatting, style, styling, insert**

I. Introduction

Transmitting huge amounts of data in Mobile Ad-Hoc Networks (MANET) is a challenging task due to i.e. the shared medium, dynamic changing topology and arising bottlenecks. Especially video or audio streams are particularly worthy to mention because they are subject to certain Quality of Service (QoS) requirements. Voice over IP (VoIP) for instance relies on a delay less than $250ms$ and a video stream should not have a packet loss rate more than 5%. MANETs are network structures without a central infrastructure. Hence, every participating node acts as router and forwards packets towards destinations. Consequently, a route through the topology is established depending on the constellation of nodes. In an MANET structure with high utilization, several situations can appear during transmission. Different video streams may be routed across a particular node. A path may be chosen twice if the same destination node is request the packets. QoS will suffer during situations and in worse case result in a denial of service. To encounter such constellation stressed areas have to be detected and avoided during path discovery process.

Identify applicable funding agency here. If none, delete this.

Several reactive and proactive routing protocols exist which implement individual path discovery processes. AODV broadcasts the whole notwork with the objective to find the fastest route towards the requested destination. Typically, the received RREP proposes the route with least intermediate node. The route discovery algorithm of DSR is almost equal to AODV. Participating nodes flood the network with a RREQ containing an id, the source and the destination. Every node which forwards the RREQ records it's address in the address. If an intermediate node has a valid route towards the destination or if the destination receives the RREQ, a RREP is transmitted according to the reverse list of the RREQ to the originator of the RREQ.

In order to identify and avoid stressed areas in the MANET topology every node is aware of its own utilization and treats an incoming RREQ accordingly. Therefore, each node monitors the consuming bandwidth of each forwarded route. Furthermore the available slot time of the Wlan Nic is recorded during transmission. This two indications are the basis of the decision which influences the treatment of an incoming RREQ. Each RREQ is extended with additional network capacity requirements (bandwidth and required slot time). In case of a node receives a RREQ, the conditions of the request are compared to the own monitored utilization. Depending on the result, the request is either dropped, queued or forwarded. A stressed node will for instance drop or queue a received request. Consequently, areas with huge network load are avoided.

The reminder of this paper ss organized as follows. Related work is discussed in II. In section III, the proposed capacity based route discovery algorithm is introduced. The section IV discusses early results followed by a conclusion and further work in section V.

II. Related Work

III. Approach of Capacity Based Route Discovery

To realize network capacity based routing every node of the MANET has to be equipped on the one hand with a local network load monitoring functionality and on the other

hand with a decision matrix weather the RREQ has to be dropped, queued or instantly forwarded. The following two subsections are divided into the monitoring concept and the decision matrix.

A. Monitoring Local Capacities

To analyze the local traffic overhead of each node, specific IPv4 header information of every routing load and payload packet is recorded for a given time span. Therefore, every node maintains information of routes $R = \{r_0 \dots r_n\}$ which are forwarded. Each route r is identified by the source and destination IP address $Id_r = (ip_{src}, ip_{dest})$. In addition each route maintains a queue containing the transmission overhead of the packets $O = \{o_1 \dots o_n\}$ in bytes where n is the number of packets received during a defined time span t. In case of the received packet is a payload, the overhead is defined as follows $o_n = pl_{size} + ACK_{size} + hdr_{size}$. If the received packet is routing load and ip_{dest} is a broadcast address the overhead is composed of $o_n = pl_{size} + hdr_{size}$. If the destination address of the routing load packet is unicast the overhead is determined equal to a payload packet.
To calculate the available slot time of the Nic per participating node,

B. Determine Local Network Utilization

If a node receives a RREQ from neighbor node, it first determines the required transmission conditions $C = (bw, st)$ of the request where bw is the minimum bandwidth required to transmit the payload and st is the minimum time the Wlan Nic has to be available for transmission in a given time span t. The next step is to calculate the available bandwidth. Due to the fact that 80211 relies on wireless communication participating nodes must share their channel capacity within node in transmission range. As a result, the throughput of a node depends theoretically on the number of node which the intermediate node exchanges data. If for instance a node is part of a single route, it must share the capacity with two other nodes. Consequently, the transmitting and receiving node can interfere the intermediate node. The available bandwidth of a node is determined see equation 1.

$$bw_r = \frac{C}{R+1} - \sum_{1}^{R} O_R \tag{1}$$

IV. Early Results

V. Conclusion and further work

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, ac, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

A. Units

- Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as “3.5-inch disk drive”.
- Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation.
- Do not mix complete spellings and abbreviations of units: “Wb/m^2” or “webers per square meter”, not “webers/m^2”. Spell out units when they appear in text: “. . . a few henries”, not “. . . a few H”.
- Use a zero before decimal points: “0.25”, not “.25”. Use “cm^3”, not “cc”.)

B. Equations

Number equations consecutively. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

$$a + b = \gamma \tag{2}$$

Be sure that the symbols in your equation have been defined before or immediately following the equation. Use “(2)”, not “Eq. (2)” or “equation (2)”, except at the beginning of a sentence: “Equation (2) is . . .”

C. LaTeX-Specific Advice

Please use “soft” (e.g., `\eqref{Eq}`) cross references instead of “hard” references (e.g., `(1)`). That will make it possible to combine sections, add equations, or change the order of figures or citations without having to go through the file line by line.

Please don’t use the `{eqnarray}` equation environment. Use `{align}` or `{IEEEeqnarray}` instead. The `{eqnarray}` environment leaves unsightly spaces around relation symbols.

Please note that the `{subequations}` environment in LaTeX will increment the main equation counter even when there are no equation numbers displayed. If you forget that, you might write an article in which the equation numbers skip from (17) to (20), causing the copy editors to wonder if you’ve discovered a new method of counting.

BibTeX does not work by magic. It doesn’t get the bibliographic data from thin air but from .bib files. If you use BibTeX to produce a bibliography you must send the .bib files.

LaTeX can’t read your mind. If you assign the same label to a subsubsection and a table, you might find that Table I has been cross referenced as Table IV-B3.

LaTeX does not have precognitive abilities. If you put a `\label` command before the command that updates the counter it’s supposed to be using, the label will pick up the last counter to be cross referenced instead. In particular, a `\label` command should not go before the caption of a figure or a table.

Do not use `\nonumber` inside the `{array}` environment. It will not stop equation numbers inside `{array}` (there won't be any anyway) and it might stop a wanted equation number in the surrounding equation.

D. Some Common Mistakes

- The word "data" is plural, not singular.
- The subscript for the permeability of vacuum μ_0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter "o".
- In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
- A graph within a graph is an "inset", not an "insert". The word alternatively is preferred to the word "alternately" (unless you really mean something that alternates).
- Do not use the word "essentially" to mean "approximately" or "effectively".
- In your paper title, if the words "that uses" can accurately replace the word "using", capitalize the "u"; if not, keep using lower-cased.
- Be aware of the different meanings of the homophones "affect" and "effect", "complement" and "compliment", "discreet" and "discrete", "principal" and "principle".
- Do not confuse "imply" and "infer".
- The prefix "non" is not a word; it should be joined to the word it modifies, usually without a hyphen.
- There is no period after the "et" in the Latin abbreviation "et al.".
- The abbreviation "i.e." means "that is", and the abbreviation "e.g." means "for example".

An excellent style manual for science writers is [7].

E. Authors and Affiliations

The class file is designed for, but not limited to, six authors. A minimum of one author is required for all conference articles. Author names should be listed starting from left to right and then moving down to the next line. This is the author sequence that will be used in future citations and by indexing services. Names should not be listed in columns nor group by affiliation. Please keep your affiliations as succinct as possible (for example, do not differentiate among departments of the same organization).

F. Identify the Headings

Headings, or heads, are organizational devices that guide the reader through your paper. There are two types: component heads and text heads.

Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is "Heading 5". Use "figure caption" for your Figure captions, and "table head" for your table title. Run-in heads, such as "Abstract", will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and, conversely, if there are not at least two sub-topics, then no subheads should be introduced.

G. Figures and Tables

a) Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation "Fig. **??**", even at the beginning of a sentence.

TABLE I
TABLE TYPE STYLES

Table Head	**Table Column Head**		
	Table column subhead	***Subhead***	***Subhead***
copy	More table copy[a]		

[a]Sample of a Table footnote.

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity "Magnetization", or "Magnetization, M", not just "M". If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write "Magnetization (A/m)" or "Magnetization {A[m(1)]}", not just "A/m". Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)", not "Temperature/K".

ACKNOWLEDGMENT

The preferred spelling of the word "acknowledgment" in America is without an "e" after the "g". Avoid the stilted expression "one of us (R. B. G.) thanks ...". Instead, try "R. B. G. thanks...". Put sponsor acknowledgments in the unnumbered footnote on the first page.

REFERENCES

Please number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use "Ref. [3]" or "reference [3]" except at the beginning of a sentence: "Reference [3] was the first ..."

Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the abstract or reference list. Use letters for table footnotes.

Unless there are six authors or more give all authors' names; do not use "et al.". Papers that have not been published, even if they have been submitted for publication, should be cited as "unpublished" [4]. Papers that have been accepted for publication should be cited as "in press" [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

REFERENCES

[1] G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955.

[2] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.

[3] I. S. Jacobs and C. P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.

[4] K. Elissa, "Title of paper if known," unpublished.

[5] R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

[6] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

[7] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.